AgriCos e-Newsletter
ISSN: 2582-7049
AgriCos e-Newsletter
Open Access Multidisciplinary Monthly Online Magazine
Volume: 04 Issue: 03 March 2023 Article No: 06

Soil Solarization

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SUMMARY

Soil health is one of the most important components in organic farming which affects yield and productivity. Soil solarization is an environment friendly method of soil disinfection process which utilizes the solar radiation for killing pathogenic disease-causing microorganisms, insects, weed seeds, nematodes etc. Since it does not require any chemicals or sophisticated equipments, it can easily be practised by farmers.

INTRODUCTION

Soil solarization is the process of hydrothermal disinfection of soil in which solar energy is used to control bacteria, fungus, insects and weeds in the soil. It is a pre plant method of soil heating in which solar energy is trapped by moist soil which are covered with transparent polyethylene films for a period of 4-6 weeks. Soil intercepts the energy radiated from the sun and its temperature rise to the level that is deadly to many soil-borne pathogens which also results in changes in physical, chemical and biological properties of soil (Gill *et al*., 2017). So, it is a sustainable eco-friendly crop protection method which uses no chemicals and can be effectively practised in places having tropical climates which are characterized by high summer air temperatures.

Principle

The mechanism of action of soil solarization is based on the increased soil temperature (45–55°C) underneath transparent polyethylene sheets which causes killing of plant pathogens. The heating effect of soil solarization is more at the surface of the soil and decreases with depth. During day time, the upper 5 cm of soil will be having a temperature of more than 50°C. At lower depth of about 10–15 cm, soil temperature may pass 40°C in warm environment and during summer, and at about 30 cm depth more than 35°C can be achieved (Stapleton, 1997). However, the effect of energy emitted by sun on soil temperature is strongly dependent on climate and weather.

Need for soil solarization

Crop loss due to pest and disease attack and also due to weed infestation is very high. Fungal pathogens like *Pythium* spp., *Phytophthora* spp., *Fusarium* spp., *Rhizoctonia* spp., *Sclerotinia* spp., *Macrophomina* spp., *Agrobacterium* spp., *Clavibacter* spp. and *Streptomyces* spp. which causes many soil borne diseases can be effectively controlled by soil solarization. Nematodes like *Meloidogyne, Heterodera, Xiphinema, Pratylenchus* which survive in soil causing huge heavy crop loss can also be easily controlled by soil solarization. Soil solarization helps in destruction of seeds of weeds like *Cynodon dactylon, Cryprus rotundus, Ageratum* spp., Barnyard grass, *Digitaria* spp., *Setaria* spp. etc. Many of these weeds act as alternate hosts for many pests. Thus, destruction of these weeds will also help in reducing the pest population also.

Yadav and Singh (2017) cited that solarised soil is found to show consistent increase in NH_4 and $NO^{3-}N$ concentrations whereas, concentration of other soluble mineral nutrients like Phosphorus, Potassium, Calcium, Magnesium etc. also increased, but less consistently. Improved mineral nutrition is also often associated with chemical soil fumigation (Stapleton, 1997). Decomposition of organic components of soil during solarization treatment is found to be the main cause for increase in mineral nutrient concentrations. All these factors, which causes changes in the physical, biological and chemical properties of soil contribute to enhanced growth and development of plants with increased plant height, number of leaves, better root formation, increased root nodulation in legumes and ultimately yield (KAU, 2009).

Soil solarization process

Solarization has to be done in open field without any shade. Summer months when the soil receives the maximum sunlight are more suitable. The land is prepared to a fine tilth by breaking the clods. All the stubbles, pebbles and other remnants should be removed so that the surface is smooth, as otherwise it may puncture the plastic sheet which will result in loss of heat. Soil should be in good tilth allowing close contact between the plastic sheet and the soil to prevent the formation of air pockets, which reduces heat conduction. If needed incorporate sufficient organic matter also.

