Impact of Cover Crop Usage on Soilborne Disease Suppressiveness in Field Nursery Production

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Abstract

Soilborne diseases are one of the major limitations to field grown nursery production. The use of cover crops is a newer area of research in woody ornamental nursery production as it has been previously explored most extensively in row crop, vegetable, fruit and flower production. The objective of this study was to determine the impact of cover crops on soilborne disease suppressiveness in woody ornamental nursery production systems. Soils from red maple plantation grown with and without cover crops (crimson clover or triticale) were sampled following the senescence of the cover crops. Greenhouse bioassays were conducted using red maple cuttings on inoculated (with *Rhizoctonia solani* or *Phytophthora nicotianae*) and non-inoculated field soils. The results showed that cover crop usage was beneficial for inducing soil disease suppressiveness against those pathogens. There was lower disease severity and pathogen recovery when the cover crops were used compared to the bare soil treatment for both pathogens. However, there were no significant differences in plant fresh weight and root weight within the treatments. Implementation of cover crop usage may improve field nursery production efficiency by reducing pressure from soilborne diseases. Therefore, the stakeholders can consider cover crop usage as an alternative sustainable management tool for soilborne diseases in field nursery production systems.

Introduction

Ornamental nursery production is one of the largest contributor to the US economy. However, soilborne diseases are becoming more troublesome as witnessed by many growers in recent years. The diseases caused by *Rhizoctonia solani* and *Phytophthora nicotianae* are among the most devastating soilborne pathogens causing wilting, stunting, leaf shed, limb dieback, leaf chlorosis, off-color foliage, crown rot (gray to brown color) (Figure 1) and root rot. Chemical fungicides had been the first line of defense against most of the plant pathogens. However, due to environmental and health concerns, study and use of cover crops in different field of agriculture is promising. Cover crops can increase the beneficial microbial community, thus increasing the competition between the microbes, resulting in increase in disease suppressive of the soil. Not limited to that, cover crops can also increase the C and N content of the soil maintaining a pool of C:N ratio; maintaining soil integrity; and improving soil chemical properties.

Figure 1. Crown and root rot of red maple caused by *P. nicotianae* (left) and *R. solani* (right)

Objective

Evaluate the impact of cover crops (crimson clover and triticale) on soil disease suppressiveness against *Phytophthora nicotianae* and *Rhizoctonia solani*.

Materials and Methods

Crimson clover (*Trifolium incarnatum* L.) and triticale (× *Triticosecale*) were sowed by dribbling in the established maple field with four replications per treatment arranged in a completely randomized design. Soils from each treatment including plots without cover crops as control were collected, mixed in-situ and stored in the greenhouse. Following one week, greenhouse bioassays were conducted using red maple cuttings in a shadehouse on inoculated (with *R solani* or *P. nicotianae*) and non-inoculated field soils with ten replications for each pathogen including control. Pots were inoculated with *P. nicotianae* grown on rice grains and *R. solani* by using agar-slurry method. Plant height, plant width, total fresh weight and root weight were recorded, and roots were assessed for disease severity using a scale of 0-100% roots affected at the end of each trial. Statistical analyses were conducted using the mixed model's procedure with SAS statistical software (v 16.0).

Results

- ✓ Use of cover crops were found to be beneficial to induce soil disease suppressiveness .
- ✓ Rhizoctonia root rot was reduced significantly when any of the cover crops were used (Triticale-18%, Crimson Clover-23%) compared to bare plot (60%) (Fig. 2).
- ✓ Both cover crops reduced root rot caused by *P. nicotianae* significantly, however, triticale suppressed the disease (17.5%) better followed by crimson clover (31.5%), and bare plot (54.5%).
- ✓ Recovery of pathogens had shown similar pattern as of severity (Fig.2) for all pathogens.
- ✓ Numerically better plant height increment, total plant fresh weight and total root weight was observed in both cover crop used soil compared to non-cover crop used soil (data not shown).
- ✓ Mean Pseudomonad count was higher in cover crop soil compared to non-cover cropped soil for both pathogens (Fig.3).

