Biology of entomopathogenic nematodes *Heterorhabditis* sp. and *Steinernema* spp.

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ABSTRACT

Nematodes associated with insects are referred to as entomophagous nematodes. Entomopathogenic nematodes are highly potential biocontrol agents for several lepidopteran and coleopteran insect pests. These nematodes are mutually symbiotic with the bacteria *Xenorhabdus* and *Photorhabdus* spp. and the bacteria are responsible for the death of the host. The biology of three species of *Steinernema viz.*, *Heterorhabditis* was studied under laboratory conditions at a temperature of 28±2°C. The infective juveniles caused mortality of *Corcyra cephalonica* in about 48 hours. Hermaphrodites were observed 72 hrs after infection. Females and males of amphimictic generation were observed 120 hrs after infection in *Heterorhabditis* and 48 hours after infection in *Steinernema* spp. Exit of infective juveniles from cadavers of *C. cephalonica* was observed after 192 hrs in *Heterorhabditis.* In *Steinernema glaseri* and *thermophilum* the exit of infective juveniles was observed 120 hrs after infection while in *S. tami* the exit of infective juveniles was observed 96 hrs after infection. The study revealed that *H. indica* completed two generations (First generation - hermaphrodite and Second generation - Amphimictic) in one insect. But all the three species of *Sterinernema* completed only one generation (Amphimictic) in the insect host.

Key words: *Corcyra cephalonica, Heterorhabditis*, hermaphrodite, *Steinernema*

INTRODUCTION

Entomopathogenic nematodes of the genera *Heterorhabditis* and *Steinernema* are used as an insect biological control in agriculture. Entomopathogenic nematodes belonging to the genera *Heterorhabditis*, *Neosteinernema* and *Steinernema* are considered as potential biocontrol agents because of their pathogenicity to insects caused by symbiont bacteria, Xenorhabdus or Photorhabdus species carried by them. The infective juveniles (IJs) of entomopathogenic nematodes (EPNs) are currently used as biopesticides for controlling various insect pests (Hom, 1994). Entomopathogenic nematode with their associated *Xenorhabdus spp*. bacteria, lethal to soil inhabiting insects. Infective juveniles occur naturally in the soil where they infect and kill their insect host within 2 or 3 days and produce 2 or 3 generations in the host. Resulting infective juveniles emerge from host cadaver 1or 2 weeks later and search for new hosts (Akhurst, 1995). These nematodes have a simple life cycle that includes the egg, four juvenile stages (separated by moults) and adult. The infective stage is the third stage juvenile. The infective juveniles are the only free living (outside host), non feeding and host seeking forms. The virulence, infectivity, biology and biocontrol efficacy of entomopathogenic nematodes are greatly influenced by temperature (Poinar, 1979). Hence in this study, the influence of room temperature on biology of *Heterorhabditis indica* and *Steinernema* spp. was studied under labouratory conditions.

MATERIALS AND METHODS

The biology of four entomopathogenic nematodes *viz*., *Heterorhabditis indica, Steinernema glaseri, S. tami, S. thermophilum* was studied under room temperature using the bait insect of *Corcyra cephalonica*. Petri plates with two whatman no. 1 filter papers were sterilized. The insect larvae (*C. cephalonica*) were exposed to infective juveniles of *H. indica* and *Steinernema* spp. 24 hrs by filter paper exposure method (Woodring and Kaya, 1988), washed free of nematodes sticking on to the body surface and placed on moist filter paper inside a Petrip dish. Two ml of nematode suspension containing 200 nematodes was added to 10 numbers of late instar larvae of *Corcyra* and covered the lid and edges sealed with parafilm (or) Klin film. The petriplate was kept in room temperature (28±2°C) for 2 days. After 2 days, the dead insects/ cadavers were dissected and observed the stage of nematode was observed at 24 hours interval. Nematode infected larvae

Table 1. Influence of temperature on biology of *H. indica* and *Sterinernema* spp.

Observation	Room temperature (Hours)			
	Heterorhabditis indica	***Steinernema glaseri***	***S. tami***	***S. thermophilum***
Mortality of Corcyra cephalonica	48	48	48	48
Hermaphrodites (First generation)	72	-	-	-
Female and males of amphimictic generation	120	48	48	48
Exit of infective juveniles	192	120	96	120

were dissected in Ringer's solution at 12 hrs intervals to observe the different stages of nematodes up to the exit of infective juveniles.

RESULT AND DISCUSSSION

The study revealed that *H. indica* completed two generations in one insect, hermaphrodites (first generation) and amphimictic (second generation). But *Steinernema* completed one amphimictic generation in the insect host. The study on the biology of *H. indica* and *Steinernema* spp. revealed that nematodes caused mortality of *C. cephalonica* in about 48 h after infection at room temperature. Hermaphrodites (first generation) were observed 72 hrs after infection at room temperature. Females and males of second (amphimictic) generation were observed 120 h and 48 hrs after infection at room temperature in *H. indica* and *Steinernema* spp., respectively. The life cycle of *H. indica* was completed in 192 h at room temperature. The life cycle of *Steinernema glaseri*, *S. tami* and *S. thermophilum* was completed in 120, 96 and 120 h at room temperature. The biology studies on *H. indica* showed that it completed the life cycle consisting of two generations (hermaphroditic followed by amphimictic generations) in 192 hrs at room temperature (28±2°C) on the larvae of *C. cephalonica*. The exit of infective juveniles were observed 192, 120, 96 and 120 hrs in *H. indica*, *Steinernema glaseri*, *S. tami* and *S. thermophilum* at room temperature respectively. In a biological study conducted by Karunakar *et al.* (1993) with *H. indica* on sugarcane internode borer, *Chilo sacchariphagus indicus* revealed similar results at room temperature. The other isolate (Sivakumar *et al.*, 1988) and *H. heliothids* (Wouts, 1979) normally complete their life cycle in 8-12 days. Subramanian (2007) reported that *H. indica* were able to penetrate, infect and multiply at 20-35 °C but not at 40°C. It was also observed that a constant temperature of 25°C is more favourable than room temperature in shortening the life cycle of the *H. indica*.

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