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Laboratory Evaluation of *Steinernema feltiae* and *Heterorhabditis bacteriophora* for the Control of the Cabbage Butterfly (*Pieris brassicae*)

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Abstract: The cabbage butterfly (*Pieris brassicae*) is a destructive pest of cruciferous crops. This study evaluated the efficacy of the entomopathogenic nematodes *Steinernema feltiae* and *Heterorhabditis bacteriophora* under laboratory conditions. Larvae were treated with different nematode concentrations, and mortality was recorded over 5–7 days. Both species caused significant larval mortality (70–90%). *S. feltiae* was more effective at lower temperatures (15–20°C), whereas *H. bacteriophora* performed better at higher temperatures (25–30°C). The results support the use of entomopathogenic nematodes as sustainable biological control agents.

Keywords: *Pieris brassicae; Entomopathogenic nematodes; Steinernema feltiae; Heterorhabditis bacteriophora; Biological Control.*

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I. INTRODUCTION

Pieris brassicae is a major pest of cruciferous crops, causing significant economic losses. Although chemical insecticides are commonly used, resistance development and environmental concerns necessitate alternative control methods. Entomopathogenic nematodes from the genera *Steinernema* and *Heterorhabditis* have been widely studied as environmentally safe biological control agents. This study assessed the laboratory efficacy of *S. feltiae* and *H. bacteriophora* against *P. brassicae* larvae.

II. MATERIALS AND METHODS

Laboratory-reared larvae of *P. brassicae* were exposed to infective juveniles of *S. feltiae* and *H. bacteriophora* at different concentrations. Experiments were conducted at 15°C, 20°C, and 25–30°C. Larval mortality was recorded daily for seven days. Untreated larvae served as controls.

- *Steinernema feltiae and Heterorhabditis bacteriophora in Pest Control*

Both *Steinernema feltiae* and *Heterorhabditis bacteriophora* have demonstrated promising results in controlling a variety of pests. They are particularly effective against soil-dwelling larvae and caterpillars like *P. brassicae*. These nematodes are applied to the soil or directly to plant surfaces and are capable of infecting the larvae either when they are in the soil or when they come into contact with treated foliage.

- *Steinernema feltiae*

Steinernema feltiae is widely recognized for its ability to control a variety of lepidopteran pests, including the cabbage butterfly. This nematode species has a broad host range, and its infectivity is high in cooler environmental conditions, which makes it suitable for temperate climates where *P. brassicae* is most problematic. Studies have shown that *S. feltiae* infects *P. brassicae* larvae efficiently when applied to both soil and plant surfaces. Upon contacting the insect, the nematodes rapidly penetrate the host and release their

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pathogenic bacteria. The larvae of *P. brassicae* exhibit symptoms of rapid tissue decay, followed by death within a few days.

➢ *Heterorhabditis bacteriophora*

Heterorhabditis bacteriophora is another promising nematode species for biological control, particularly in the management of *P. brassicae*. This nematode species thrives in warmer soil conditions, which makes it effective in controlling pests in regions with higher temperatures. Like *S. feltiae*, *H. bacteriophora* uses a symbiotic bacterium (*Photorhabdus*) that aids in the nematode's infection process. Research indicates that *H. bacteriophora* is effective in reducing *P. brassicae* populations when applied in the larval stages. In laboratory trials, *H. bacteriophora* has been shown to cause rapid mortality in *P. brassicae* larvae due to the potent toxins produced by the nematode's symbiotic bacteria.

III. RESULTS AND DISCUSSION

Both nematode species significantly increased larval mortality compared to controls ($p < 0.05$). *S. feltiae* achieved up to 85% mortality at cooler temperatures, whereas *H. bacteriophora* reached 90% mortality at warmer conditions. These findings highlight temperature as a critical factor in determining nematode efficacy.

