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Soil Solarization – a novel technique of weed management

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ABSTRACT

Effective control of weeds, soil borne plant pathogens (plant parasitic nematodes, fungi, some bacteria) and weed pest is a serious challenge to farmers for the crop protection. Soil fumigation is used to control this soil borne diseases, insects and weeds in the crops but use of these soil fumigants for pest control is often undesirable due to their residual toxicity in plants and soil, unfavourable effects on humans and animals, complexity of treatments and high cost of chemicals and kills beneficial microorganisms in soil. Soil solarization is a simple, safe, non-chemical and effective alternative to soil fumigants needed to control many weeds, soil borne pathogens and pests. Soil solarization is a hydrothermal process, occurs in moist soil when covered by plastic films and heated by exposure to sunlight during the warmer months. The process changes physical, chemical and biological properties and there by improves soil health and effectively control weeds. When soil moisture is adequate, heat produced pasteurizes the soil and kills pathogens, insects and weed pests but leaves the intact population of many beneficial soil microbes in the soil that promotes plant growth and maintain soil health.

Key words: Soil heating, non-chemical method, pesti cide

INTRODUCTION

The impact of pesticide use on the environment is now well documented, and a more wide spread adoption of integrated weed management strategies and tactics is recommended in sustainable agriculture systems. In India, nearly 45 percent of the annual loss is mainly due to weeds, 30 per cent due to insects, 20 per cent due to diseases and 5 per cent due to pests. Some of the soils borne pathogens which are responsible for annual loss of agricultural produce. Soil - borne pests can be controlled in crop fields by application of Pesticide (Pesticide is a broad term include Insectides, Herbiscides, Fungicide, Rodenticide and Miticides). Pesticides can be used as

Spary and Fumigants such as methyl bromide, chloropicrin *etc.*

Pesticides are poisonous and more toxic than others. The use of these chemicals is undesirable due to their toxic, impacts on Human - beings, animals, nontarget organisms and environment in soil beneficial soil micro-organisms and destroys the soil health. The one of the most important alternative method to kill all the weeds, soil borne pathogens which are present in soil without using pesticides is **Soil solarisation**

Soil solarization is a novel technique of controlling soil borne pests including weeds. This hydrothermal process occurs in moist soil which is covered by a transparent plastic film for 4-6 weeks and exposed to sunlight during the warm summer months. The practice was first reported from Germany in 1888 and was first used commercially by USA in 1897. Soil propagules, as weed seeds, offer a wide range of tolerance to high temperatures, conditioning the long term success of weed control by solarization. It seems probably that not only harmful organisms, but also beneficial organisms are killed by using soil fumigants for soil disinfestations.

Principles of solarization

Solar heating involves the use of heat as lethal agent for tarps for capturing solar energy by means of transparent polythene soil mulches. The thin polythene mulch allows the maximum transmission of solar radiation through moist soil and reduces moisture loss from soil through evaporation. Increase in soil temperature was achieved through improved heat conduction within the soil owing to its higher moisture levels. The principle behind the soil solarization is enhancing the diurnal heating and cooling cycle of the soil.

Solar heating method: The soil solarization method for weed control is similar in principle to that of soil steaming.

Soil preparation: The area to be solarized should be levelled and free from large clods of soil or plant debris.

Soil moisture: Soil moisture constitutes a critical element in the success of soil solarization. Appropriate soil moisture (exceeding 60-70 per cent of field capacity) increases sensitivity of target weeds and organisms to heat and improves soil heat conductivity.

The plastic sheet: Efficacy of plastic cover tarping is affected by plastic type, transmittancy, width and color. Low density transparent plastic mulch is considered as ideal because it transmits maximum solar radiation and reduces the escape of heat from the soil.

Soil covering: The entire field is covered with plastic film and the edges are buried in the soil to the depth of about 20 cm.

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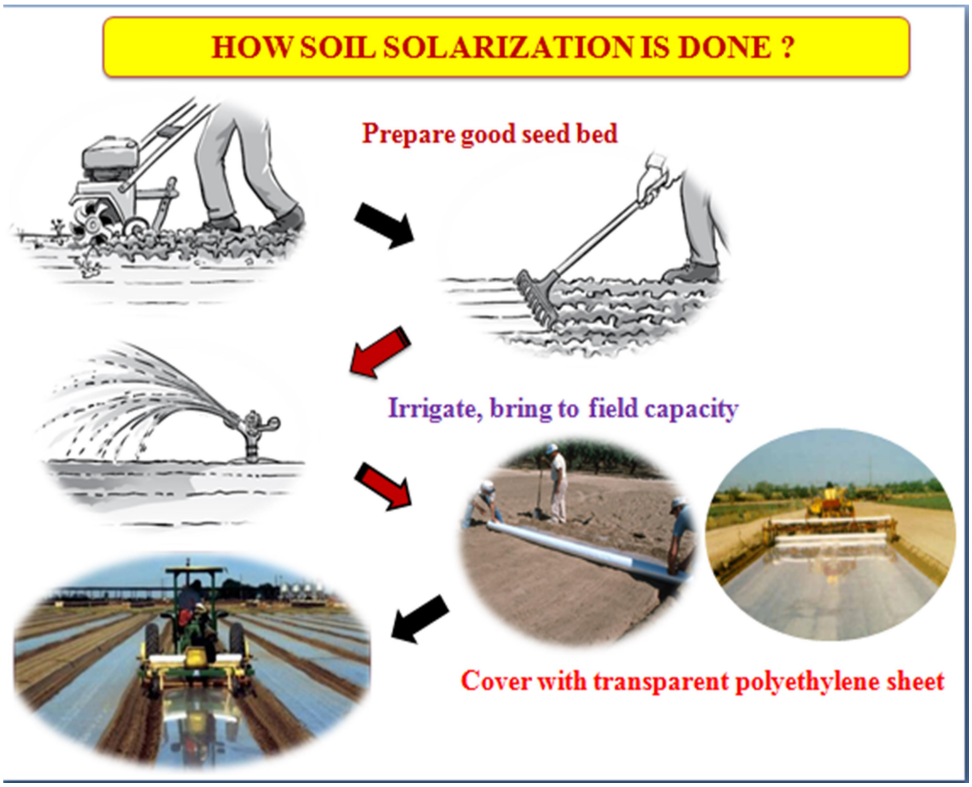

