SOIL SOLARIZATION USING SPRAYABLE PLASTIC POLYMERS TO CONTROL SOILBORNE PATHOGENS IN FIELD CROPS

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Introduction

Applying plastic films for soil solarization requires special equipment and procedures. The film edges should be buried to hold the film in place, and in continuous mulch treatment, the sheets should be glued together. The capacity of area coverage is limited and the films must be removed from the fields at the end of the crop. Plastic removal is expensive and requires intensive labor. Plastic residues are often left in the field and can cause difficulties to agricultural practices and machinery of future crops. Sprayable soil mulch for soil solarization using degradable polymers offers a feasible and cost-effective alternative to plastic tarps. The polymer is sprayed on the soil surface at the desired quantity and forms a membrane film, which can maintains its integrity in soil and elevates soil temperature. Nevertheless, the formed membrane is porous and allows overhead irrigation. A sprayable polymer product "Ecotex" was developed together with the technology to economically apply it on soil for various purposes. Black polymer formulation, can raise the soil temperature and retain soil moisture under the summer conditions. This process allows soil solarization and can significantly reduce populations of soilborne pathogens.

Material and methods

The effect of soil solarization using sprayable polymers was tested in several field plots for controlling soilborne diseases in potato and peanut crops. Sprayable polymer (Ecotex, NirOz, Israel) was applied at rates of 800-1000 kg/ha, using the special technology and sprayer which was developed for that purpose. In specific experiments, standard plastic mulch was applied for comparison. In order to enhance pest control, solarization was combined with fumigants or organic amendments. These were applied prior to mulching the soil. In some cases fumigants were applied during the solarization process through the irrigation system.

Soil temperature and control of soilborne fungi and bacteria was determined at the termination of the solarization process. Potato or peanut crops were planted in the fields and were cropped under commercial practices. during crop growth, developments parameters, disease control and yield were determined. In some cases, long term effect of the treatments was assessed on a second and third crop following the soil treatment.

Results

Soil coating using sprayable resulted in a membrane film, which can raise soil temperature to solarization level (Fig. 1). The soil heating process with

sprayable mulch is faster that that with plastic film but, soil is also cooled down to lower degrees at night. Overall, soil temperatures under sprayable mulch are inferior to those obtained under plastic film. The thickness of the sprayed coat is critical to obtained effective heating mulch (Fig. 1).

Combining solarization with formalin enables effective reduction of populations of Streptomyces at reduced dosages (Fig. 2). Soil solarization using sprayable mulches was effective in controlling Verticillium wilt in potato, and peanuts. Combining solarization with formalin at reduced dosage (1000 l/h) was effective in controlling potato scab and peanut pod wart. The level of control of these diseases was similar to solarization using plastic films.

A long-term field study was established to test the effect of soil solarization combined with fumigants (formalin) or organic amendments (poultry manure and soy meal) on root diseases in potato and peanuts in continuous cropping. Solarization with sprayable polymers had a long-term effect in controlling disease incidence of Verticillium and Rhizoctonia in three successive potato and peanuts crops. These combined treatments were effective in controlling potato scab and peanut pod wart after two or three successive crops. Combining soil treatment, with appropriate crop rotation further improved pathogen control.

Conclusion

- Sprayable polymers such as Ecotex together with the application technology enables implementation of solarization on large field scale were plastic film mulch (to be held for few weeks) is limited. The polymer is degradable and there is no need for disposal treatments.
- Solarization alone is in many cases not effective against all pest. Therefore, combination with other agents (fumigants) is needed.
- Combination of solarization with other fumigants or organic amendments enhances the efficacy of pest control and extends the spectrum of controlled pests. Application of fumigants on sprayable mulch can be done before or during the solarization by overhead irrigation. This is an advantage over plastic film mulch.
- Solarization using sprayable mulch often results in increased yield and long-term effect of disease control and increased yield even after two consecutive crops after the treatment.
- Soil type is a limiting factor in applying this technology. Application is limited in heavy clay soil.

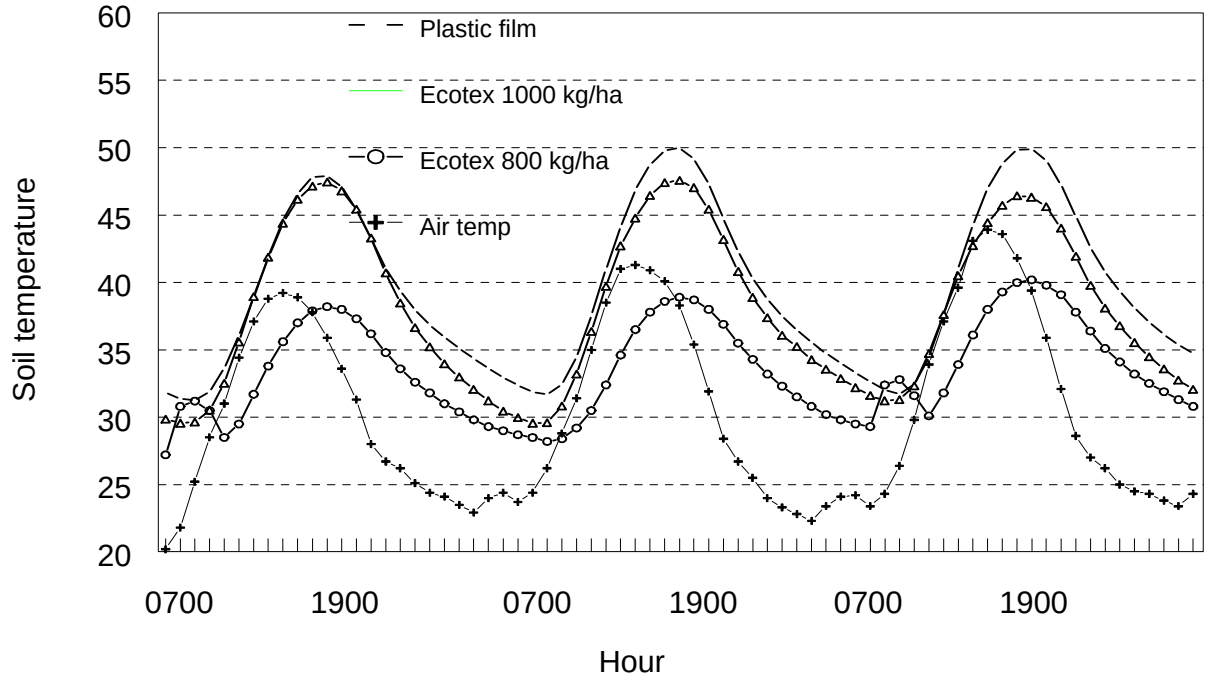

Figure 1. Soil temperatures during July at depth of 10 cm under plastic film or sprayable “Ecotex” mulch at the specified rates

Figure 2. Effect of Soil solarization using sprayable “Ecotex” mulch and combined with formalin, on reduction of population of streptomycetes in soil.