Sustainable Management of Soil-borne Diseases in Nursery Production

SARE PROJECT GS16-155 Baysal-Gurel

Fulya Baysal-Gurel and Prabha Liyanathianage*

Introduction

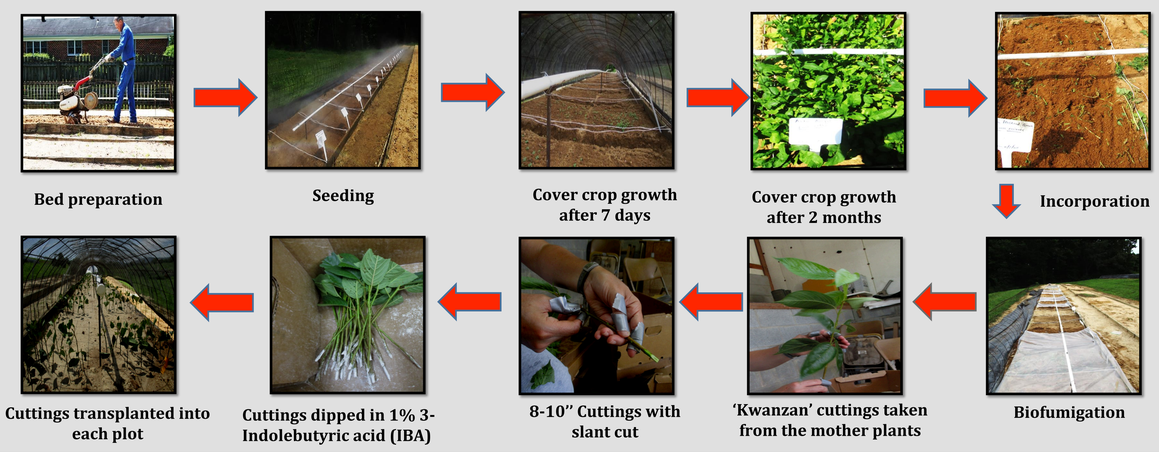
- Soil-borne diseases are a major constraint in woody ornamental nursery production.
- Soil-borne pathogens have been conventionally controlled by performing soil fumigation using methyl bromide, which was completely phased out from the market of developed countries by 2005.
- Finding an effective alternative for methyl bromide is an high priority in agriculture sector.
- In agriculture, plants containing Glucosinolates (GSL) have a long history of use as rotation crops, green manures or as seed meal soil amendments to the soil due to its biocidal properties.
- Cover crops in the family Brassicaceae have the ability to suppress soil microorganisms through the hydrolysis of GSL into isothiocyanate, a natural biofumigant.
- Most of the studies have been conducted on GSL-related suppression and they show significant ability to control soil-borne pathogens
- Use of biofumigation in woody ornamental nursery production have not been documented so far.

Objective

The objective of this study was to assess Brassicaceae cover crops as biofumigant for soil-borne disease management in nursery production.

Materials and Methods

- Fifteen *Brassicaceae* cover crops were selected at the beginning of the study (Figure 1).
- Sterilized top soil was inoculated with *Rhizoctonia solani* and *Phytophthora nicotianae* and 10 cover crop seeds were sown in each pot to evaluate root rot disease severity and incidence after 1 month.
- Selected cover crops were used to perform biofumigation in greenhouse studies. Hydrangea and viburnum plants grown in biofumigated soil (14- and 30- days) and plant roots were evaluated for disease symptoms.
- Cover crops that showed highest disease suppression ability were selected for the field study at a collaborator's nursery with prevalent *R. solani* pressure. Biofumigation was performed for 14-days with astro arugula, amara mustard and purple top forage turnips. Mustard meal and compost was also tested in this experiment.
- Flowering cherry cuttings were planted two weeks after biofumigation. Plant height and weight were measured and root rot disease severity was determined at the end of the trial.



Results and Discussion

- Oilseed radish, mustard (*Sinapis alba)*, purple top forage turnip, astro arugula, mighty mustard® pacific gold, oriental mustard, dwarf essex rape brassica and amara mustard green showed lower root rot disease severity percentages and disease incidence percentages (data not shown) compared to the other tested cover crops (Figure 1 and 2).
- When biofumigation was performed for 14- and 30-days as two greenhouse trials, similar disease severity values were recorded by the plants grown in Brassicaceae cover crops incorporated pots (Table 1).
- Plants grown in amara mustard, astro arugula and purple top forage turnips incorporated soil resulted less Phytophthora and Rhizoctonia root rot.
- Amara mustard, astro arugula and purple top forage turnips were effective in controlling soil-borne pathogens compared to compost and mustard meal amendments under field condition (Table 2).
- **Amara mustard, astro arugula and purple top forage turnips biofumigant cover crops showed promising results in controlling soil-borne pathogens of woody ornamental plants under both greenhouse and field conditions.**

