



## Soil Solarization: A safe, affective and practicable technique for the management of plant-parasitic nematodes

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### Introduction

The changes in agricultural situations have tremendous effects on the emergence of new plant parasitic nematode problems in India. Nematodes can parasitize plants, animals, insects, etc. Plant parasitic nematodes are capable of causing disease on many economically important crops grown in India and attained the status of pests for substantial reduction of crop yield but root-knot nematodes is the most damaging one. The most predominant species of root-knot nematodes are *Meloidogyne incognita*, *M. javanica* and *M. graminicola*.

There is hardly any crop which is not attacked by the root-knot nematodes. All the species of root-knot nematodes produce a characteristic 'root gall' or 'root-knot symptom' which could be easily recognized by the naked eye. The expression of damage in crop plants due to nematodes often goes unnoticed for want of diagnostic symptoms. Above ground symptoms are nonspecific in nature. Infected plants exhibit symptoms of general mineral deficiency, yellowing, stunting and wilting during hotter part of the day, chlorosis and premature shedding of leaves resulting in low yield. Besides inflicting direct losses in crop yields, plant-parasitic nematodes also play an important role in disease complexes involving other pathogens. The lack of awareness among the farmers about the nematode problems and non-availability of suitable package of practices to extension workers for managing nematodes are the major hindrance for protecting the crops.

Effective control of nematodes and soil-borne plant pathogens is a serious challenge for farmers and home gardeners. For the management of nematode problems preventive measures can be taken up to keep the population of nematodes below economic threshold level. To manage nematode menace, use of organic amendments, crop rotation and cultivation of resistant crop varieties, application of nematicides etc. are widely adopted at present in different crops. Chemical approach of nematode management is no doubt effective, but high doses of nematicides required for managing nematodes are



neither economical nor environmentally safe. As a result, there has been an increased emphasis on reduced-pesticide or non-pesticidal control methods. Soil solarization is a simple, safe, and effective alternative to the toxic, costly soil pesticides and the lengthy crop rotations now needed to control many damaging soil-borne pests including plant parasitic nematodes. Solarization is a new additional option to use and include suitably in such IPM programs.

### **How to do soil solarization?**

Soil solarization or “solar heating” is a non-chemical disinfestation practice that may serve as a component of a sustainable integrated nematode management program. Soil solarization is based on the exploitation the solar energy for heating wet soil mulched with transparent polythene sheet to 40–55°C in the upper soil layer. However, it is consistently effective only where summers are predictably sunny and warm. Thermal killing is the major factor involved in the nematode management process, but chemical and biological mechanisms are also involved. It is a method of pasteurization, can effectively suppress most species of nematode.

Soil solarization by 2-3 deep summer ploughings in the month of May-June at 15 days interval followed by light irrigation and covering of soil with 25-micron transparent polythene sheet on the soil surface in such a way that it should remain air tight (Fig 1). Keep film in this way for 30 days and protect it from the damage by dogs, animals and men. By keeping film in this way, soil gets heated up due to conversion of solar radiation into thermal radiation. Radiant heat from the sun is the lethal agent in this process, in which a clear polyethylene mulch or tarp is used to trap solar heat in the soil. As a result, water droplet could be seen on the inner side of film. After 30 days, remove film carefully and preserve or else use it in a similar war for another nursery area/field. If handled with proper care, same film can be reused 2-3 times.



Fig 1. Soil solarization for control of nematodes & soil-borne diseases

### **Principles of soil solarization**



Most of the plant parasitic nematodes cannot survive at soil temperature above 40 °C. During the solarization the temperature will rise beyond 40 °C. The basic principle of soil solarization is to elevate the temperature in a moist soil to a lethal level that directly affects the viability of certain organisms. The heating process also induces other environmental and biological changes in the soil that indirectly affect soil-borne pests including plant parasitic nematodes.

### **Advantages**

Soil solarization as a disinfestation's method, has potential advantages. It is a non-chemical method which is not hazardous to the user and does not involve substances toxic to the consumer, to the host plant or to other organisms. This technology can easily be transmitted to the ordinary farmers and can be applied in large areas manually and mechanically. Thus, it is suitable for both developed and developing countries. It may have a long-term effect, since effective disease control lasts for more than one season. This method has the characteristics of an integrated control, since physical, chemical and biological mechanisms are involved and because the control of varieties of pests (nematodes) is achieved.

### **Limitations**

- ❖ It requires longer time for process and climate dependent.
- ❖ There are geographical limitations on where the method can be used in terms of solar radiation availability.
- ❖ It is too expensive for some crops and ineffective in the control of certain diseases.
- ❖ Heat tolerant pathogens might develop after repeated application, though selection for tolerance to lethal agents is not likely to develop with disinfestation methods which are not target specific.
- ❖ Another possibility would be an increase in pathogen population due to a harmful effect on its antagonists.
- ❖ It is difficult to protect PE sheets from wind and animals.

### **Recommendations generated for field applications**

1. For the management of rice root-knot nematode in rice nursery, soil solarize the nursery beds before sowing for 15 days during summer. Cover the nursery beds with transparent polythene sheet (25-micron thickness) after light irrigation. Cover the edges of polythene sheet with soil to make it air tight.
2. Soil solarization by 2-3 deep summer ploughings in the month of May-June at 15 days interval followed by light irrigation and covering of soil with 25-micron transparent polythene sheet



for 30 days during June-July in polyhouse reduce root-knot nematode population.

3. For the management of root-knot nematode in the cucumber in polyhouse, take the following measures.
  - i) Remove and destroy the plants of the previous crop along with the roots.
  - ii) Solarize the soil during summer by covering it with a 25µm thick transparent polythene sheet for 15-20 days, after light irrigation. Cover the edges of polythene sheet with soil to make it air tight.
  - iii) Add FYM enriched with fungus (*Purpureocillium lilacinum*) @ of 1 kg/m<sup>2</sup> in the soil. For preparing enriched FYM, mix 2 kg of fungus in 1 ton of FYM. Cover it with polythene sheet after sprinkling with water. After 10-15 days, mix it well on the paved surface.

## **Conclusion**

Soil solarization should not be regarded as a universal method but rather as an additional one which, if used correctly, can reduce pest damage safely, effectively and economically. Population of nematodes fungi, bacteria, actinomycetes, decreased drastically due to solarization in all the conditions as compare to non-solarized soils which indicates that this technique can be an effective physical strategy in controlling soil borne pathogens. Solarization is a new additional option to use and include suitably in such IPM programs. Its scope and rate of dissemination in the future will depend on our capacity to both weigh its pros and cons and use it effectively.

