COMBINED ORGANIC AMENDMENTS WITH SOIL HEATING TO CONTROL SOILBORNE PLANT PATHOGENS

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Chemical soil disinfestation often leads to eradication most microbial residents in soil. This creates microbial vacuum, which often leads to a rebounding of pathogens that may cause even more damage that those originally targeted for control. Soils especially those with low microbial population are more vulnerable to re-invasion of pathogens following fumigation. Combining organic amendments with soil solarization is a non-chemical approach to improve the control of soilborne pests. Heating of soils, covered with plastic film and amended with appropriate organic material, actuates chain reaction of chemical and microbial degradation leading to the generation of toxic compounds in the vapor and liquid soil phase. Generation of toxic compounds is increased with temperature. These toxic compounds accumulate under the plastic mulch, and enhance toxic activity against soil flora and fauna, especially soilborne plant pathogen. The plastic mulch traps the volatile compounds and creates atmosphere in soil, which enhances the degradation of the organic matter. The toxicity of the generated volatile compounds is expected to be higher under the high soil temperature prevailing during solarization. At the end of the process, the soil contains less pathogens, and different microflora, which may suppress new establishment of pathogens in this soil.

Significant qualitative and quantitative differences in volatile compounds from heated and non-heated soil amended with plant residues (aromatic herb plants) or high nitrogen organic material (poultry manure, soy meal) were evident in both controlled-environment studies and field experiments. Concentrations of volatile compounds were higher in heated soil amended with plant residues than from the corresponding non-heated soil, and were directly related to increased soil heating. Numbers of propagules of *Fusarium oxysporum* f. sp. *basilici* , *Scleroium rolfsii*, and *Pythium ultimum* were reduced by more than 95% when the propagules were exposed to volatile compounds from heated, amended soil. In contrast, volatile compounds from non-heated, amended soil had only a low killing effect on these fungal propagules after four weeks of incubation. Microbial activity in heated or solarized soil amended with plant residues increased after the first two weeks of incubation, or solarization as compared to non-amended soil. Apparently, microbial activity is involved in pathogen control during solarization of amended soil.

The effect solarization of organic amended soil as a control method was tested in field experiments. Combining solarization with soy meal completely eliminated viability of fungal propagules to a depth of 50 cm. Soil solarization combined with organic amendments effectively controlled crown rot of tomatoes, Verticillium wilt of potatoes, and other diseases.

A long-term field study was established to test the effect of crop rotation, soil solarization and organic amendments (poultry manure and soy meal) on root diseases in potato and peanuts. Rotations included intensive cropping of alternated potato and peanut during five crops compared with crop rotation of only one crop of potato and peanuts and two wheat crops. of solarization had a long-term effect in controlling *Verticillium* and *Rhizoctonia* in potato and peanuts after three susceptible crops. Combining soil treatment, with wheat rotation further improved pathogen control. *Verticillium* and *Rhizoctonia* incidence in the fifth crop (potato) were still very low in the disinfested, wheat-rotation crops.

Conclusions:

1. Combining organic amendments with soil solarization is a non-chemical approach to improve the control of soilborne pests
2. Pest control is achieved through thermal inactivation, volatile generation, and shift in biological activity in soil.
3. Treated soil becomes suppressive to reinfestation by soilborne pathogens
4. A long-term effect of pest control is evident in field experiments.
5. Application technology is available and makes the implementation of this approach very feasible.