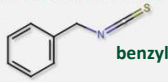
Papaya Ground Seed as a Biofumigant Against Soil-borne Pathogens In Hawaii

Lauren Braley[1], Koon-Hui Wang[1]
[1]Department of Plant and Environmental Protection Science
University of Hawaii

Background

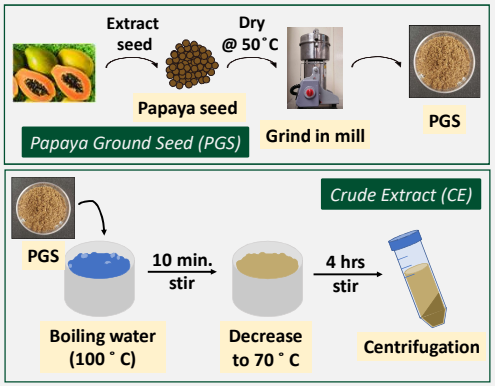
- Soil-borne nematodes and fungi, such as root-knot nematodes (RKN; *Meloidogyne* spp.) and *Fusarium oxysporum* (causing Fusarium wilt), pose a serious threat to food security.
- Growers in Hawaii are challenged by pest pressure all year round.
- Rising cost of agriculture production inputs is calling food producers in Hawaii to adopt sustainable pest management tactics using local resources.
- Papaya production is a major industry in Hawaii, but up to 50% of fruit produced is culled or wasted
- Papaya contain prerequisites for benzyl isothiocyanate (BITC) production, a toxic volatile to various soil-borne fungi and nematodes.



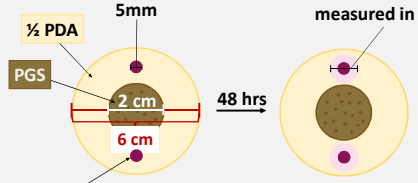
benzyl isothiocyanate (BITC)

Objectives of this project were to examine the use of papaya ground seed (PGS) as a biofumigant against RKN or *Fusarium* spp. *in vitro*, in greenhouse pots, or in the field.

Methods *Papaya Seed Preparation*

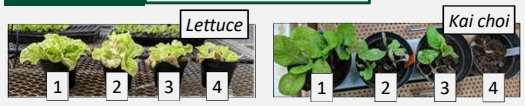


Methods *in vitro*



Treatments
0.5 g PGS + 0.5 ml H2O
1 g PGS + 1 ml H2O

Methods *Greenhouse Trials*



Inoculum Used
- *Fusarium*-infested field soil from commercial lettuce/kai choi field
- 100 *Meloidogyne incognita* J2s/pot

Treatments (x4 reps each)
1) ***PGS 0.5%*** = papaya ground seeds at 0.5%
2) ***PGS+CE*** = PGS 0.5%+0.5% of crude extract
3) ***PGS 1%*** = papaya ground seeds at 1%
4) ***BM*** = brown mustard at 1%
5) ***NA*** = not amended
6) ***Auto*** = not amended and autoclaved

Roots & selective media

Acid fuchsin stain

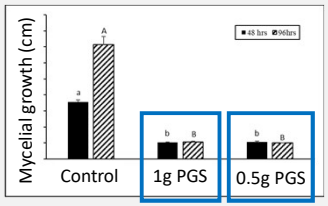
Methods *Field Trial*

Treatments (x4 plots each)
1) ***Control*** = no amendment
2) ***BM*** = mustard at 1%
3) ***1% PGS***
4) ***0.5% PGS***
5) ***Sg*** = sorghum at 50lbs/acre
6) ***Vapam*** = conventional fumigation

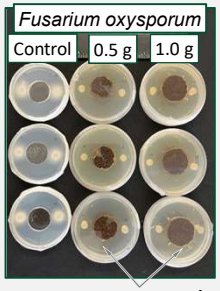
Timeline

Transplant 2 wks post-amend → Disease incidence @ 3 wks → Terminate @ 6 wks

Results *in vitro*



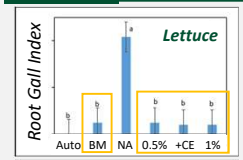
PGS completely suppressed *F. oxysporum* *in vitro*

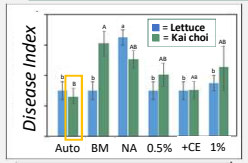


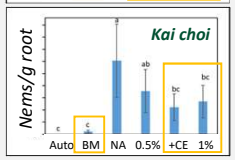
2 cm wells w/ PGS + H_2O

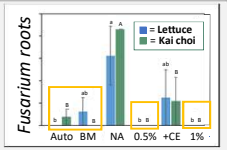
Not Pictured
- Some reduction in *F. solani* growth
- No reduction in *Setophoma* sp.

Results *Greenhouse*



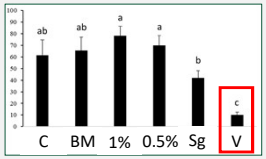






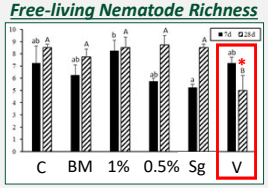
Results *Field*

Percent Disease



- **% disease was lowest in Vapam (V)**
- **PGS treatments failed to suppress *F.oxysporum* on roots (data not shown)**

Free-living Nematode Richness



- **PGS did not affect nematode richness but V significantly lowered richness**
- **General decrease in omnivores in V (data not shown)**

Conclusions

- BITC produced by PGS suppressed root colonization of *Fusarium* spp. and RKN infection in kai choi and lettuce
- PGS did not reduce disease index in kai choi, suggesting possibility of another pathogen (*Rhizoctonia solani*)
- Vapam was effective, but is also destructive to all beneficial nematodes
- PGS offers a potential biofumigation that does not require extensive plant growth beforehand

Future Research

- Optimize of PGS amendment rate in the field and modify PGS burial depth.
- Activate pathogen survival structures prior to PGS biofumigation
- Examine different PGS application methods (liquid drench vs dry powder
- Confirm PGS biofumigation can suppress a wide range of plant pathogens

Acknowledgements

This project is supported by NIFA OREI (HAW09705-G) CTAHR Hatch, Multistate (NE2140), Plan of Work (HAW 9048-H, 9034-R, and POW 16-964), and WSARE Grant SW20-911. Special thanks to Roshan Paudel, Justin Mew, and Wei Wen Su.