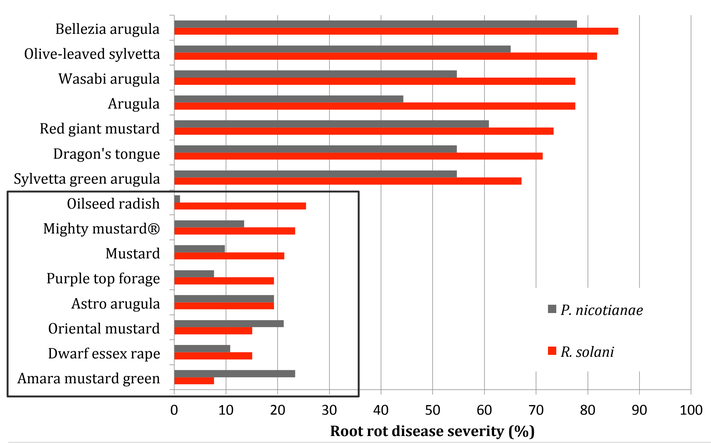


Figure 1. Root rot disease severity of tested Brassicaceae cover crops when inoculated with *R. solani* and *P. nicotianae*

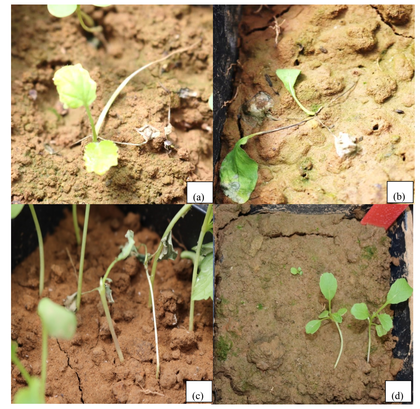


Figure 2. Brassicaceae cover crops showing disease symptoms due to *R. solani* infection. a) chlorosis, b) post-emergence damping-off, c) plant death, d) pre- emergence damping-off.

Table 1. Rhizoctonia root rot disease severity of viburnum and Phytophthora root rot disease severity of hydrangea plants after 14 days or 1 month biofumigation (Greenhouse study)

Cover crop used for biofumigation	*Viburnum suspensum* Rhizoctonia root rot severity (%)		*Hydrangea paniculata* Phytophthora root rot severity (%)	
	Biofumigation (14-days)	Biofumigation (30-days)	Biofumigation (14-days)	Biofumigation (30-days)
Amara mustard	19.3 de	15.1 ef	23.4 d	23.4 c
Astro arugula	23.4 cd	27.6 cde	23.4 d	15.1 cd
Mighty mustard	23.4 cd	19.3 e	31.8 bcd	27.6 c
Mustard	35.9 b	35.9 cd	31.8 bcd	23.4 c
Oriental mustard	40.1 b	40.1 bc	40.1 bc	23.2 c
Radish	44.3 b	52.6 b	44.3 b	56.8 ab
Rape	40.1 b	35.9 cd	27.6 cd	15.1 cd
Purple top forage turnips	31.8 bcd	23.4 de	35.9 bcd	48.4 b
Non-inoculated control	6.8 e	4.5 f	2.3 e	8.7 d
Inoculated control	77.6 a	73.4 a	65.1 a	69.3 a
P-value	0.00	0.00	0.00	0.00

Table 2. Effects of soil amendments and biofumigant cover crop usage on crop health (On-farm study)

Treatment	Root rot (%)	Plant height	Plant width	Root weight
Amara mustard	33.7 b	22.7 ab	18.6 b	7.3 b
Astro arugula	34.4 b	21.5 bc	18.2 b	7.0 b
Turnips	38.8 b	21.0 bc	18.8 b	6.3 b
Mustard meal	49.4 ab	21.7 abc	21.9 b	7.3 b
Compost	49.7 ab	26.4 a	27.2 a	10.7 a
Non-treated control	63.2 a	17.8 c	18.2 b	6.3 b
P-value	0.02	0.04	0.00	0.01

This project is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number GS16-155 Baysal-Gurel through the Southern Sustainable Agriculture Research and Education program under subaward number RD309-134/S001230. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture or SARE. USDA is an equal opportunity employer and service provider.

southernsare.org