Technology developed through demonstration on the management of root knot nematode, *Meloidogyne incognita* in polyhouse cultivated cucumber by soil solarization

K.V.V.S. Kranti¹, T. R. Kavitha² and N.G. Ravichandra²

¹ AICRP (Nematodes), ICAR-IARI, New Delhi 110 012, India
² AICRP (Nematodes), Department of Plant Pathology, UAS, GKV, Bangalore 560 065, Karnataka, India

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***ABSTRACT***

Two field demonstrations were conducted to convince cucumber growers on the effect of soil solarization in the management of root–knot nematode (*Meloidogyne incognita*) infesting cucumber grown under protected cultivation. Soil solarization along with a bioagent effectively can suppress nematode populations in soil. Initial nematode population of 364 nematodes/200 cc soil was recorded in soil solarization combined with *Trichoderma harzianum* treated plot. Reduced final nematode population of 85 nematodes/200 cc soil and reduced root galling (2.21) was recorded in soil solarized combined with *T. harzianum* treated plot. Root knot index (RKI) of this treatment was lower than those in farmer's practice (Carbofuran 3 G) (2.46) and untreated control (5.00). Untreated control plot recorded an initial and final nematode population of 325 and 358 nematodes/200 cc soil respectively, with highest root knot index of 4.58 and reduced yield. Maximum yield was recorded from soil solarization combined with *T. harzianum* treated plots and the lowest yield was from the untreated control plots.

**Key words:** Solarization, *Meloidogyne incognita*, Cucumber, Management, *Trichoderma harzianum*

**Introduction**

Cucumber (*Cucumis sativus*) is a widely-cultivated creeping vine plant in the Cucurbitaceae family that bears cucumiform fruits, which are used as edible fruit and also for pickling. Cucumber is affected by many different fungal, bacterial, viral and nematode diseases. Among them root-knot nematode (*Meloidogyne incognita*) causes a major disease which leads to heavy yield loss, particularly when grown under protected cultivation.

Resistant varieties, crop rotation, and pesticides are not always viable control options for these destructive pests. Fear of pesticides and an interest in organic farming methods highlight the need for alternative methods of controlling the damaging nematodes. Soil solarization is a simple, safe and effective alternative to the toxic, costly chemical pesticides. Radiant heat from the sun is the lethal agent that kills nematodes in soil. For this a transparent polyethylene mulch or trap is used to trap solar heat in the soil. Over a period of several weeks to a few months, soil temperatures become high enough to kill many of the damaging soil pests and weed seed to a depth of nearly 8 inches. In view if this, a demonstration was conducted in two seasons in a cu-
cucumber polyhouse, naturally infested with *M. incognita*. The sole purpose is to popularize the soil solarization technique among farming community to manage root-knot nematodes.

**Materials and Methods**

Two demonstrations were conducted in farmer’s polyhouses located at K.G. Pura village, Shiddlaghatta taluk, Chikkaballapura dist., Karnataka. Previously hosted cucumber cultivar in this greenhouse was heavily infested by *M. incognita*. Soil temperature before and after solarization technique was recorded. Initial nematode population was recorded from three plots in the polyhouse, viz., soil solarization plot, farmer’s practice plot (carbofuran 3G) and untreated control.

Prior to the treatments, the soil was prepared using a moldboard plow followed by a disk harrow and was irrigated to a depth of 50 to 60 cm. One week later, raised beds were prepared on moistened soil; they were 25 cm in height and 40 cm in width, with 50 cm between rows. Drip irrigation pipes were placed on the raised beds during soil solarization periods to maintain the slight soil moisture.

For soil solarization, plots were covered manually with 100 µm thickness transparent polyethylene sheets including the soil between 2 raised beds. Polyethylene sheets were covered during April-May for 6 weeks. After solarization, *Trichoderma harzianum* (2×10⁸ CFU) obtained from Department of Plant Pathology, UAS, GKV, Bengaluru was applied one week before sowing. Two kg of *T. harzianum* (treatment 1) was mixed with well decomposed FYM and applied to plots and mixed with soil. Soil temperature was recorded before and after solarization. Carbofuran 3 G soil application at 20 g /vine was considered as the farmer’s practice (Treatment 2) and untreated as check (Treatment 3).

