

# LATERAL MOVEMENT OF THE ENTOMOPATHOGENIC NEMATODE *Heterorhabditis bacteriophora* IN SOIL UNDER LABORATORY CONDITIONS

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## Abstract

Despite the growing importance of entomopathogenic nematodes as biocontrol agents for soil inhabiting insect pests, little is known of their population and spatial ecology. Lateral movement of the nematode *Heterorhabditis bacteriophora* GPS11 strain was quantified in 5 cm deep autoclaved soil with 24% moisture content placed in three separate experiments each with a different sized wooden tray (22.86 cm x 22.86 cm, 61 cm x 61 cm, and 122 cm x 122 cm) at room temperature (21°C). A single 10-day old cadaver of final instar *Galleria mellonella* infected with *H. bacteriophora* was placed in the center of each tray to track nematode movement. Soil sample were collected in plastic cups with soil core samples (2 cm dia) at intervals from 6 to 240 hours and at distances from 3.8 to 61 cm from the center, was and one uninfected *G. mellonella* larva (bait) was placed in each cup. The number of bait insects infected by nematodes was recorded three days later. Each experiment was replicated five times and all three experiments were repeated.

A two-dimensional modified Fick diffusion model was fit to the spatio-temporal data by least squares method. Average movement of infective juveniles in soil was 6 cm/day. Number of infective juveniles moving a given distance declined with increasing distance from the cadaver with 40% traveling >15 cm and 2.5% traveling >60 cm in up to 240 hours. This study has shown the dispersal ability of *H. bacteriophora* in soil with no source of attraction in the form of bait or carbon dioxide.

## Background

- Entomopathogenic nematodes have emerged as effective therapeutic biological insecticides for soil borne insect pests.
- More knowledge on their dispersal ability, population structure and dynamics is required to fully utilize their potential in conservation biological control.
- *Heterorhabditis bacteriophora*, being a cruiser, is highly mobile and strongly responds to long range host chemical cues.
- Quantification of dispersal ability of *H. bacteriophora* in soil would help form the basis for further studies on spatial and temporal dynamics of natural populations in the field.
- Therefore, this study was planned to study the horizontal movement of *H. bacteriophora* in soil in the absence of host insects under laboratory conditions.

## Hypothesis

- Infective juveniles of *H. bacteriophora* can disperse rapidly in the soil in the absence of any host insect species.

## Materials and Methods

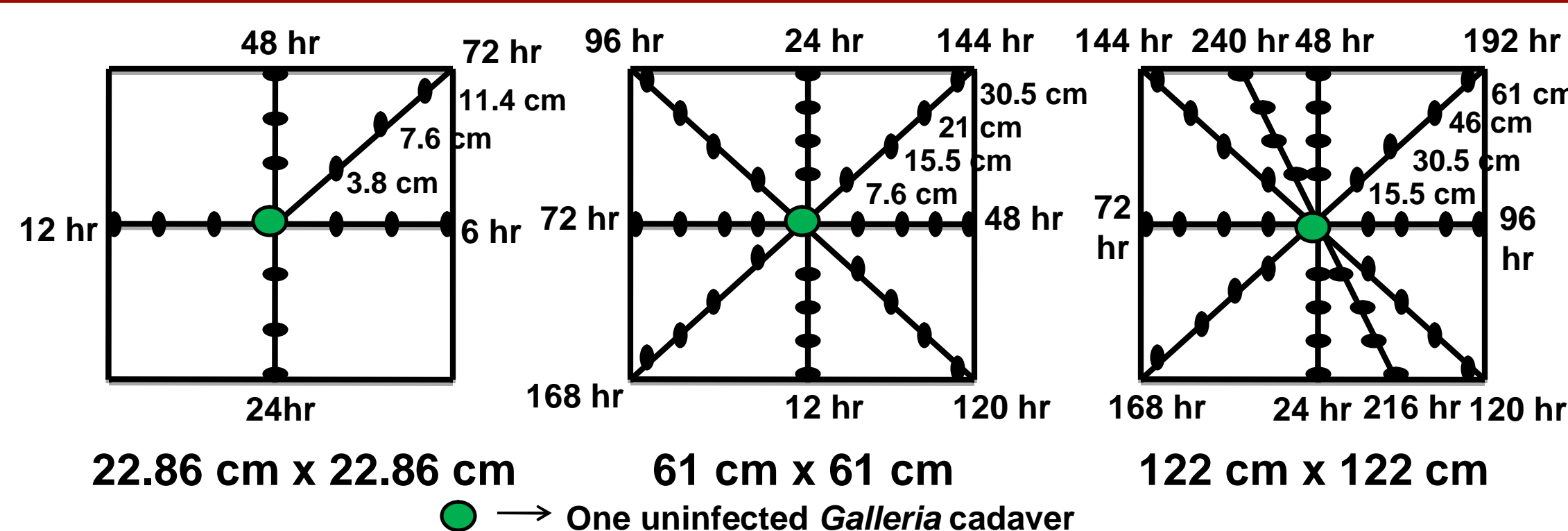


Figure 1 Experimental layout (three wooden trays)

