SYSTEMIC NEMATICIDAL EFFECT OF EUGENOL[1]

S. K. Bala and N. C. Sukul
Department of Zoology, Visva-Bharati University, Santiniketan-731235, West Bengal, India.

Accepted:
11.IX.1987
Aceptado:

RESUMEN

Bala, S. K. y N. C. Sukul. 1987. Eugenol, un nematicida con efecto sistémico. Nematropica 17:219-222.

En una prueba realizada en macetas, el eugenol, un compuesto nematicida derivado del *Ocimum sanctum*, fue aplicado al suelo y al follaje de okra, *Hibiscus esculentus*, infestado de *Meloidogyne incognita*. Aspersiones foliares con más de 0.5 ml de eugenol/L de agua produjeron la muerte de las plantas. Sin embargo, tratamientos de 0.2 a 0.5 ml/L de eugenol incrementaron significativamente el desarrollo de las plantas y redujeron las poblaciones de nematodos, agallamiento y el contenido proteico radicular. El compuesto mostró actividad sistémica, siendo la aspersión foliar más efectiva que la aplicación al suelo.
Palabras claves adicionales: nematicida sistémico, Meloidogyne inconita, Hibiscus esculentus, okra.

Eugenol, a 4-allyl-2-methoxyphenol ($C_{10}H_{12}O_2$), is the active nematicidal principle of the plant *Ocimum sanctum* L. (Lamiaceae) (2,4) and a component of clove oil (3), which is used as a dental analgesic. Our objective was to determine if eugenol could be used as a systemically translocated nematicide for control of *Meloidogyne incognita* on *Hibiscus esculentus* L.

Phytotoxicity of eugenol. Each of six dilutions of an aqueous emulsion of eugenol (0.2, 0.5, 0.7, 1, 5, and 10 ml/L) was sprayed onto 10 *Hibiscus esculentus* plants (10 ml emulsion/plant) 20 days after emergence. Plants were then observed for 15 days. Eugenol was obtained from Loba Chemic Indoaustranal Co., Bombay, India.

Nematicidal activity of eugenol. Anaseptically germinated seed of *H. esculentus* was sown in each of 50 pots (32-cm-diam) containing an autoclaved mixture of clay soil and composted manure (2:1, v/v). When plants were at the 4-leaf stage, 40 plants were inoculated with *M. incognita* (550 ± 29.74 juveniles/pot). The remaining 10 plants served as uninoculated, untreated controls. *M. incognita* juveniles were collected from roots of *H. esculentus* by the Baermann funnel method. Ten days after inoculation, the 40 inoculated plants were treated as follows: 10 plants received a foliar spray of distilled water; 10 plants received a foliar spray of eugenol emulsion at 0.5 ml/L; 10 plants received a foliar spray of eugenol emulsion at 0.2 ml/L; and 10 plants received a rhizospheric soil

Table 1. Effect of eugenol on *Meloidogyne incognita* populations and growth of *Hibiscus esculentus* compared to inoculated and uninoculated controls.

Treatments	Shoot length (cm)[z]	Root length (cm)[z]	Shoot weight (g)[z]	Root weight (g)[z]	No. of galls/ plant[y,z]	No. of juveniles[y,z]		% Root protein (mg/100 mg)[z]
						Per 250 g soil	Per 2 g root	
Uninoculated untreated	52 a	16 a	59 a	8 c	—	—	—	0.59 d
Inoculated untreated	28 d	10 b	22 d	15 a	278 a	305 a	177 a	1.12 a
Inoculated treated with eugenol (0.5 ml/L) by soil drench	39 c	10 b	36 c	10 b	132 b	97 b	72 b	0.91 b
Inoculated treated with eugenol (0.5 ml/L) by foliar spray	51 ab	14 a	57 ab	7 c	48 d	24 d	26 c	0.62 cd
Inoculated treated with eugenol (0.2 ml/L) by foliar spray	49 b	13 a	54 b	8 c	80 c	36 c	32 c	0.65 c

[y]Dashes (—) indicate no nematodes in the treatment.

