COMBINING METHYL ISOTHIOCYANATE, COMPOSTS, AND BRASSICA AMENDMENTS TO CONTROL SOUTHERN BLIGHT OF TOMATO.

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The removal of methyl bromide from the marketplace will likely require growers to adopt an integrated approach to disease management. Our research project is examining the effectiveness of combining chemical and non-chemical methods to reduce the incidence of southern blight in plasticulture tomato production to economically manageable levels. Accumulating evidence suggests that composted soil amendments, solarization, and biofumigation with *Brassica* cover crops all have the potential to reduce phytopathogenic fungal propagule numbers to some degree. In fields extensively infested with *S. rolfsii*, the causal agent of southern blight, it is probable that elevated propagule numbers will need to be initially reduced via a chemical fumigant. We will be examining the ability of Methyl Isothiocyanates (MITC), such as the commercially available compounds dazomet and metam-sodium, to substitute for MeBr for this purpose. When disease is evident but soil tests reveal more moderate numbers of propagules present non-chemical means of suppression may prove to be sufficient for control to tolerable levels.

The utilization of composts will result in the re-establishment of a balanced soil microbial community that will be capable of providing extended and sustainable disease suppression. Our study focuses on enhancing the beneficial effects of composts via either combining them with other non-chemical treatments such as biofumigation and solarization or via a compost/MITC combination. In order for any of the tested treatment combinations to be adopted commercially the mode of action of disease suppression needs to be described and documented more extensively. That can be accomplished via a detailed exploration and description of the changes that occur in the soil microecology. Traditional methods of enumeration and isolation via culture plating have flaws and limitations. Phospholipid fatty acid (PLFA) analysis permits both more precise calculations of microbial biomass and identification of the microbial community members. By utilizing techniques that can quantify PLFAs and their related biomarkers, we are able to describe how a treatment alters microbial populations and the community structure. Relating this information to disease incidence will accrue valuable information regarding soil microbial community diversity and pathogen suppression. This knowledge will permit meaningful testing and analysis of any potential soil treatment, thus, providing growers with a test that may be used to determine when a chemical or biological control is needed in an integrated production system.

Methods: Field studies

In 2000 a three-quarter acre research site was established at the Knoxville Agricultural Experiment Station. The 2000 and 2001 field treatments are displayed in Table 1. The rows were prepared using common methods for forming raised beds covered with black plastic mulch. Yield data was collected throughout the season. An inspection of each plant for southern blight was also conducted. This data was also collated and compared to treatment type.

Phospholipid Fatty Acid Analysis

PLFA analysis was conducted on soil samples taken from the treated beds. The process includes: 1) Lipid extraction via a modified Bligh/Dyer method. 2) Total lipid extract fractionated into neutral lipids, glycolipids, and polar lipids by silica acid column chromatography. 3) Fatty acids methyl esters (FAMES) recovered from the organic fraction of the sample. 4) FAMEs analyzed by capillary gas chromatography with flame ionization detection on a Hewlett-Packard 6890 series 2 chromatograph. 5) Definitive identification of peaks by gas chromatography/ mass spectroscopy of selected samples using a Hewlett-Packard 6890 series 2 gas chromatograph interfaced to a Hewlett-Packard 5971 mass selective detector.

Results and Conclusions

The first year of the field study demonstrated that tomato yields are greatly influenced by soil treatment type. The compost amended plots produced yields 59% higher than controls. MITC and biofumigation plots had 39 and 40% higher yields than controls. However, the combined MITC + compost plots produced the highest yields - 82% above control. In 2001 the compost plots yielded 91% above controls and the "compost + 50% MITC" plots 79% higher. In 2000 the incidence of southern blight was also lower in all treatment plots compared with control. The most noteworthy result from 2001 was the low incidence of disease in the "compost + 50% MITC' treatments - 5% of control. These results, and similar ones from other researchers, suggest that the most effective treatments for prevention of tomato diseases and enhanced yields may be those that integrate two or more control mechanisms while also favoring the growth of beneficial soil organisms.

The analysis of PLFA data from soil samples taken from numerous plots also reveals several trends that may increase our knowledge in regards to the properties of suppressive soils. A shift in structure of the microbial populations due to the treatments was apparent. The microbial biomass of the compost and MITC + compost treatments was significantly higher than the controls. However, the relative proportion of fungal lipid biomarkers was lower in these two treatments than in any other. This observation was also true in regards to polyunsaturated PLFAs, a general soil micro-eukaryote biomarker. Plants in these two treatments recorded the lowest incidence of southern blight. From this preliminary data a hypothesis could be formed suggesting a treatment that encourages a high bacteria to fungi ratio in the will be effective at disease control.

Table 1. Field treatments for 2000 and 2001.

2000	2001
Biofumigation (*Brassica juncea)*	Biofumigation
Spent mushroom substrate (SMS)	SMS + PWC combination
Poultry waste compost (PWC)	Biofumigation + compost
MITC	MITC
MITC + compost (SMS/PWC)	MITC + compost (2nd year)
Control (Rye cover)	Solarization
	Solarization + compost
	Compost + 50% MITC
	Control

∗The composts were applied at a 30 ton/acre rate.

∗The MITC (Basamid) was applied at the rate of 350 lbs/acre.

∗The *Brassicas* were seeded at a rate of 13g/row.

∗The MITC (Basamid) was applied at the recommended rate of 350 lbs/acre except for the "50%" treatment.

∗The "MITC + compost" treatment entails fumigating the plots followed two weeks later by a compost application (PWC/SMS @ 30 t/a).

∗Solarization is achieved by laying a clear polyethylene tarp over the established black plastic mulched beds. A 15cm airspace is establish between the two plastic layers via the use of spacers.

∗The "solarization + compost" treatment consists of incorporated compost into the soil, forming the raised beds, and covering them with a clear plastic tarp.

∗The "compost + 50% MITC" treatment requires the incorporation of compost into the soil followed several weeks later by fumigation with MITC applied at a rate of 175 lb/acre (50% of the recommended dose).

*Biofumigation + compost" consists of a compost incorporation into which the *Brassica* crop is planted and, upon obtaining a suitable biomass (approx. 60 days), the plant material is tilled into the soil.