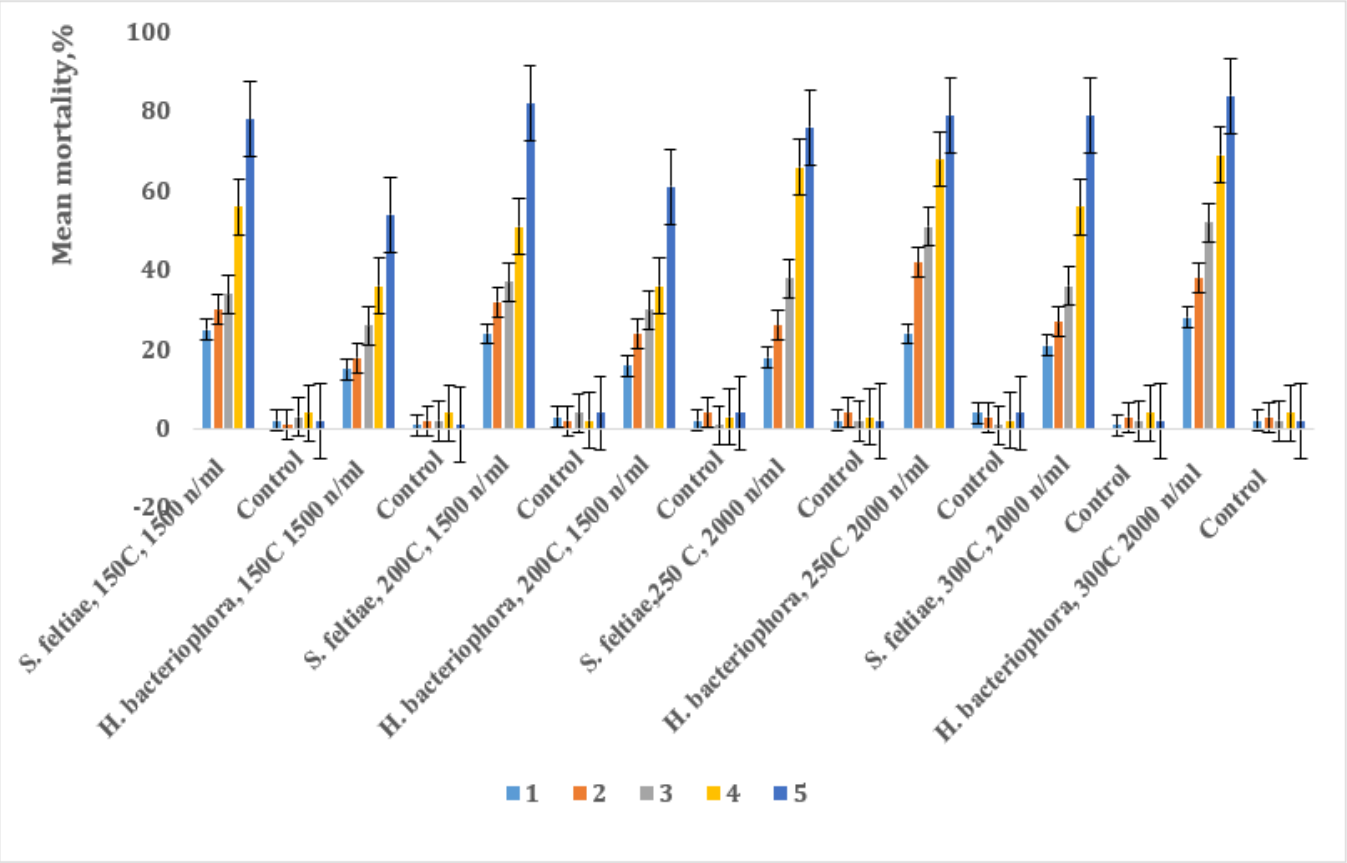

Fig 1. Virulence of *S.feltiae* and *H. bacteriophora* Against *Pieris brassicae* on temperature 15, 20^0c in Lab. Conditions

