MUSTARD MEAL BIOFUMIGATION OF SOILS IN STRAWBERRY PRODUCTION

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Most strawberry growers in the United States utilize the annual raised-bed plasticulture system, which depends heavily on annual soil fumigation with methyl bromide for pathogen and nematode control. Martin and Bull (2002) reported that root rots caused by *Pythium*, *Rhizoctonia*, and *Cylindrocarpon* spp. caused a 25 to 85% reduction in strawberry yield in nonfumigated soils.

In vitro bioassays have demonstrated that secondary metabolites (glucosinolates) from *Brassica* tissues killed several soilborne pathogens (Charron and Sams, 1999). Research has demonstrated that *Brassica juncea* incorporated into the soil before planting strawberries resulted in higher yields than untreated soil. Brown et al. (2006) reported that the seed meal could contain up to 10 times higher glucosinolate concentrations than other plant parts.

Composts may suppress pathogens by containing non-harmful fungi that may out-compete pathogenic fungi for nutrients, be parasitic or predatory of pathogenic fungi and may induce systemic resistance in plants, produce metabolites that may suppress the growth of other fungi, or produce metabolites that may suppress fungi.

The goal of this project was to determine if mustard meal would effectively fumigate the soil and if mushroom compost would introduce less pathogenic microbial populations more quickly, thus benefiting strawberry plants. The objectives were to study the effects of timing, cover and rates of soil incorporation of mustard meal (*B. juncea* L.) and mushroom compost on strawberry yield, diseases, and weeds.

Materials and Methods

A three-year study was initiated in 2003 in Knoxville, Tenn. with four replications and treatments of 1) nontreated soil; 2) 1000 lb/acre (1120 $kg \cdot ha^{-1}$), 3) 2000 lb/acre (2240 $kg \cdot ha^{-1}$), or 4) 4000 lb/acre (4480 $kg \cdot ha^{-1}$) of mustard meal (MM) tilled into soil beds in early September and covered immediately with plastic; 5) 30 ton/acre (67.3 $t \cdot ha^{-1}$) of mushroom compost (MC) tilled and covered immediately with plastic; 6) 2000 lb/acre of MM and 30 ton/acre of MC tilled into beds and covered with plastic; 7) 2000 lb/acre or 8) 4000 lb/acre of MM tilled, covered with plastic, the cover removed three weeks later, 30 ton/acre of MC tilled, beds reformed and covered with plastic 9) 2000 lb/acre of MM tilled, sealed with 0.5 inch (1.3 cm) sprinkler irrigation water, 30 ton/acre of MC tilled in three weeks later; and beds reformed and covered with plastic; and 10) 2000 lb/acre of MM tilled into beds and sealed with irrigation water. Each of the beds not sealed with irrigation water was watered for 24 hours with a single dripline irrigation tube, starting immediately after covering with plastic. All plots were covered with plastic after the last treatment, and plants were grown in the raised-bed plasticulture system after application of the last treatment. Plants were spaced 12 inches (30 cm) apart in double rows 16 inches (41 cm) apart in plots 14 feet (4.3 m) long. 'Chandler' plug plants were established in early November in 2003 and 'Sweet Charlie' plug plants in late October 2004 and 2005.

Results and Discussion

In 2004, the first spring after treatment, those plots treated with 2000 lb/acre MM and covered immediately with plastic had 20% more yield than untreated plots. Plots treated with MM (1000 lb/acre to 4000 lb/acre) averaged 12% more yield than untreated plots. Plots treated with 30 ton/acre compost also averaged 12% more yield than untreated plots, but the combination of MM and MC did not increase yield over either treatment alone.

In 2005, the effects of MM and MC on strawberry yield were not consistent with the first year, perhaps because of differing cultivars or changes in the soil (microflora or nutrient). Plants grown on beds treated with MM averaged 20% greater yield than control plots. Beds treated with 4000 lb/acre MM and sealed with plastic had 25% greater yield than plants on untreated beds. Beds treated with 2000 lb/acre MM, sealed immediately with irrigation water, and with incorporation of 30 ton/acre MC three weeks after the MM meal, had the highest yield in 2005 and 2006.

Most of the 'Chandler' plants planted the first year were infected with anthracnose but had >97% survival at harvest the next spring. Plants on beds treated with 2000 lb/acre MM and covered with plastic had less anthracnose ($P<0.05$) and more plant vigor than control plants, indicating the protective effect of MM.

The application of up to 4000 lb/acre of incorporated mustard meal did not control weeds. Broadleaf and grassy weeds grew through holes in the plastic and a few nutsedge plants grew through the plastic. Other research (Brown et al., 2006) has demonstrated that mustard meal had herbicidal activity but the application method was different from that in this trial.

Literature cited

Brown, J., M. Hamilton, J. Davis, P. Brown and L. Seip. 2006. Herbicidal and crop phytotoxicity of Brassicaceae seed meals on strawberry transplants and established crops. Second International Biofumigation Symposium. Moscow, ID. www.ag.uidaho.edu/biofumigation/abstractinfo.asp?ID=75, 20 July 2006.

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