- Topsoil was autoclaved at 250°F and 15 psi pressure for 10 hours.
- Soil moisture content was adjusted to its field capacity i.e. 24 % by adding tap water.
- Particle size analysis of the soil was estimated to be 26.2% clay, 2.6% sand and 61.8% silt content. Soil pH was 7.11 and organic matter content was 3.6%.
- Three different sized wooden trays filled with soil up to 5 cm deep were kept at room temperature (21°C) (Fig.1).
- A single 10-day old final instar *G. mellonella* cadaver infected with 420 infective juveniles of *H. bacteriophora* was placed 2.5 cm below the soil surface in the center of each tray (Fig. 1).
- Soil core samples (2 cm dia and 5 cm deep) were collected in plastic cups at intervals from 6 to 240 hours and at distances from 3.8 to 61 cm, depending upon the experiment from the infected *G. mellonella* cadaver (Fig. 2).

- One uninfected *G. mellonella* larva was placed in plastic cup with soil and was examined for nematode infection (red coloration and leathery texture of resulting cadaver) after 3 days (Fig.2).
- All trays were covered with black plastic sheets to prevent moisture loss from the soil.
- Each tray was replicated five times and all three experiments (different sized trays) were repeated.
- Proportion of dead *G. mellonella* baits was computed at all 96 combinations of distance and time from 10 replicates (5 x 2 repetitions).
- A two-dimensional modified Fick diffusion model was used to estimate the fit of the spatio-temporal data by using least squares method.