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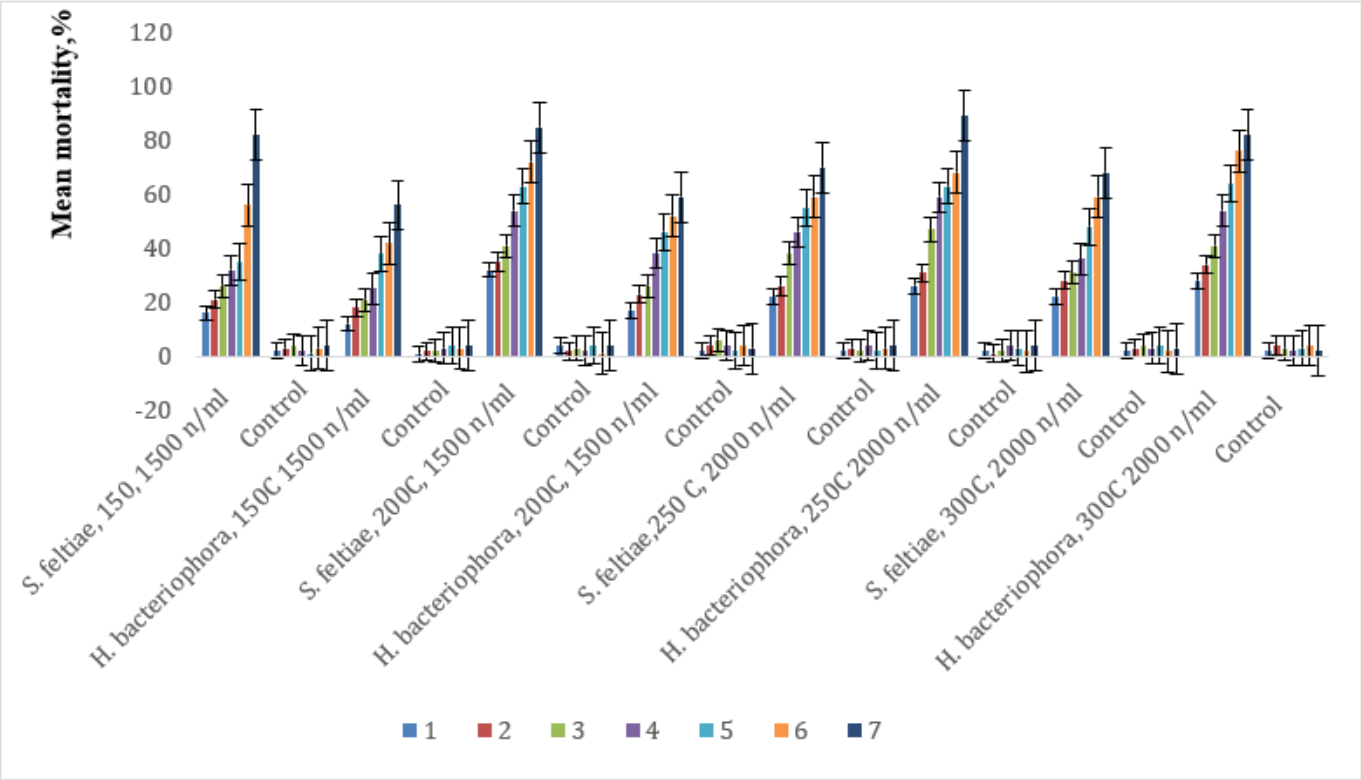

Fig 2.Virulence of *S. feltiae* and *H.bacteriophora* Against *Pieris brassicae* on Temperature 25,30^0 c in Lab Conditions

IV. CONCLUSION

Steinernema feltiae and *Heterorhabditis bacteriophora* demonstrated strong potential for the biological control of *Pieris brassicae* under laboratory conditions. Their effectiveness depends on environmental temperature, suggesting that appropriate species selection is essential for successful application. These nematodes represent promising alternatives to chemical pesticides.

➢ *Statistical Analysis (Anova)*

A one-way anova was conducted to compare the mortality rates of *Pieris brassicae* larvae treated with *Steinernema feltiae*, *Heterorhabditis bacteriophora*, and a control group under laboratory conditions. The analysis tested for differences in mortality across three temperature treatments (15°C, 20°C, 25°C). Results indicated significant differences in mortality rates between the treatment groups ($p < 0.05$). Both nematode species caused higher mortality compared to the control, with *H. bacteriophora* showing greater efficacy at 25°C and *S. feltiae* performing better at cooler temperatures (15-20°C). Post analysis confirmed that the nematode treatments were significantly more effective than the control. These findings suggest that both nematodes are effective biocontrol agents and their efficacy is influenced by temperature.

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