J. Biol. Control, 2(2) 112 — 113, 1989

Observations on an Indian population of the Entomopathogenic Nematode, *Heterorhabditis bacteriophora* Poinar, 1976

C.V. SIVAKUMAR, S. JAYARAJ AND S. SUBRAMANIAN
Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore 641 003

ABSTRACT

The natural occurrence of *Heterorhabditis bacteriophora* Poinar, 1976 in a forest soil from Burliar, Tamil Nadu, India, is reported along with the dimensions of this population. The life cycle of this isolate was completed in eight days at laboratory temperatures of 23.0°C (minimum) and 30.2°C (maximum) on larvae of *Corcyra cephalonica* Stainton (Galleridae : Lepidoptera). Under experimental conditions, it infected larvae of certain Elateridae (Coleoptera), Noctuidae, Papilionidae and Nymphalidae (Lepidoptera) and adults of Acrididae (Orthoptera). The LC_{50} for fourth-instar larvae of *Spodoptera litura* (Fabricius) (Noctuidae : Lepidoptera) was 19.14 dauers per larva at room temperatures of 22.3°C (minimum) and 30.0°C (maximum).

KEY WORDS : *Heterorhabditis bacteriophora, Spodoptera litura, Corcyra cephalonica,* entomopathogenic nematode.

In a survey for steinernematid and heterorhabditid nematodes conducted by the soil baiting technique (Bedding and Akhurst, 1976) using larvae of the meal moth, *Corcyra cephalonica* Stainton, as bait, a nematode since identified as *Heterorhabditis bacteriophora* Poinar, 1976 was recovered from a forest soil, from Burliar, the Nilgiris, Tamil Nadu, at an elevation of about 900 m. Investigations made on the morphometrics of this isolate, its life cycle and LC_{50} to *Spodoptera litura* F. are reported.

MATERIALS AND METHODS

H. bacteriophora reared on larvae of *C. cephalonica* were used in the investigations. Nematode specimens fixed in 5 per cent formalin were processed to glycerine by the rapid method through lactophenol series (Goodey, 1963), mounted in glycerine and measurements taken with a camera lucida.

The life history of the nematode from the infective juvenile stage to the second generation second-stage juvenile was studied at laboratory temperature using larvae of *C. cephalonica* as host. The insect larvae were confined to a petridish over a moist filter paper and inoculated with 40 dauers per larva for 12h. They were then transferred to an uninoculated sterile petri dish over a moist filter paper and observed at 12 h intervals. Ten larvae or cadavers were examined by dissection in water for each observation.

Host range studies were made by exposing atleast ten insect larvae to dauers in an infection chamber in the manner described above and cadavers examined 8 - 10 days later.

LC_{50} of the isolate to the fourth-instar larvae of *S. litura* was determined following the procedure of Dunphy and Webster (1986) at room temperature. The inoculam levels used were 5, 10, 20, 40, 80 and 160 dauers per insect larva, with 10 larvae per replicate and five replicates for each level. The mortality was recorded 72 h after confinement of the insect larvae in the inoculated chamber. The LC_{50} values were calculated by probit analysis (Finney, 1962).

RESULTS AND DISCUSSION

The morphological features of the Burliar population agreed closely with those described by Poinar (1976), but some morphometrical differences existed (Table 1). The difference in the size of the second-generation females was very pronounced when compared with the original description (L = 0.99 - 1.70mm as against 3.18 - 3.85mm) and this reflected on the other body dimensions also. The dimensions of the infective third-stage juveniles showed close agreement with the original description. The infective juveniles were 539 (495 - 586) µm long and had a tail length of 95 (88 - 105) µm, thus conforming to the criteria given by Wouts (1984) for diagnosing *H. bacteriophora.*

The larvae of *C. cephalonica* were killed in about 36 - 48 h after infection. The cadavers assumed a red ochre colour which turned to dark brown. The life cycle was similar to that described for *H. bacteriophora* (Poinar, 1976) and *H. heliothidis* (Wouts, 1979). The adult stage (hermaphroditic first generation) was reached in about three days after infection and the second generation females and males appeared in

about seven days after infection at room temperature (23.0°C min. and 30.2°C max.). Males were very rarely produced. The juveniles exited from the female body in about eight days after infection. The yield of juveniles per full grown larvae of *C. cephalonica* was 17108 ± 856 when inoculated at the rate of 20 dauers per larva.