Randomly, 4 plants in each plot were chosen and uprooted at the end of the growing season. The effect of treatments on the populations of *M. incognita* was evaluated using the galling index scale of 1-5. Cucumber yields were recorded from 4 plants in each plot which were chosen and marked randomly at the beginning of the season. These plants were harvested weekly and the yield per plant was measured.

**Results**

The maximum soil temperature average was 50.2 °C in the solarized plot and it was 39.0 °C in the non-solarized soil.

In the first demonstration season trail, the initial nematode population of 364 nematodes/200 cc soil was recorded in soil solarization combined with bio-agent treated plot (T1). After the treatment, the reduced final nematode population of 85 nematodes/200 cc soil and reduced root galling (2.21) was recorded in soil solarized combined with bio-agent treated plot (T1). RKI of this treatment was lower than those in Carbofuran (2.46) treated plots (T2). In untreated control plot (T3) the initial and final nematode population of 325 and 358 nematodes/200 cc soil, respectively was recorded with highest RKI of 5.00. In soil solarized combined with bio-agent treated plot recorded 4x10⁴ cfu/g of soil at harvest. The highest yield (3.8 t/ac) was recorded from soil solarization combined with bio-agent treated plots, followed by farmer’s practice plots (3.1 t/ac) however, the lowest cucumber yield was recorded from the untreated control plots (2.5 t/ac) (Table 1).

In the second demonstration polyhouse trial, least final nematode population (116 /200 cc soil) was recorded from soil solarized plots as compared to farmer’s practice (138) and untreated control (361), respectively. Minimum RKI (2.18) was recorded from soil solarized plots as compared to farmer’s practice (2.36) and untreated control (5.00), respectively. Soil solarized plots also recorded maximum yield (3.61) followed by the farmer’s practice (3.04) and the untreated control (2.63). At harvest, cfu/g of soil was evaluated using the galling index scale of 1-5.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>INP (200 cc soil)</th>
<th>FNP(200 cc soil)</th>
<th>Yield tons/acre</th>
<th>RKI</th>
<th>cfu/g of soil at harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1: Soil solarization + <em>T. harzianum</em> (2×10⁸ CFU)</td>
<td>364</td>
<td>85</td>
<td>3.8</td>
<td>2.21</td>
<td>4x10⁴</td>
</tr>
<tr>
<td>T2: Farmer’s practice (Carbofuran 3G)</td>
<td>313</td>
<td>96</td>
<td>3.1</td>
<td>2.46</td>
<td>-</td>
</tr>
<tr>
<td>T3: Untreated control</td>
<td>325</td>
<td>358</td>
<td>2.5</td>
<td>5.00</td>
<td>-</td>
</tr>
</tbody>
</table>
soil in soil solarized plots was $5 \times 10^6$ (Table 2).

**Discussion**

A number of researchers have recorded the effect of soil temperature on root-knot nematode populations. Cartia et al. (1991) reported 42.3 °C at a 15 cm depth of soil in Italy, while Mejeias Guisado et al. (1993) and Tacconi and Santi (1994) reported 46.0 and 43.2 °C at a 10 cm depth of soil in Spain and Italy, respectively. Moreover, soil temperature was increased 44.0, 35.0, and 33.0 °C by using 4-mm thick transparent polyethylene sheet at 5, 15, and 30 cm depth of soil, respectively, in the USA (West Samoa) (Ragone and Wilson, 1998). Herrera et al. (1999) determined similar results in Chile. Lazarovits et al. (1991), Chellemi and Olson (1994), Rao and Krishnappa (1995), Eddaoudi and Ammati (1995), Nasr-Esfehani et al. (2000), and Söüt and Elekçiolu (2007) reported that soil temperature was increased by soil solarization between 7 and 10 °C at a 10-15 cm depth of soil in the different agricultural areas of the world.

A number of plant parasitic nematodes in solarized pots were reduced compared with nonsolarized plots in the East Mediterranean region of Turkey. In Antalya province, root-knot nematodes in greenhouse-grown eggplants were reduced dramatically 73.4%-100% by 6-week soil solarization (Göçmen and Elekçiolo, 1996).

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**References**


