Effect of biofumigation with brassica cover crops on black shank of burley tobacco

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INTRODUCTION

In Kentucky the most important disease of tobacco is black shank, which is caused by *Phytophthora nicotianae*. Due to its destructive and widespread behavior, management of this disease is crucial. The concept of biofumigation refers to the breakdown and release of volatile compounds from *Brassica* tissues. It has been shown that plants in the genus Brassicaceae have pesticidal activity due to their production of glucosinolates (Angus 1994, Kirkegaard 2000, Mithen 2001, Matthiessen 2006). Once plant tissue is chopped up and exposed to air, the glucosinolates produced are hydrolyzed and broken down into many volatile compounds shown to have antimicrobial activity (Kirkegaard 1998). The most important glucosinolate break-down product is isothiocyanate. Isothiocyanates have been shown to be biocidal against a wide range of soil organisms including nematodes, bacteria and fungi (Sarwar 1998, Kirkegaard 1998, Brown 1997). Biofumigation has been studied in several cropping systems but very little has been done with tobacco.

The purpose of these experiments was to evaluate what effect biofumigation has on populations of *P. nicotianae* in the soil and if this has any impact on disease progression throughout the growing season. A pilot field study was conducted during the summer of 2008. Incorporation of a mustard cover crop was compared to plots with no cover crop (bare ground) to examine the effect on populations of *P. nicotianae* in the soil. Results showed that plots with the incorporated mustard had lower (P≤0.05) populations of *P. nicotianae* than plots with bare ground. However, no effect was seen on incidence of disease. Based on these results a greenhouse study and another field project was performed in 2009 to look at the effect of incorporated mustard on *P. nicotianae*.

MATERIALS AND METHODS

Greenhouse Study, 2009

Objective

•Compare bare soil, wheat cover and mustard cover at different seeding rates for effects on survival of *P. nicotianae.*

Methods

•CRD with 6 replications

•Treatments:

Bare Ground (ProMix)
Winter Wheat (100 lb/A)
Mustard 1X (12 lb/A), 0.1X (1.2 lb/A), 0.5 X(6 lb/A), 2X (24 lb/A)

•Grown in 8-inch pots (12:12 hr, light:dark)

•Planted: December 16, 2008, Incorporated: February 13, 2009 (no flowering)

•Biomass harvested, chopped, and incorporated into soil; water added

•6 µm mesh bag with sterile soil spiked with *P. nicotianae* chlamydospores was placed in the center of each bag containing cover crop-soil mixture

•Bags were sealed and incubated for 7 days at 75F/60F (12h)

•Mesh bags were removed, soil was plated on selective medium and colonies were counted then isolated

Field Project, Clark County 2009

Objective

•Examine the effect of incorporated mustard vs. wheat biomass on varieties of burley tobacco with different levels of resistance to *P. nicotianae.*

Methods

•Split plot RCB (4 replications)

•Cover crops (whole plots): wheat (50 lb/A) vs. 'Pacific Gold' mustard (12 lb/A)

•Mustard planted: April 2; Mustard incorporation: May 16

•Tobacco set: June 16; 4 varieties (sub-plots): KY 14 x L8, TN 90, NC 7, and KT 206 (in order of low to high resistance to race 1 of *P. nicotianae*); Plot size: 7 x 40 ft.

•Soil sampled 5 times and assayed for *P. nicotianae* on selective medium

•Number of healthy plants counted during growing season; disease incidence calculated

•Assessed disease severity of roots post harvest from each plot using the Horsfall-Barratt scale

Figure 1. A) Mustard cover and wheat cover growing in Clark County 2009 B) Black shank in Clark County field 2009 C) Roots collected post harvest from Clark County field 2009

RESULTS

Greenhouse Study, 2009

•No differences in plant biomass were seen between the different mustard seeding rates (data not shown)

•Soil plating showed that all three mustard seeding rates significantly impacted chlamydospore survival in soil (Figure 2)

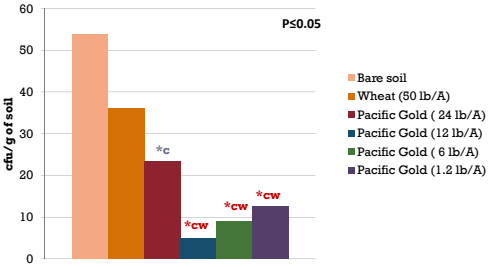

Figure 2. Effect of incorporated mustard vs. bare ground on populations of *P. nicotianae* in soil ***c***=significantly different from control (bare soil); ***cw***=significantly different from control and wheat cover. Pairwise comparisons made.

Field Study, 2009

•No significant differences in populations of *P. nicotianae* were observed between the mustard and wheat cover crop (Figure 3)

•No significant differences were found between mustard and wheat for incidence of black shank (Figure 4)

•No significant differences were found between mustard and wheat for disease severity of tobacco roots sampled (Figure 5)

•No significant differences were found in yield between plots with mustard and wheat cover (Figure 6)

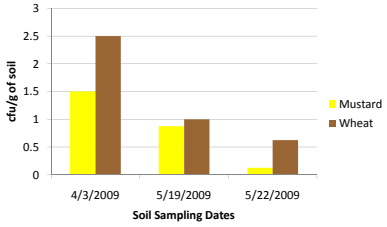

Figure 3. Effect of mustard vs. wheat cover crops on *P. nicotianae* in soil. Not significant (NS) at P≤0.05.

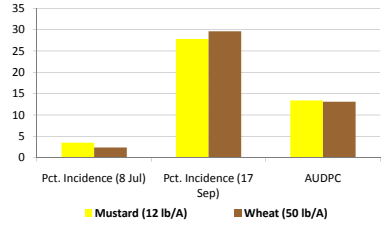

Figure 4. Effect of mustard and wheat incorporation on incidence of black shank. NS at P≤0.05.

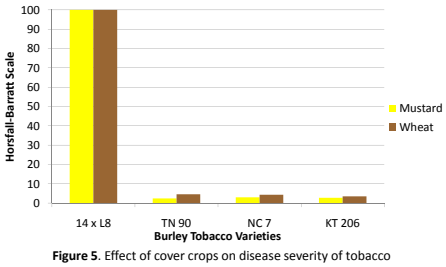

Figure 5. Effect of cover crops on disease severity of tobacco roots. NS at P≤0.05.

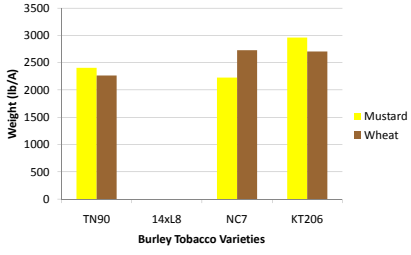

Figure 6. Effect of cover crops on yield of burley tobacco varieties. NS at P≤0.05.

CONCLUSIONS

Greenhouse Study

•There appears to be an effect on the pathogen (chlamydospores) due to the incorporation of mustard residues compared to wheat.

•Incorporated wheat affected chlamydospore survival.

Field Project

•Our results are inconclusive as to whether there is an effect from incorporated mustard cover versus wheat cover on populations of *P. nicotianae.*

•Possibly another year in the same field will show an impact on populations of *P. nicotianae* in the soil.

•Based on greenhouse study, mustard biomass levels in the field may not be sufficient to have a biological effect.

ACKNOWLEDGEMENTS

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