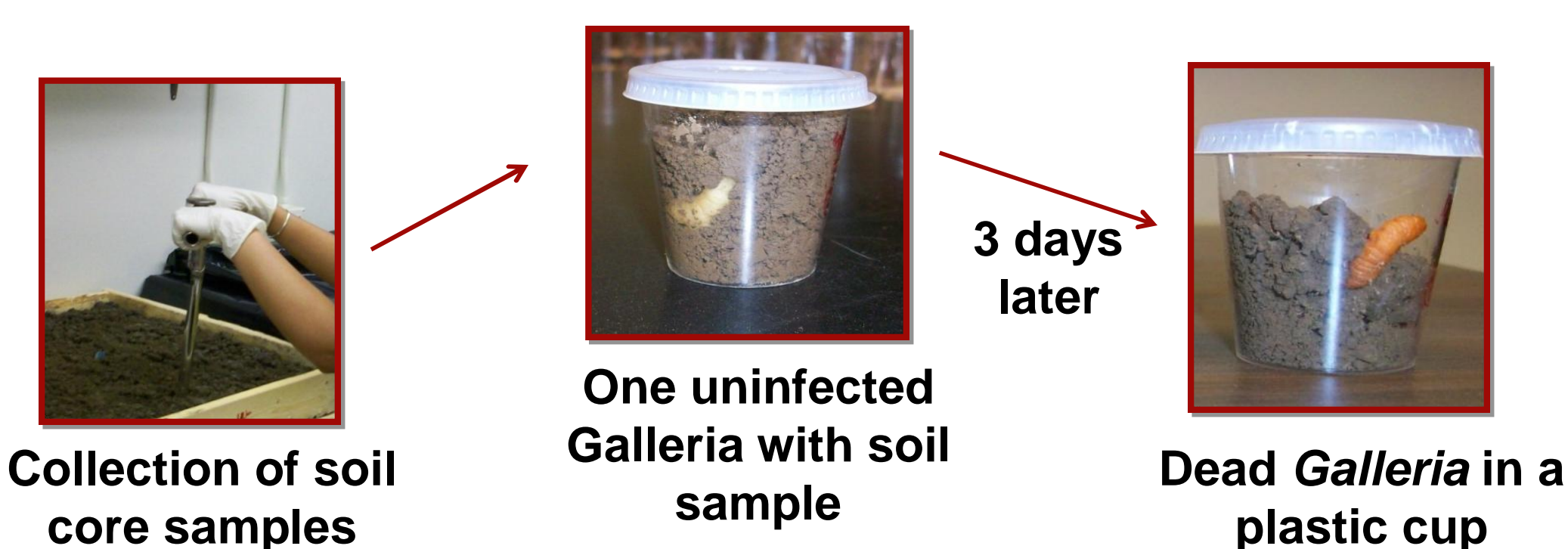


Figure 2 Collection and examination of soil core samples

## Results

- Number of infective juveniles moving away from the infected cadaver increased initially with time, then leveled off (Fig.3) and finally decrease with distance (Fig. 4).
- Majority of IJs (92%) remain within <5 cm distance from the infected cadaver (Fig. 5) .