Precautions should be taken out during soil solarization

- Film should be applied as tightly: to minimize air gaps and potential damage from wind
- The polythene sheet should be regularly inspected
- Shady areas should be avoided
- Entry into the fields covered with polythene sheet should be avoided
- Coloured films should not be used
- To prevent the tearing of polythene sheet in the wind, it is recommended that some weight should be placed on the sheet Elements influencing effectiveness of solarization

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Physical identification of successful solarization:

- **Water droplets** collected in the inner surface of the film.
- The upper surface of the film will be very hot.
- Weeds under the film will be eliminated due to **high temperature**

HOW SOIL SOLARIZATION CONTROLS WEEDS

- Direct killing of weeds by solar heat
- Indirect microbial killing of weakened weed seeds
- Killing of seeds stimulated to germinate in the moist mulched soil
- Killing of germinating seeds whose dormancy is broken

Benefits of soil solarisation

The primary advantage of this method is non-chemical management of weeds and soil borne pathogens. In addition to the lethal effects of radiant heat energy on weed seeds and other pests in the soil, solarization may increase crop yields through biochemical and biophysical changes which occur in the rhizospheres, especially in relation to nutrient availability. The method is simple, safe, effective, and not too costly, leaves no toxic residues, and does not harm the environment.

- Very effective in preventing **weed growth**
- Nonpesticidal and simple
- Controls nematodes and soil borne diseases
- It sustains **moisture** in the soil
- It prevents **evaporation** of water
- Tends to increase **soil fertility**
- Enhances **plant growth** and yield.
- Enhances **germination** and helps in the development of healthy seedlings.
- No health problems associated with use
- Helps in reducing usage of weedicides / herbivides / Insecticide.

Limitation of soil solarisation

- Is restricted to areas with warm to hot summers
- May not fit with some cropping cycles
- High winds and animals may tear the plastic Non cropping for a relatively long period, especially in areas of summer cropping.
- Shortage of supplementary irrigation water during solarization.
- Survival of weed seeds deeper in the soil.
- Pollution of plastic residues resulting from the treatment.

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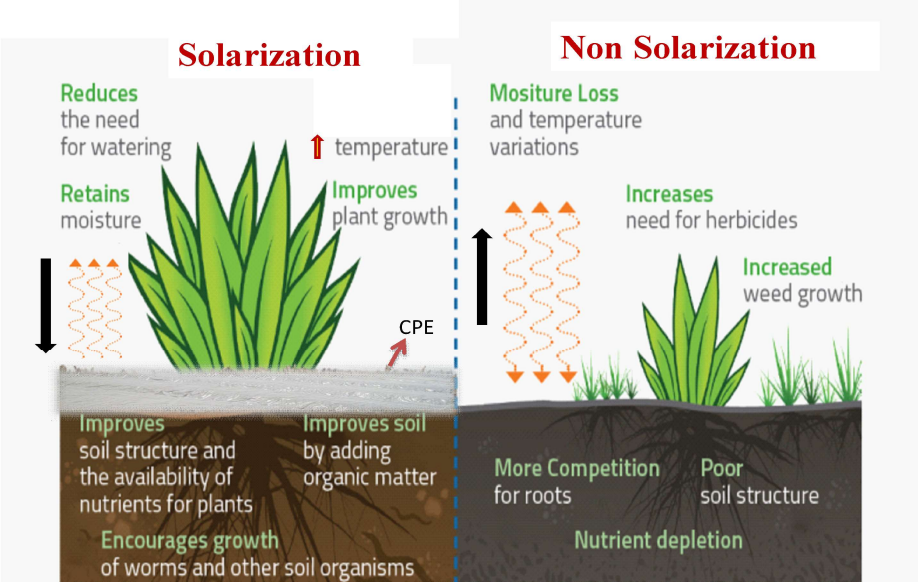
Differences between solarisation and non-solarization soil.



CPE : Clear polyethylene film

Conclusion

Soil solarization non chemical method for controlling soil borne pathogens like fungi, bacteria, nematodes and weeds in soil prior to planting the crops and it is alternative to soil fumigants and increase plant growth and soil health through increased soil moisture accumulation, infiltration and retention, weed control, soil temperature management, protection against soil erosion, improvement of soil tilth, increases in available soil nutrients and pest and disease control. Soil solarization is simple, safe, cost effective and ecofriendly technology for farmers. Various researchers have recommended soil solarization for weed control besides improving the efficiencies of different inputs of crop production. Unfortunately, in our country most of the farmers and rural people are not aware about the application of soil solarization technology. Hence there is a need for the popularization of the soil solarization technology among farmers and rural communities through the training workshop and mass awareness programmes.

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