[z]Data are means of 10 plants. Data followed by the same letters in a column indicate no significant difference ($P \leq 0.05$) by the analysis of variance.

drench of eugenol emulsion at 0.5 ml/L. The total volume of fluid applied to each plant was 10 ml and during foliar spray applications, soil was protected with a cover of polyethylene sheeting. Ten days later, this procedure was repeated. Twenty days after the last treatment, all plants were uprooted and their shoot lengths, shoot weights, root lengths, and root weights were measured. The root galls on each plant were counted and the nematode population per 250 g soil and 2 g root in each pot was estimated.

The roots of the test plants were chopped, three samples of root cuttings from each treatment were taken at random, and the total protein fraction in each sample was estimated by the Folin-phenol method (1,5). The experiment was conducted out of doors under ambient atmospheric temperature (28 ± 3C) and humidity ($80 \pm 4\%$). The pots were irrigated regularly.

Phytotoxicity of eugenol. All plants sprayed with aqueous emulsion of eugenol at 0.7, 1, 5, and 10 ml/L died within 10 days. Emulsions of 5 and 10 ml/L killed plants within one day. No toxicity was observed at 0.2 and 0.5 ml/L.

Nematicidal activity. Eugenol increased the shoot length, root length, and shoot weight of inoculated plants ($P \leq 0.05$) (Table 1). Eugenol treatment also pronouncedly reduced root galling and the augmentative effect of galling on root weight. Treated plants had less root-galls, fewer juveniles in the roots and rhizosphere, and less root-protein ($P \leq 0.05$) than did inoculated, untreated plants (Table 1). Total root protein increases with the intensity of infection by root-knot nematodes and thereby is a measure of the efficacy of a nematicide (1,6). Of the two methods of applying eugenol, the foliar spray produced superior response for all eight parameters measured ($P \leq 0.05$), as compared to the soil drench (Table 1).

It is evldent from our results that eugenol can reduce nematode infection of *H. esculentus,* thereby promoting plant growth. However, it is phytotoxic at high concentrations. Eugenol showed systemic activity. In fact, the foliar spray was more effective in reducing nematode infection to permit normal development than was the soil drench. Eugenol is effective at a low concentration (0.2 ml/L) and is of moderate cost ($ 90/L). It could be applied with profit on standing crops on a large scale without disturbing the agro-ecosystems.

LITERATURE CITED

1. CHATTERJEE, A., and N. C. SUKUL. 1981. Total protein content of galled roots as an index of root-knot nematode infestation of lady's finger plants. Phytopathology 71:372-374.
2. CHATTERJEE, A., N. C. SUKUL, S. LASKAR, and S.

GHOSHMAJUMDER. 1982. Nematicidal priciples from two species of Lamiaceae. J. Nematol. 14:118-120.
3. CHOPRA, R. N., S. L. NAYAR, and I. C. CHOPRA. 1956. Glossary of Indian Medicinal Plants. CSIR, New Delhi. 330 pp.
4. DUTT, S. 1940. New Indian essential oil. Ind. Soap J. 6:248-255.
5. LOWRY, O. H., N. J. ROSEBROUGH, A. R. FARR, and R. J. RANDALL. 1951. Protein measurement with the Folin-phenol reagent. J. Biol. Chem. 193:265-275.
6. SINHABABU, S. P., and N. C. SUKUL. 1984. Influence of inoculum densities of root-knot nematodes on the total protein content of roots of lady's finger plants and amelioration of root-knot disease by *Ocimum sanctum*. Indian Phytopath. 37:188-191.

Received for publication:
25.II.1987
Recibido para publicar:

---

[1]The work described here has been supported by a grant from the Department of Science and Technology, Government of India, New Delhi.