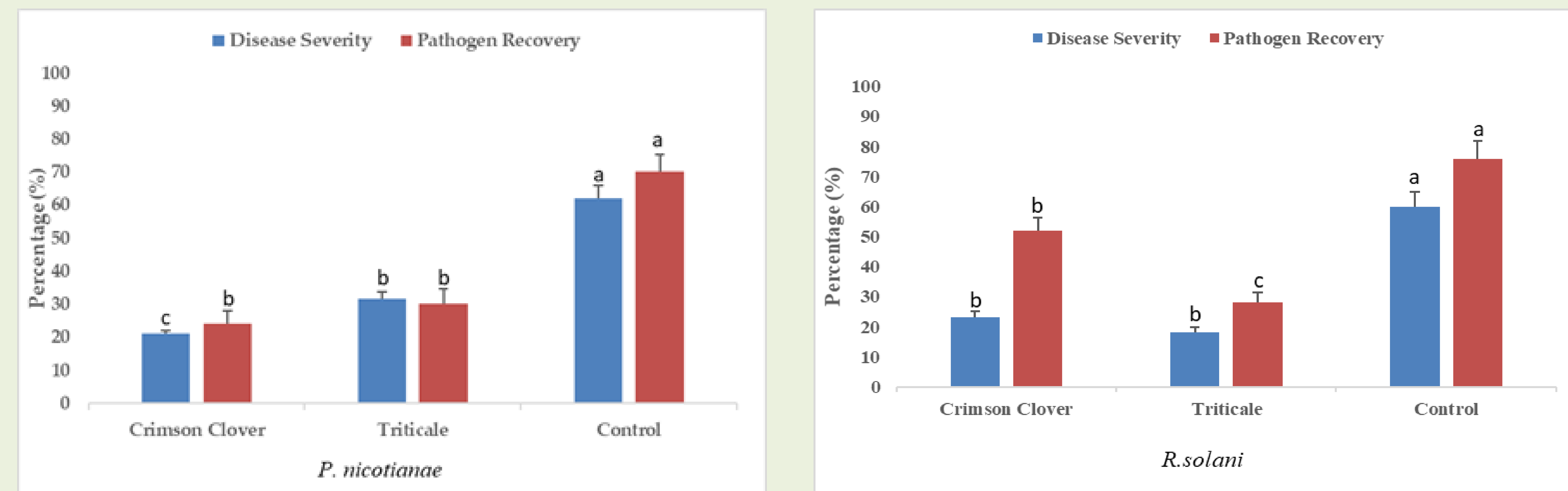

Figure 2. The effect of different cover crops on disease severity and recovery of pathogens, *P. nicotianae* (left) and *R. solani* (right). Disease severity ratings were based on percentage root affected. Recovery of pathogens were based on the pathogens recovered per plate using five root cuttings per replication. Treatments followed by the same letter within a column are not significantly different at P≤0.05.

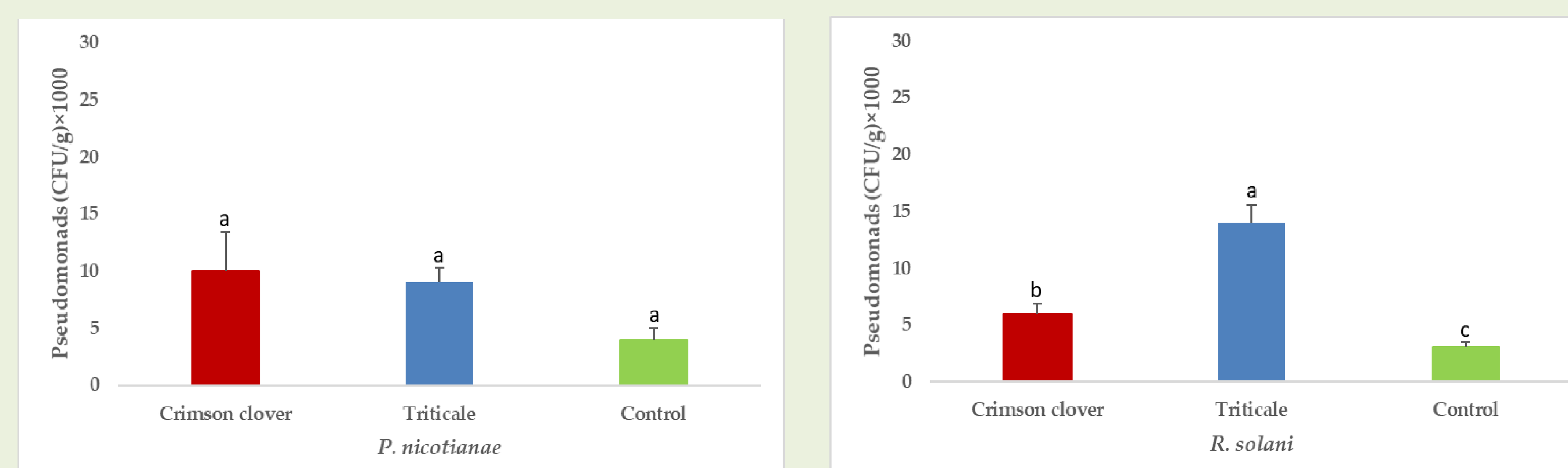

Figure 3. Mean Pseudomonad count (CFU/g of soil) challenged with *P. nicotianae* (left) and *R. solani* (right)

Discussion

- ✓ Cover crops has the potential to increase microbial populations in the soil.
- ✓ Cover crops are effective in reducing the disease severity caused by *P. nicotianae* and *R. solani*.
- ✓ Long term use of cover crops is required to see the more effective results.
- ✓ Different rates of cover crops, alone and in combination; as well as influence of cover crop application timing on soil disease suppressiveness are on-going.

Acknowlegment

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