International Journal of Agricultural and Applied Sciences, December 2022, 3(2): 105-107
https://www.agetds.com/ijaas
ISSN: 2582-8053
https://doi.org/10.52804/ijaas2022.3219

Research Article

OPEN ACCESS

Influence of hot water and UV radiation on host infectivity of entomopathogenic nematode *Steinernema glaseri (*Glaser, 1932)

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(**Received:** 09/08/2022; **Revised:** 15/11/2022; **Accepted:** 29/11/2022)

ABSTRACT
Entomopathogenic nematodes act as good bio-control agents to manage lepidopteron and coleopteran pests. *Steinernematidae* and *Heterorhabditae* are considered important families in entomopathogenic nematodes. An *in-vitro* experiment was conducted to enhance the efficacy of *Steinernema glaseri* using hot water and UV radiation on final instar larvae of *Corcyra Cephalonia*. The results showed that the highest number of larvae were infected at 35 °C and 45 °C of hot water immersion. Among the UV-exposed larvae, the highest number of larvae infected was obtained by UV exposure for 10 minutes.
Keywords: *Corcyra cephalonica*, *Steinernema glaseri*, hot water, UV radiation.

INTRODUCTION

Insect pests, pathogens and nematodes are known to cause more economic damage in both agricultural and horticultural crops (Thomas, 1999). Insecticides cause more toxicity in the environment. Most insecticides are banned because of their residual effect on the soil ecosystem. Entomopathogenic nematodes act as good bio-control agents to manage lepidopteron and coleopteran pests (Gaugler, 2002). *Steinernematidae* and *Heterorhabditae* are considered important families in the entomopathogenic nematodes group ((Kaya & Gaugler, 1993).

Third-stage juveniles (J3) are the infective stage of entomopathogenic nematodes. *Xenorhabdus* and *Photorhabdus* are the bacterium associated with the intestinal region of *Steinernema* and *Heterorhabditis* infective juveniles. Infective juveniles (IJs) enter the host through spiracles, vulva, excretory pore and anal openings. With the help of labial tooth, *Heterorhabditis* spp enters into the host body and finally reaches the haemocoel. Infectivity of entomopathogenic nematodes was enhanced by physical and chemical stressors in *Tenebrio molitor* larvae (Brown, Shapiro-Ilan, & Gaugler, 2006). With this background, an *in-vitro* study was undertaken with the following objectives to assess the influence of stressors on entomopathogenic nematodes, *Steinernema glaseri.*

MATERIALS AND METHODS

Culturing of rice moth, *Corcyra cephalonica:*
Rice moth, *Corcyra cephalonica* was cultured using cumbu grains and groundnut medium. About 2kg of cumbu grains and 200g of broken groundnut were taken in a plastic tray. Eggs of *C. cephalonica* were obtained from the Department of Entomology, TNAU, Coimbatore. One cc of *C. cephalonica* eggs was inoculated in 2.25 kg medium in a plastic tray. This plastic tray was covered with a cotton cloth. The final instar larvae of *C. cephalonica* were collected 25 days after egg hatching and used for further experiments.

Culturing of entomopathogenic nematodes:
Culture of entomopathogenic nematodes, *Steirnernema glaseri* was obtained from the Department of Nematology, TNAU, Coimbatore. A Whatmann No.1 filter paper was placed in the bottom of a 9cm Petri plate. About one ml (200 IJs) of nematode (*S. glaseri*) suspension was inoculated on the filter paper. After inoculation of nematodes, ten larvae of rice moth, *C. cephalonica* was placed on the filter paper. These plates were sealed with Klin film and incubated for three days for *S. glaseri* infection.

Preparation of Modified White traps:
A small petriplate (5cm) is filled with plaster of Paris. The plate with plaster of Paris was placed in the bottom of Petri-plate. The surface of plaster of Paris was wet sparingly. Placed the *S. glaseri* infected insect larva on the plaster of Paris. Sterile water was added to the Petri-dish. Infective juveniles were collected in the water after crawling on Plaster of Paris (JL Woodring, 1988).

Mass culturing of entomopathogenic nematodes:
The infective juveniles (IJs) of *S. glaseri* emerged out from the infected insect larvae on the 3rd day after inoculation. The IJs were washed with the sterile

distilled water four times and then excess water was decanted. The nematode suspensions were stored in a BOD incubator (Genuine model) at 20° C. A drop of Triton X was added to *S. glaseri* suspensions to avoid stickiness of nematodes.

Inducing Physical Stressors to Rice moth, *C. cephalonica:*

Immersion of *C. cephalonica* in hot water:

The final instar larvae of the rice moth, *C. cephalonica* were immersed in hot water at different temperatures *viz.*, 35°, 40° and 45° C for ten minutes. Control was maintained by immersing larvae in tap water for ten minutes. The hot water stressed larvae were inoculated with 0.5 ml (100 IJs) of *S. glaseri* . After the infection of *S. glaseri* infected larvae were transferred to Modified White's trap. The experiment was conducted in a Completely Randomized Design with six replications.

Exposure to UV radiation on *C. cephalonica* :

Final instar larvae of *C. cephalonica* were exposed to UV rays in a Laminar Air Flow chamber (Clean Air instruments) at different time intervals *viz.*,10, 20 and 30 minutes. The larvae were maintained at normal light (room temperature) served as control. UV stressed larvae were inoculated with 0.5 ml (100 IJs) of *S. glaseri.* After the infection, the larvae were transferred to Modified White's trap.

