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ORIGINAL PAPER

Soil solarization: An effective method to control pest, diseases and weeds of vegetable crops.

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INTRODUCTION

Since the beginning of agriculture, weeds have been a recurring issue. Weeds impede crops from growing by competing with the plants for water, nutrients, and sunlight, which causes major losses in agriculture production. Nearly one third of the entire cost of cultivating field crops is conserved by weed control. The manual approach of weed management is immensely popular and economical in India. Bulk of weeds are either mechanically managed by using specialized farming techniques or by applying herbicides. But heavy mechanization promotes soil erosion, which weakens its fertility. Herbicide usage contaminates the soil, water, food, and air, leading to illnesses in people and animals, the emergence of herbicide resistance and the degradation of ecosystems. A shift to sustainable weed management is required for a number of environmental, social, and economic reasons. Sustainable agriculture can conserve natural resources for the future and grow farms at a lower cost. With precision weed control, inputs can be minimized without reducing the efficiency of weed control. The objective of IWM is to maximize crop output and promote farm profit through the use of the integrated use of preventative measures, scientific knowledge, managerial skills, monitoring processes, and effective control methods. Several variables, including weed emergence time, weed density, type of weeds and crops, etc., influence the yield losses brought on by weeds. Weeds left untreated can completely destroy a crop's yield. In addition, weeds engage in interactions with other ecosystem biological agents by serving as hosts for insects and diseases (fungi and bacteria), which can seriously injure crop plants. So, in order to increase crop output, organic weed management is highly desired. One of the most problematic, time-consuming, and expensive production issues in an organic farming system is weed growth. Weeds are controlled using non-chemical techniques in an organic agriculture system. Microbes are effectively killed by soil solarization, which also

effectively manages diseases, pests, and weeds. It also improves soil health, which has more significant benefits. The soil solarization method is chemical-free since it relies on the energy of the sun and water to accomplish its objectives rather than using them. Using the sun's heat to suppress weeds, soil solarization is a low-cost, environmentally friendly method of soil disinfestation that may be used with organic and integrated crop management techniques.

OBJECTIVES

- To optimize the efficiency of the weed control available tools.
- To establish cultivation techniques that control weeds, enhance soil quality, and evaluate the effects of weed management systems.
- To utilize renewable energy and recycling mineral resources while decreasing the use of nonrenewable substances like pesticides.
- To save and improve the natural environment and its resources.
- To ensure farming operations' capacity to generate profit.
- To provide sufficient nutritious and secure food.
- To improve weed control technology, expertise, and ability in ways that are compatible with environmental circumstances and capability.
- To avoid the application of pesticides in a way that threats the health and safety of farm workers, animals, local communities, and society in general.

SOIL SOLARIZATION

Soil solarization is a novel approach method of controlling weeds involves heating the soil's surface by trapping solar energy with plastic sheets laid on soil surface. The key method for minimizing weed seed population and weed emergence is the direct destruction of weed seed in the soil by lethal soil temperature maintained under transparent polyethylene mulch. The process of soil solarization raises soil temperature by 18–12°C. Due to the prevalence of high summer time air temperatures and greater exposure to high-energy electromagnetic radiation, this mechanism is particularly appropriate to the mediterranean environment and other related climates. With the use of soil solarization, farmers can keep the soil at a temperature over 40°C, which is sufficient to kill off weed seeds, plants, insects, and diseases that affect plants, such nematodes and fungi.

EFFECT ON WEED GROWTH

Soil solarization has been proven to be extremely efficient at reducing the population of grassy and broad-leaf weeds, as well as parasitic weeds like *Orabanche spp* by 70% to 100%. This technique is ideal for nurseries and high-value crops like vegetables. Controlling weeds also prevents the spread of insects or harmful bacteria that may spend their whole life cycle on wild plants. About 98% of corn weeds were successfully controlled by solarization, although un solarized control plots likewise sustained 90% weed-only crop damage. Around the world, solarization has been successful in eradicating annual weeds including redroot pigweed, annual bluegrass, *ageratum spp*.,

amaranthus spp., barnyard grass, cogon grass, common purslane, *digitaria spp.*, *portulaca spp.*, and many more. Generally summer wild plants like *cyperus spp*. or Convolvulus arvensis demonstrated a good tolerance to the disinfection treatment, but winter wild plants are easier to eliminate.

EFFECT ON WEED GROWTH IN VEGETABLE CROPS

Due to the slower rate of temperature rise at deeper layers, soil solarization at (37°C) for 2-4 weeks virtually eliminates the emergence of many annual weeds. Due to their deeply buried subterranean vegetative structures, such as roots and rhizomes, cuscuta species, bindweed, and purple nut sedge are not controlled by soil solarization as efficiently as *Orobanche spp.* and many other weeds. When irrigation is supplied at least 2-3 weeks before to soil solarization, weeds are allowed to develop and are incorporated into the soil before the solarization treatment is in place, which enhances the efficiency of soil solarization for weed control in the field.

