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Soil Solarization: A Non Chemical Method for Pest Management

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Soil solarization is a method of controlling soil bome pests and pathogens by raising the temperature of the soil through application of transparent polyethylene to a soil surface. Soil solarization is indeed a non-chemical method of controlling soilborne pests by placing plastic sheets on moist soil during periods of high ambient temperature. It is an environmentally friendly and sustainable technique used in agriculture and gardening.

Soil solarization involves covering moist soil with clear plastic sheets during periods of high ambient temperature, typically during the hot summer months for 4-6 weeks. The plastic sheets trap solar energy, raising soil temperatures in the upper layers of the soil. The increased soil temperature resulting from solarization can kill or significantly reduce populations of pathogens, nematodes, weed. In addition to pest control, soil solarization can improve soil structure and increase the availability of nutrients, such as nitrogen (N), by breaking down organic matter and making it more accessible to plants. Soil solarization was developed for the first time in Israel (Egley and Katan) for the management of plant pathogenic pests, diseases and weeds.

Disease Management

Soil solarization control diseases caused by many fungal pathogens such as *Rhizoctonia solani*, *Fusarium* spp. *Pythium* spp., *Phytophthora* spp., *Verticilium* spp.. *Sclerotium rolfsii* etc in many crops. It also significantly decrease the population of disease causing *Agrobacteria* and *Pseudomonas*. Many nematode diseases caused by *Meloidogyne* spp. *Heterodera* spp. etc. also successfully controlled by soil solarization.

Weed Control

Soil solarization generally controls most of the annual and many perennial weeds. Winter annual weeds seem to be especially sensitive to solarization. Soil solarization is especially effective in controlling weeds in fall-seeded crops such as onions, garlic, carrots, broccoli and other brassica crops and lettuce. Although summer annual weeds are less temperature-sensitive than winter annuals, most summer annuals are relatively easily controlled by soil solarization.

Improved Soil Physical and Chemical Features

Solarization initiates changes in the physical and chemical features of soil that improve the growth and development of plants. It speeds up the breakdown of organic material in the soil, resulting in the release of soluble nutrients such as nitrogen ($N0_3$, NH^{4+}), calcium (Ca^{++}), magnesium (Mg^{++}), potassium (K^{+}), and fulvic acid, making them more available to plants. Improvements in soil tilth through soil aggregation are also observed.

Encouragement of Beneficial Soil Organisms

Fortunately, while many soil pests are effectively eliminated by soil solarization but many beneficial soil organisms are able to either survive solarization or recolonize the soil very quickly afterwards. Among them, mycorrhizal fungi and fungi and bacteria that parasitize plant pathogens and aid plant growth. The shift in the population in favor of these beneficials can make solarized soils more resistant to pathogens than nonsolarized or fumigated soil.

Soil solarization comes with several limitations, challenges, and potential adverse effects that need to be considered. It is predominantly suitable for regions with a hot climate and requires that the soil remains crop-free for an extended period, typically around one month or more when covered with polyethylene (PE) sheets. It is too expensive for some crops and ineffective in the control of certain diseases. There is also a concern that repeated use of soil solarization could potentially lead to the development of heat-tolerant pathogens, although this is less likely than with target-specific disinfection methods. Another possibility would be an increase in pathogen population due to a harmful effect on its antagonists.

Advantages

- Nonpesticidal and simple
- No health or safety problems associated with use
- No registration is required
- Crops produced are pesticide-free and may command a higher market price
- Controls multiple soilborne diseases and pests
- Selects for beneficial microorganisms
- Tends to increase soil fertility Increases soluble $N0_3$, NH, Ca, Mg, K and soluble organic matter
- May improve soil filth
- Can speed up in-field composting of green manure

Disadvantages

- Restricted to areas with warm to hot summers
- Land must be taken out of production for 4 to 6 weeks during the summer
- May not fit in with some cropping cycles
- May be difficult for those using a small amount of land intensively
- Limited number of retail outlets for UV-inhibiting plastics
- Disposal may be a problem
- Some pests are not controlled or are difficult to control
- No pest control in the furrows between strips (if applied in strip coverage)
- High winds and animals may tear the plastic

References

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