CHANGES IN SOIL AND PLANT HEALTH DUE TO PEST MANAGEMENT AND CROP PRODUCTION PRACTICES

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The objectives of these studies were to measure the biological impact of crop production practices and soil disinfestation procedures on plant and soil health. Duplicate studies were established in an organic vegetable farm, which had a low incidence of soilborne disease and little damage from plant parasitic nematodes, and in a conventional vegetable farm where severe damage from soilborne diseases and nematodes has occurred. Treatments were selected to include practices and procedures performed in conventional, organic, and conservation tillage production systems. Treatments were arranged in a randomized complete block design with split plots. Main treatments consisted of partially composted urban plant debris applied at rates of 0 and 67 metric tons per hectare. Split plots consisted of an untreated control, methyl bromide fumigation, soil solarization, and minimum tillage using a cover crop stubble of Crotolaria juncea (sunn hemp) or Vignia unguiclata (iron-clay cowpea). The methyl bromide treatment was omitted from the organic vegetable farm site. Bell pepper was cultivated in the conventional vegetable farm site while pepper and tomato were cultivated in the organic site. The entire experiment was conducted in 1999 and repeated again in 2000. Measurements of soil pH, organic matter, carbon-to-nitrogen ratio, cation-exchange capacity, and bulk density were taken as chemical and physical indicators of soil health. Disease incidence, severity of root-galling, density of phytoparasitic nematodes, marketable yield, and fungal colonization of plant roots were used as biological indicators of plant and soil health.

Differences in soil organic matter and cation-exchange capacities were noted between the two sites. Addition of the urban plant debris increased the cation-exchange capacity and decreased bulk density. In the conventional site, the incidence of blight caused by Phytophthora capsici was significantly reduced by the addition of urban plant debris in 1999 but not in 2000, when a severe epidemic occurred in all treatments. Disease incidence remained low in the organic site in both years, despite the identification of fungal plant pathogens in soil and plant samples. In the conservation tillage treatments, the stubble mulch left behind by the cover crops failed to provide suppression of weeds in both locations in both years. The highest yields were obtained in the solarization treatment in the organic site and in the solarization and methyl bromide treatments in the conventional site.

Colonization of pepper and tomato roots by mycorrhizal fungi was low at both sites in both years, even after the crop was planted directly into the cover crop stubble using minimum tillage. Root colonization by species of Trichoderma, Gliocladium, and Myrothecium were low at both sites in both years. Fusarium was the dominant fungal genus identified in plant roots across all treatments and locations, often exceeding an incidence of colonization of 90%. Other fungal genera with colonization incidences

frequently above 50% were Aspergillus, Curvularia, Macrophomina, Penicillium and Pythium.

These studies indicate the need to refrain from generalizations regarding the broad association of some fungal groups with soil health. While mycorrhizal fungi and species of Gliocladium, Myrothecium, and Trichoderma are often promoted and marketed for the biological control of soilborne pests, their competitive fitness in some agro-ecosystems may be low and not a prerequisite to soil health. The results from this study suggest that in some high input vegetable production systems located in subtropical, high precipitation areas with sandy soils, other genera dominate the community of root colonizing fungi and may be more active in the suppression of plant pests.