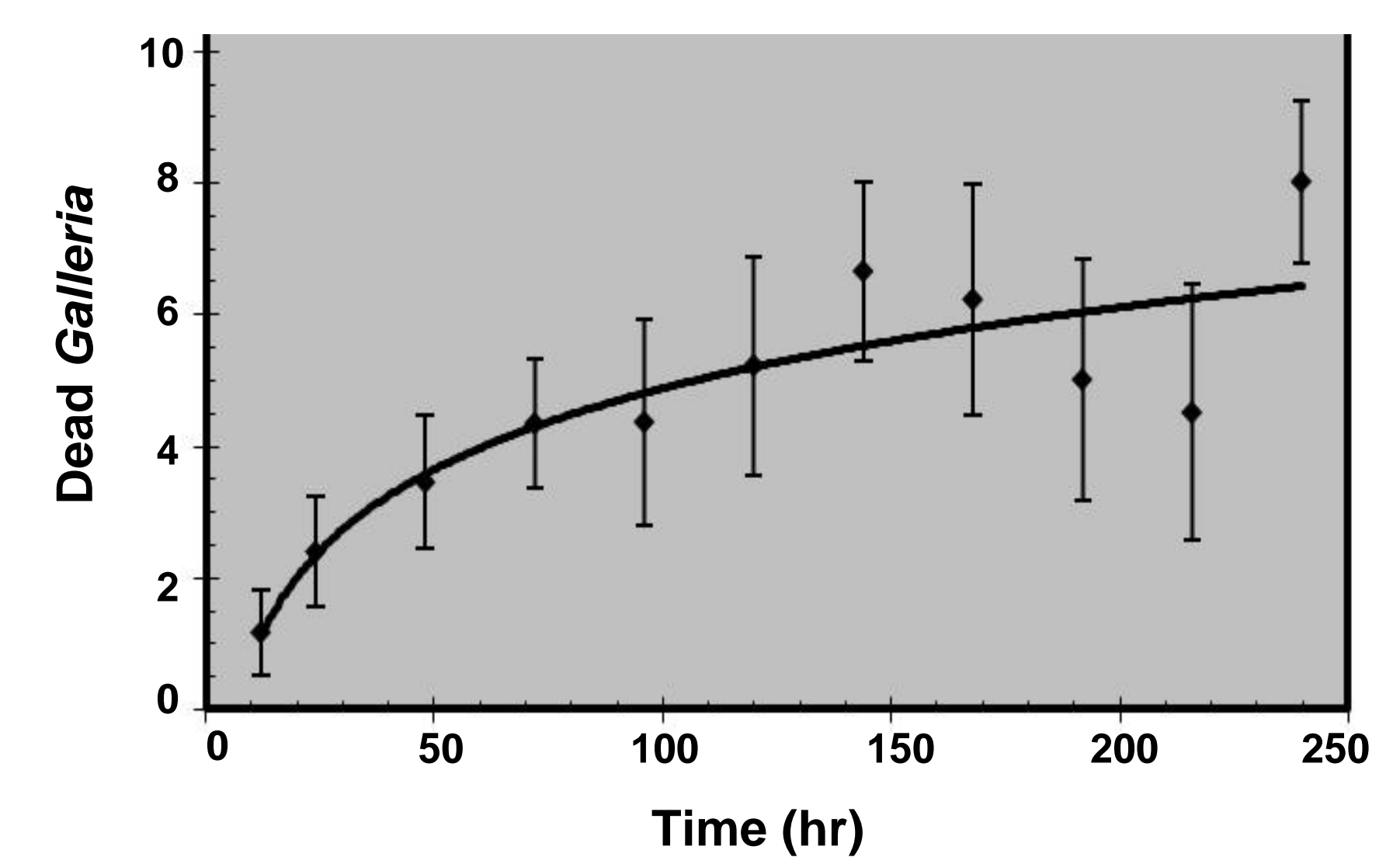


Figure 3 *Galleria* infection by nematode over time

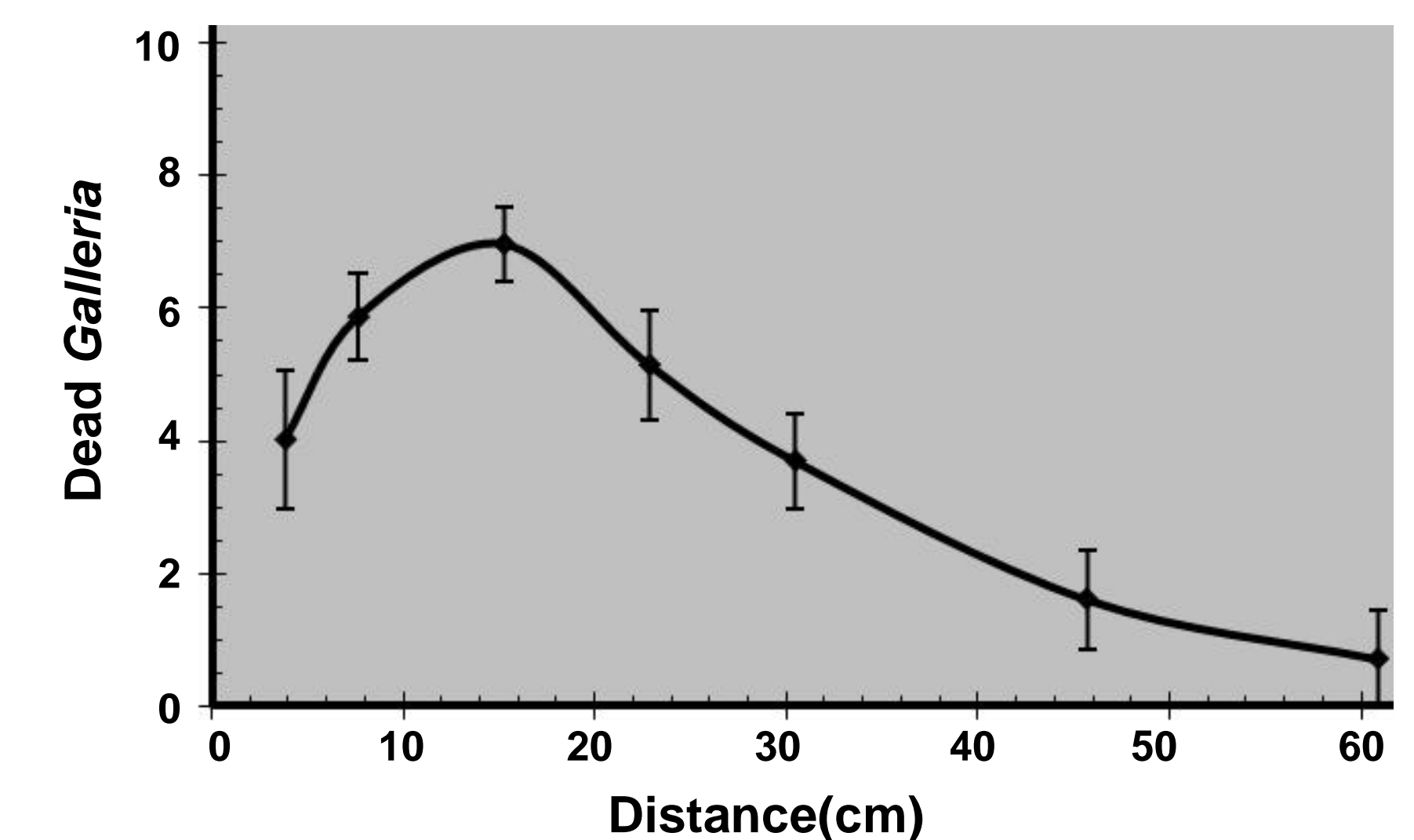
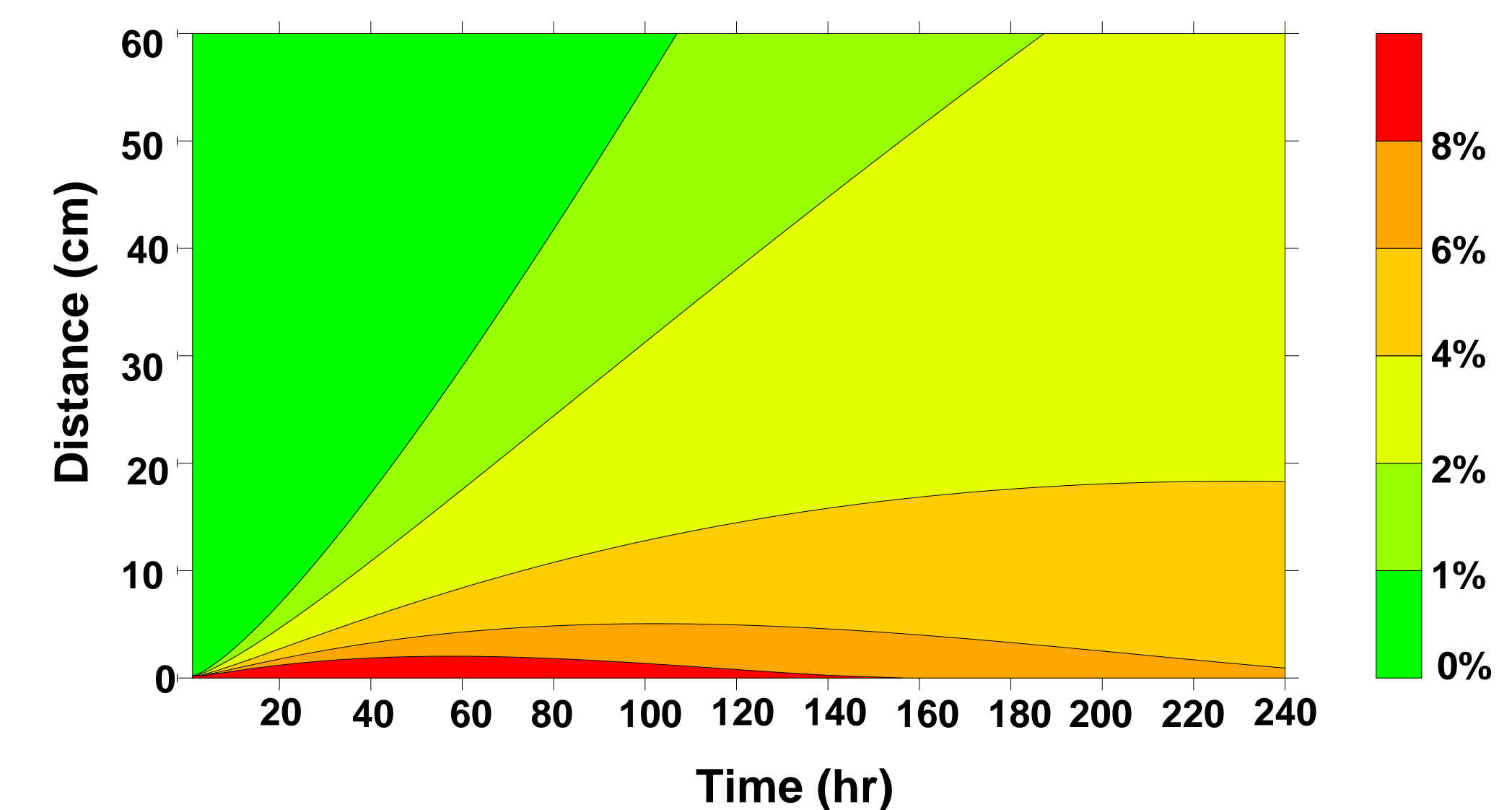


Figure 4 *Galleria* infection by nematode over distance



$$\text{Fitted equation: } N = 100 * \exp[-18.4 * (D^{*0.63})/T] / \text{sqrt}(T)$$

Figure 5 Percentage of *H. bacteriophora* travelling D cm in T hours

## Conclusions

- *H. bacteriophora* have the potential to disperse in soil in the absence of insect hosts.
- Large number of nematodes can travel small distances, while a few manage to travel long distances away from the infected *Galleria* cadaver in optimum soil moisture.
- Such dispersal ability of infective juveniles in natural habitat, i.e., soil would play an important role in their utilization as effective and successful biocontrol agents of various soil dwelling pests.

## Acknowledgments

Support was provided by OARDC and Grewal Lab members