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Population fluctuation of entomopathogenic nematode, *Heterorhabditis* sp. in South Andaman as influenced by weather parameters

The study on the population fluctuation of *Heterorhabditis* sp. in South Andamans indicated that the rainfall was positively correlated to nematode population ($r = 0.92^{**}$), whereas relative humidity ($r = -0.87^{**}$) and maximum temperature ($r = -0.67^{*}$) were negatively correlated. The prevalence increased from May onwards, reaching a peak in July and thereafter decreasing gradually till January coinciding with the wet period, thus having sufficient soil moisture for survival and persistence.

Entomopathogenic nematodes (Rhabditidae: Heterorhabditidae) occur throughout the world, where they play an important role in soil[1]. They are also used as biological control agents against many soil-dwelling insect pests[2].

The study of population dynamics of entomopathogenic nematodes is fundamental to understanding their persistence, distribution and effect on insect populations and for the development of predictive models for control programmes[3].

The weather parameters such as rainfall, relative humidity, soil and air temperature have influence on the persistence of entomopathogenic nematodes. Soil, the natural habitat for entomopathogenic nematodes varies greatly in chemical composition and physical structure. It is a dynamic system in a continual state of flux combined with its physical, biological and chemical complexity; this dynamic state makes the soil a difficult medium in which to conduct quantitative research.

A random survey undertaken during August 1996–December 1999, showed the presence of *Heterorhabditis* sp. in soil samples collected from various localities representing various agro ecosystems in South Andamans.

For study of the population dynamics of *Heterorhabditis* sp., a permanent site was selected at Chidiyatapu (latitude 11°41′–13°04′N and longitude 92°43′–30°16′E) where the nematode existed naturally. The soil of the site was sandy with organic matter content of 1.27% and pH of 7.11. Soil samples were collected at monthly intervals from a depth of 30 cm for a period of 41 months. The samples were baited with ten larvae of rice moth, *Corcyra cephalonica* and three replicates were maintained. The per cent larval mortality due to parasitization after three days of inoculation gave indirect measurement of the population of *Heterorhabditis* sp. in soil.

The data on per cent mortality of *Corcyra cephalonica* were pooled and subjected to simple correlation analysis against weather parameters[4]. The per cent *Corcyra* mortality served as dependent variable and weather parameters as independent variables.

The prevalence of *Heterorhabditis* sp. was significantly positively correlated with rainfall ($r = 0.92^{**}$). The prevalence was influenced by rainfall to the extent of 92%, the rest being contributed by other factors (Table 1). The prevalence started increasing from May onwards and reached a peak in July; thereafter it dropped gradually till January (Figure 1). Hence, the prevalence is greatly influenced by soil moisture. In Florida citrus groves, *Steinernematids* and *Heterorhabditids* were recovered from the soil most often from May to November[5].

Moisture plays a major role in survival of the entomopathogenic nematodes, which is influenced by the rainfall and soil type. Most of the positive sites were coastal, with sandy soils. The sandy soils have large pore space but less total pore space, than loam or clay soils[6]. The survival of *Steinernema carpocapsae* and *S. glaseri* was best in the sandy loam and sandy soils; high clay content resulted in lower nematode survival[7]. Similar observations were noticed with *S. carpocapsae* and *Heterorhabditis bacteriophora*[8]. Hence, *Heterorhabditis* sp. was recovered in coastal sandy soils frequently during May to January, coinciding with well-distributed rainfall and thus maintaining required conducive moisture and relative humidity in soil.

The prevalence of *Heterorhabditis* sp. was significantly negatively correlated with the relative humidity ($r = -0.87^{**}$).

Table 1. *Heterorhabditis* sp. population fluctuation as influenced by weather parameters

Statistics	Rainfall	Relative humidity	Maximum temperature	Minimum temperature	Soil temperature at 30 cm
r	0.92**	–0.87**	–0.67*	0.55	–0.56
a	22.00	706.82	350.49	–438.51	284.54
b	0.12	–7.83	–9.84	20.75	–7.92
x	234.64	83.93	30.54	23.53	29.69

r, Coefficient of correlation; *a*, Intercept; *b*, Slope; *x*, Independent variable mean; *, Significant at 0.05% level; **, Significant at 0.01% level.