Under laboratory condition, the nematode infected adult *Orthacris simulans* B. (Orthophera : Acrididae) and larvae of *Drasterius* sp. (Coleoptera : Elateridae), *Heliothis armigera* Hbn. (Lep. : Noctuidae), *Spodophera litura* F. (Lep. : Noctuidae), *Papilio aristolochiae* Fb. (Lep. : Papilionidae) and *Ergolis merione* Cr. (Lep. : Nymphalidae).

LC_{50} for fourth-instar larvae of *S. litura* was 19.14 dauers per larva at room temperature (22.3°C min and 30.0°C max.) (Y = -1.9873 + (3.0621) X). Mortality occurred within 48 h at the levels of 40, 60, 80 and 160 dauers per larva.

TABLE 1. Dimensions of *H. bacteriophora* - Indian population

Character	Hermaphroditic generation Females (n = 10)		Dioecious generation Females (n = 10)		Dioecious generation Males (n = 5)		Infective juveniles (n = 10)	
Total length (µm)	3.52	(3.30 - 4.49)	1.38	(0.99 - 1.70)	0.581	(0.56 - 0.60)	0.539	(0.495 - 0586)
Greatest width (µm)	176	(162 - 197)	99	(68 - 117)	34	(30 - 38)	20	(19 - 21)
Length of stoma (µm)	8	(7 - 11)	5	(5 - 7)		--		--
Width of stoma (µm)	8	(7 - 10)	6	(6 - 7)		--		--
Length-head to base of oesophagus (µm)	185	(175 - 211)	119	(106 - 134)	82	(81 - 84)	114	(110 - 120)
Length-head to excretory pore (µm)	202	(176 - 211)	136	(117 - 148)	93	(87 - 95)		--
Length-head to nerve ring (µm)	117	(94 - 125)	75	(64 - 80)		--		--
Percent vulva	46.0	(42.8 - 50.0)	50.7	(46.6 - 53.9)		--		--
Length tail (µm)	89	(75 - 103)	48	(39 - 52)	16	(15 - 17)	95	(88 - 105)
Width at anus (µm)	55	(46 - 61)	99	(68 - 117)		--	13	(12 - 14)
Length of spicules (µm)		--		--	39	(37 - 42)		--
Length of gubernaculam (µm)		--		--	20	(17 - 22)		--

Figures in parenthesis represent range.

REFERENCES

Bedding, R.A. and Akhurst, R.J. 1975. A simple technique for detection of insect parasitic rhabditoid nematodes in soil. *Nematologica*, 21, 109-110.

Dunphy, G.B. and Webster, J.M. 1986. Temperature effect on the growth and virulence of *Steinernema feltiae* strains and *Heterorhabditis heliothidis*. *J. Nematol.*, 18, 270-272.

Finney, D.J. 1962. *Statistical methods in biological assay*. Charles Griffin and Co., Ltd., London, U.K., 661 pp.

Goodey, J.B. 1963. *Laboratory methods for work with plant and soil nematodes*. Ministry of Agriculture, Fisheries and Food, London, No. 2, p. 28 - 29.

Poinar, G.O. Jr. 1976. Description and biology of new insect parasitic rhabditoid, *Heterorhabditis bacteriophora* nigen. n. sp. (Rhabditida; Heterorhabditis n.fam). *Nematologica*, 21, 463 - 470.

Wouts, W.M. 1979. The biology and life cycle of a New Zealand population of *Heterorhabditis heliothidis* (Heterorhabditidae) *Nematologica*, 25, 191 - 202.

Wouts, W.M. 1984. Nematode parasites of Lepidopterans. In : *Plant and Insect nematodes* (Ed.) W.R. Nickle. Marcel Dekker, Inc., New York. p 655 - 696.