Irrigate the area with water in such a way that the field is sufficiently wet. Wet soil conducts heat better than dry soil and makes soil organisms more vulnerable to heat. Yadav and Singh (2017) reported that in order for the soil solarization to be effective, the soil under the plastic sheets must be saturated to at least 70% of field capacity in the upper layers and should be moist to depth of 60 cm. Soil should be kept moist during solarization to increase the thermal sensitivity of resting structures of soil-born plant pathogens and weeds, and to improve heat conduction (KAU, 2009).

After irrigation cover the area with a transparent polythene sheet which allows passage of solar energy into the soil. The thinner the plastic, the greater the heating will be. Transparent film allows passage of solar energy into the soil, where it is converted into longer wavelength infrared energy. Sheets preferably of 100–150-gauge thickness is used, as it is both cheaper and more effective in heating due to better radiation transmittance than thicker sheets. Polyethylene (PE) plastic of 0.025 mm thickness is efficient and economical but it is not very resistant to tearing by wind or puncture by animals (Yadav and Singh, 2017).

In order to maintain the temperature and moisture inside the polythene mulch, the edges of the polythene sheet have to be sealed with soil. Adequate care is also to be taken to see that the sheet is in close contact with the surface of soil to prevent the formation of air pockets between the soil and polythene sheet as otherwise solarization will be improper. It has to be maintained like this for a period of 4 to 6 weeks. This will allow the soil to get heated to the greatest depth possible to ensure pathogen control at deeper layers. So, it is better to solarize the soil during a period of high solar radiation with little wind or cloud cover. After solarization, the plastic may be removed without disturbing the untreated underlying soil. The same procedure can be followed for nursery beds, for potting mixtures and also for main field preparation.

Advantages

Not much investment in terms of infrastructure or equipment is needed for practising this technique. It is an eco-friendly method of disinfection which does not use any chemicals nor leaves any chemical residue. So, there is no detrimental effect on environment. It has the extensive effect against many disease-causing pathogens and weeds. It is a safe, simple, effective, and eco-friendly tool for our home gardens and also for the field.

Disadvantages

The disposal of plastic film which is used for covering the area is one drawback. But this can be avoided if biodegradable films are used. Although many soil pests are killed at higher temperatures, plant pathogens, weeds, and other soil borne organisms differ in their sensitivity to soil heating and cannot be consistently controlled by solarization. These may require additional control measures also. Nematodes may penetrate to deeper layers in soil and may survive solarization which will subsequently affect the plant. The effectiveness of soil solarization greatly depends on location and weather conditions also, particularly temperature. If favourable weather conditions are not there, the desired effect will not be possible.

CONCLUSION

Soil solarization, an eco-friendly crop protection technique will help in improving our soil health which is ultimately the base for any crop production technology. This can be effectively used as a component in Integrated Pest and Disease Management and also in organic farming. It is compatible with other disinfection processes also.

REFERENCES

Gill, H. K., Aujla, I. S., De Bellis L., and Luvisi, A. (2017). The Role of Soil Solarization in India: How an Unnoticed Practice Could Support Pest Control. *Frontiers in Plant Science*. 8:1515. doi: 10.3389/fpls.2017.01515

Kerala Agricultural University (2009). The Adhoc Package of Practices Recommendations for Organic Farming, Kerala Agricultural University, Thrissur, 209p.

Stapleton, J. J. (1997). Solarization: an implementable alternative for soil disinfestation. In: Canaday, C.H. (ed.) Biological and Cultural Tests for Control of Plant Diseases, Vol. 12.

Yadav, A. S. and Singh, S. P. (2017). Soil solarization: sustainable tool for insect-pest and weed management. In: Pant, H., Singh, K., Singh, M. K., and Swaroop, D. (eds), *Emerging Trends in Agricultural, Environmental and Rural Developmental Challenges and Solution: An Overview*, Society of Biological Sciences and Rural Development, pp. 225-238.