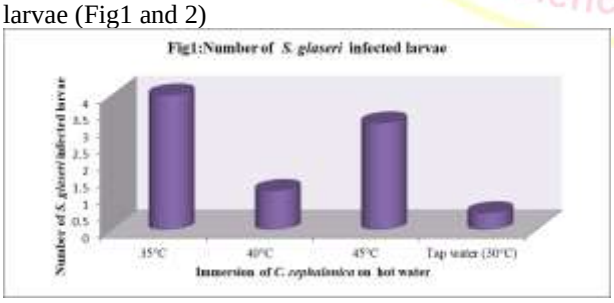
Statistical analysis

The data obtained from above-mentioned experiments were subjected to statistical analysis following the method formulated by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

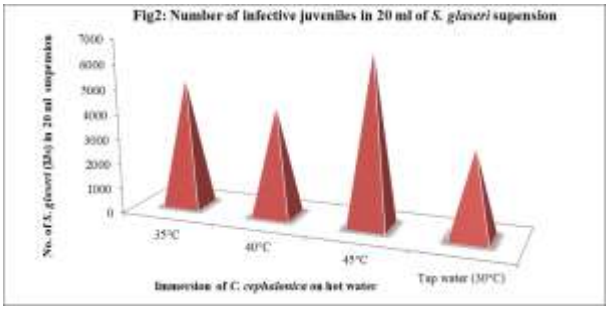
Effect of Hot water immersion on *C. cephalonica*:

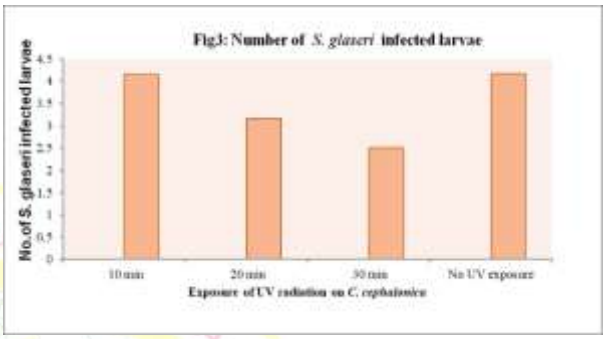
Immersion of *C. cephalonica* in hot water showed a positive influence on the infectivity of *S. glaseri*. The highest number of larvae was infected at 35 °C which was on par with the number of infected larvae at 45 °C. The lowest number of infective larvae was observed in treatment with tap water. However, there was no increase in the number of juveniles that emerged from infected larvae (Fig1 and 2)

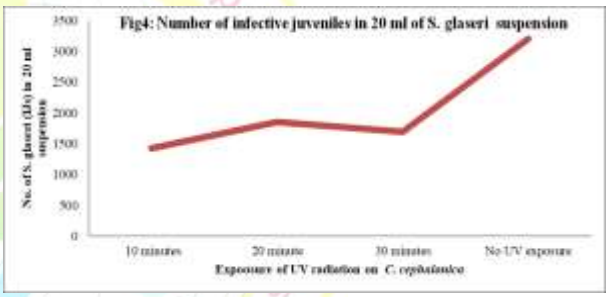


Effect of UV radiation exposure on *C. cephalonica*:

Among the UV-exposed larvae, the highest number of larvae infected was obtained by UV exposure for 10 minutes. Exposure to *C. cephalonica* for 30 minutes reduced the number of infected larvae to an extent of 66.8 per cent compared to the control. On the other hand, there was no influence of UV exposure on the number of juveniles that emerged (Fig 3 and 4).







Exposure to hot water on *C. cephalonica*

Inducing stress on *C. cephalonica* by immersing it in hot water slightly improved the infection rate. The final instar larvae of *C. cephalonica* were inactive immediately after immersing in hot water. Hence, the present study was restricted up to 45° C but the results obtained by (Brown *et al.*, 2006) are contradictory to those where treatment in hot water at 65° and 70°C increased *Tenebrio molitor* infection by *H. bacteriophora.* The variation in cuticle properties of *C. cephalonica* and *T. molitor* might be the reason for difference in temperature tolerance. The observations of present study revealed that immersion of *C. cephalonica* in hot water initially inactivated the insect and softened the cuticle. This might have facilitated the improvement in the infectivity of entomopathogenic nematodes.

UV radiation exposure on *C. cephalonica:*

UV radiation on the larvae of *G. mellonella* increased the infectivity of *S. glaseri* in the current investigation. Studies by (Herlin, Stevens, & S, 2015) showed that UV radiation altered the lifecycle of *C. cephalonica.* This finding proved that UV exposure can reduce the lifecycle of insects which can also change the morphological characteristics.

CONCLUSION

It is speculated that there might be modification in the external layer of cuticle which helped the entomopathogenic nematodes to penetrate and thus resulted in increased infectivity of *S. glaseri* in the present study.

ACKNOWLEDGEMENT

The authors express gratitude to the Department of Nematology, TNAU, Coimbatore for providing *S. glaseri* culture and laboratory facilities to conduct this research work.

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Citation: Mouniga. R, Swarnakumari. N and Suganthi. A. 2022. Influence of hot water and UV radiation on host infectivity of entomopathogenic nematode *Steinernema glaseri (*Glaser, 1932). *International Journal of Agricultural and Applied Sciences*, 3(2): 105-107. https://doi.org/10.52804/ijaas2022.3219