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

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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 Cucrbitaceae 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-

cumber 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, Shidlaghatta taluk, Chikkaballapur dist., Karnataka. Previously hosted cucumber cultivar in this green house 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* (2×10^8 CFU) obtained from Department of Plant Pathology, UAS, GKVK, 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 Carbofuron (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 $4x10^{-5}$ 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

Table 1. Effect of soil solarization on the populations of *M. incognita* and the yield in polyhouse grown cucumber (First demonstration)

Treatments	INP (200 cc soil)	FNP(200 cc soil)	Yield tons/acre	RKI	cfu/g of soil at harvest
T1: Soil solarization + *T. harzianum* (2×10^8 CFU)	364	85	3.8	2.21	4×10^5
T2: Farmer's practice (Carbofuran 3G)	313	96	3.1	2.46	-
T3: Untreated control	325	358	2.5	5.00	-

Table 2. Effect of soil solarization on the populations of M. incognita and the yield in polyhouse grown cucumber (Second demonstration)

Treatments	INP(200 cc soil)	FNP(200 cc soil)	Yield tons/acre	RKI	cfu/g of soil at harvest
Soil solarization + *T. harzianum* (2×10^8 CFU)	328	116	3.61	2.18	5×10^6
Farmer's practice (Carbofuran 3G)	335	138	3.04	2.36	-
Untreated control	317	361	2.63	5.00	-

soil in soil solarized plots was 5×10^6 (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 Elekçiolu, 1996).

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References

Cartia, G., Greco, N. and Cirvilleri, G. 1991. Soil solarization in a plastic house. *FAO, Plant, Product. Protec.* 109: 266-275.

Chellemi, D.O. and Olson, S.M. 1994. Effect of soil solarization and fumigation on survival of soilborne pathogens of tomato in Northern Florida. *Plant Dis.* 78: 1167-1172.

Eddaoudi, M. and Ammati, M. 1995. Study on the effects of single and combined soil solarization and the use of resistant tomato varieties on the populations of *Meloidogyne javanica* and the production of tomato in South Morroco. *Afro-Assian J. Nematol.* 5: 28-33.

Gocmen, H. and Elekciolu, H. 1996. Antalya'da toprak solarizasyonunun seralarda Kok-ur nematodlarý (*Meloidogyne* spp) uzerindeki etkilerinin arafltýrýlmasý (The effect of soil solarization on *Meloidogyne* species in greenhouses in Antalya). *Turkiye Entomoloji Dergisi*. 20: 67-74. (In Turkish with English abstract).

Herrera, C.R., Aballay, E. and Montealagre. A.J.R. 1999. Efecto de una solarizacion prolongada en la sobrevivencia del nematodo del nudo (*Meloidogyne incognita*) en un suelo con monocultivo de tomates (*Lycopersicon esculentum* Mill.). *Fitopatologia.* 34 : 63-8.

Lazarovits, G., Hawke, M.A., Tomlin, A.D., Olthof, T.H.A. and Squire, S. 1991. Soil solarization to control *Verticillium dahliae* and *Pratylenchus penetrans* on potatoes in central Ontario. *Canadian J. Plant. Pathol.* 13: 116-123.

Mejeias-Guisado, A., Chacon-Ortega, A. and Macarro-Corillo, M.G. 1993. A technique for the future: solarization. Control of the root-knot nematode (*Meloidogyne incognita*) using solar energy. *ALBEAR*. 3: 24-29.

Nasr-Esfehani, M., Akhiani, A., Fatemi, R. and Hassan-Pour, H. 2000. Soil solarization effects on soil-borne fungal diseases, nematodes and weeds in autumn cucumber fields. *J. Sci. & Technol. Agrie. and Natu. Res.* 4: 111-123.

Ragone, D. and Wilson J.E. 1998. Control of weeds, nematodes and soil-borne pathogens by soil solarization. *Alafua Agri. Bull.* 13: 13-20.

Rao, V.K. and Krishnappa, K. 1995. Soil solarization for the control of soil-borne pathogen complexes with special reference to *Meloidogyne incognita* and *Fusarium oxysporum* f.sp. *ciceri*. *Indian Phytopathol.* 48: 300-303.

Sout, M.A. and Elekciolu, H. 2007. Methyl bromide alternatives for controlling *Meloidogyne incognita* in pepper cultivars in Eastern Mediterranean Region of Turkey. *Turkish J. Agri. and For.* 31 : 31-40.

Tacconi, R. and Santi, R. 1994. Solarization of soil for the control of nematodes and infestations. *Informatore Agrario.* 50: 53-56.