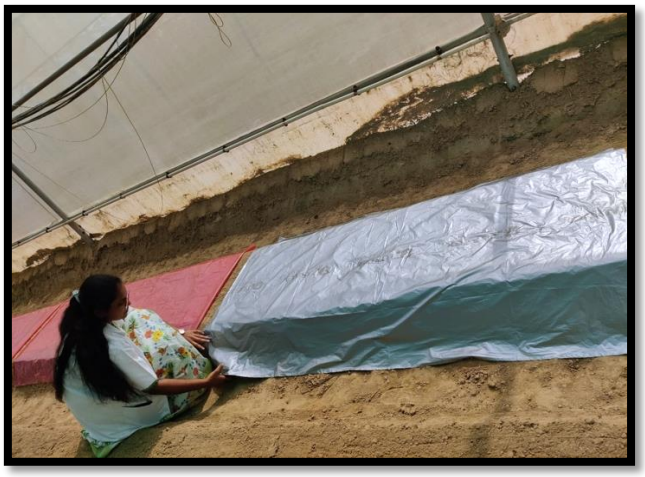

Plate no 01: Silver mulch in poly house cultivation

EFFECT ON NEMATODE MANAGEMENT

In conventional agricultural methods, soil solarization was found to be beneficial against the nematodes *Meloidogyne javanica* and *Globodera pallida* that infect potato crops since it reduced nematode proliferation and enhanced plant production and yield. Moreover, a combination of solarization and bio fumigation was reported to be effective in reducing the severity of pathogenic fungus. The combination of soil solarization and organic amendments has a high potential for controlling *M. javanica* and *M. incognita* in organic farms.

EFFECT ON PEST CONTROL

The efficacy of soil-borne insect inoculum destruction during solarization of open fields or greenhouse floors takes appropriate at the surface and declines with depth. It has been revealed that after in vegetable gardening by soil solarization, bacterial species like *Bacillus* and *Pseudomonas spp.*, fungi like *Trichoderma* and some free-living nematodes

are more prevalent. In solarized soils, their increased presence may induce a short- or long-term shift in the biological balance that deprives pest recolonization and promotes better root and overall plant productivity.

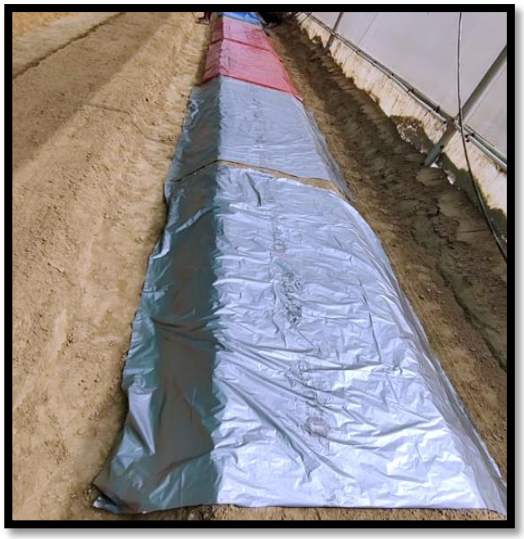

Plate no: 02 Silver and red colored mulch

EFFECT ON DISEASES IN VEGETABLE CROPS

The best control strategy for pre- and post-emergence seedling loss and stem rot disease of potato caused by *Sclerotium rolfsii* was the combined application of soil solarization and bio fumigation. Treatment aids in improving potato growth and yield in addition to inhibiting the pathogen's development and growth. Root-knot nematode population in sweet pepper are considerably reduced by bio fumigation and solarization whereas saprophytic nematode populations are increased, enhancing biodiversity.

Plate no: 03 Black plastic mulch

Table no: 01 effect of soil solarization in vegetable crops

Regulation of nematodes and disease using soil solarization	
Verticillium wilt	Tomato, potato, eggplant, cotton, strawberry.
Southern stem rot	Peanut.
Fusarium wilt	Tomato, melon, onion, cotton.
Rhizoctonia seedling disease (sore shin and damping off)	Potato, onion, beans.
Crown gall	Walnut.
Phytophthora root rot	Ornamental plants.
Nematodes (Lesion, root knot, reniform, cyst, ring, stuby root, dagger)	Various vegetable, fruit crops.

CONCLUSION

The use of soil solarization is stress free, secure, economical, and environmentally friendly
method for the farming community in India to develop sustainably. To manage weeds in vegetable and other crops, use the simple, reliable, economical, and environmentally friendly
technology of soil solarization. It appears to be flexible enough to be used both separately and in combination with agricultural chemicals and biological control agents for a wide range
of agriculture applications. In addition to serving as a potential substitute for herbicide, fumigant, and other pesticide treatments, soil solarization can also be employed to control
weeds, diseases, and pests that are transmitted by the soil.