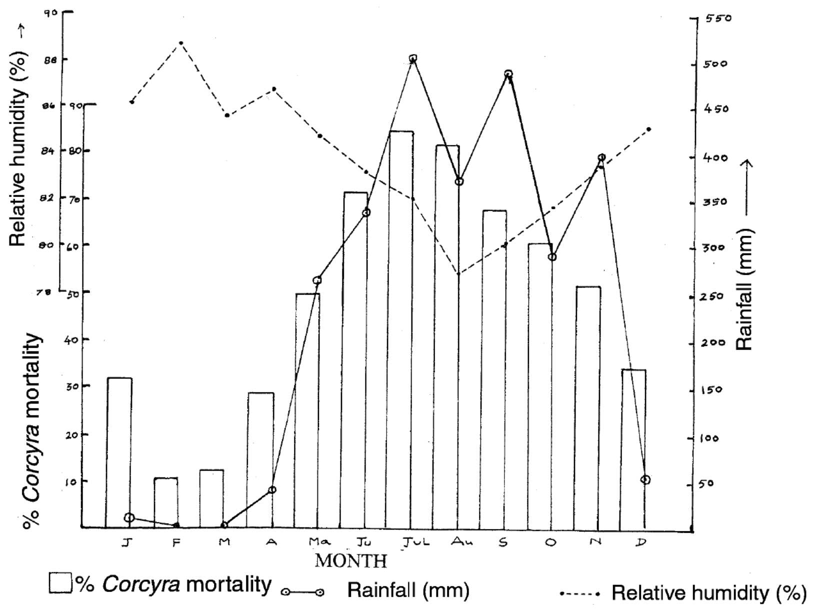

Figure 1. Population fluctuation of *Heterorhabditis* sp. as influenced by rainfall and relative humidity.

The prevalence decreased to the extent of 87% with increase in relative humidity and vice versa. There is a negative relationship between relative humidity and prevalence of *Heterorhabditis* sp. (Figure 1). As the rainfall increases, the relative humidity decreases and consequently the prevalence of nematode increases. Optimum soil humidity favoured the survival of entomopathogenic nematodes[9]. The enhanced survival at low relative humidity in soil may be due to the retention of second-stage cuticle by the infective juvenile, thereby slowing down their rate of drying. Apart from soil moisture, texture and porosity also influence relative humidity of the soil.

The prevalence of *Heterorhabditis* sp. was significantly negatively correlated to maximum temperature ($r = -0.67$*) and positively correlated to minimum temperature ($r = 0.55$; Table 1). The poor survival of Heterorhabditids at higher temperatures was probably related to their relatively high motility and respiration, which would have depleted food reserves quickly[10].

The soil temperature at 30 cm depth exhibited a positive correlation with nematode prevalence ($r = 0.56$). The soil temperature ranges in South Andaman extend from 28.3 to 33.2°C at 30 cm depth. Such a positive relationship was reported by Beavers *et al.*[5]. Mild temperature favoured survival of entomopathogenic nematodes[11]. Soil temperature is determined to large extent by factors which control transfer of heat in and out of the soil. Wet soil has a greater conductance and smaller rise in temperature than dry soil with the same input of heat at the surface. The solar heat penetrates deeper in wet soil, but produces a smaller rise in temperature than in dry soil. The deeper layers are more buffered than the surface, which tends to heat and cool rapidly along with the atmosphere and under the influence of direct sunlight[1].

The extremes of the weather parameters like rainfall, relative humidity and soil temperature are the major limiting factors affecting their persistence. Our results indicate that persistence is good in mild temperatures with adequate soil moisture, wherein gradual desiccation prevails.

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