

The Separated and Combined Effect of Entomopathogenic Nematodes in the Control of *Halyomorpha Halys* in Georgia

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Abstract:- *Halyomorpha halys*, also known as the brown marmorated stink bug (BMSB), or simply the stink bug, is a serious agricultural pest that has been readily causing damage to crops across the west and eastern Georgia. The brown marmorated stink bug is an agricultural pest that can cause widespread damage to fruit and vegetable crops. They feed on a wide array of plants including apples, apricots, Asian pears, cherries, corn, grapes, lima beans, peaches, peppers, tomatoes, and soybeans. This makes them extremely versatile as they do not require a specific plant to feed on. Species of the entomopathogenic nematodes, *Steinernema carpocapsae* isolate "Zi" (Germany) and strain *Steinernema carpocapsae* (Israel) were studied against *Halyomorpha halys* (Stink bug). Under laboratory conditions, by using different nematode strains 500 juveniles IJ/ml of *S.carpocapsae* isolate "Zi"(Germany) and strain *S. carpocapsae* (Israel) were used separately and in combination against *H. halys* (Stink bug). In both strains were used water for control. In the results of investigation to shown that high effect of all treatments of pests such as, 4th and 5th instar larvae of *H.halys* (Stink bug) were recorded on the 7th day, after treatments with *S.carpocapsae* isolate Zi (Germany) and *S.carpocapsae* (Israel) in combination. Separately the percentages of 4th instar larvae mortality were 68 % for *S.carpocapsae* izolate Zi, 84 % for *S.carpocapsae* (Israel). In combination of both strains *S.carpocapsae* izolate Zi,(Germany) and *S.carpocapsae* (Israel) were 91%. Separately the percentages for 5th instar larval mortality for *S.carpocapsae* izolate Zi,(Germany) was 62 % for *S.carpocapsae* (Israel). 82%, in combination of both strains were 85% and no larvae mortality on control treatments.

In conclusion, It was determined that, *H. halys* (Stink bug). can be controlled by *S.carpocapsae* izolate Zi (Germany) and *S.carpocapsae* (Israel) in the combination and further studies should be conducted at field and greenhouse conditions.

Keywords:- *Halyomorpha Halys*, *Entomopathogenic Nematodes*, *Steinernema Carpocapsae*, *Brown Marmorated Stink Bug*.

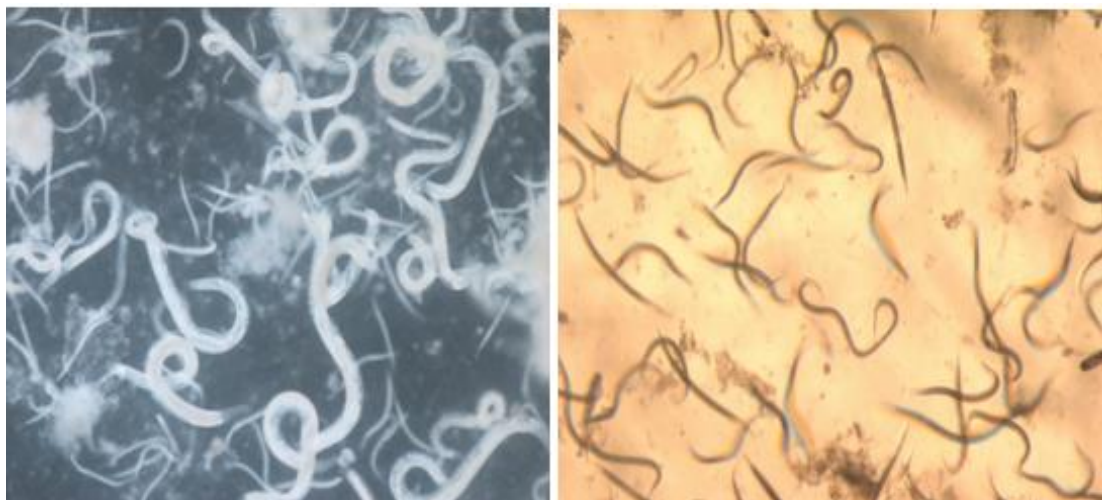
I. INTRODUCTION

Halyomorpha halys, also known as the brown marmorated stink bug (BMSB), or simply the stink bug, is a serious agricultural pest that has been readily causing damage to crops across the west and eastern Georgia. The brown marmorated stink bug is an agricultural pest that can cause widespread damage to fruit and vegetable crops. They feed on a wide array of plants including apples, apricots, Asian pears, cherries, corn, grapes, lima beans, peaches, peppers, tomatoes, and soybeans. This makes them extremely versatile as they do not require a specific plant to feed on.

The adults are approximately 1.7 cm long. They are various shades of brown on both the top and undersides, with gray, off-white, black, copper, and bluish markings.

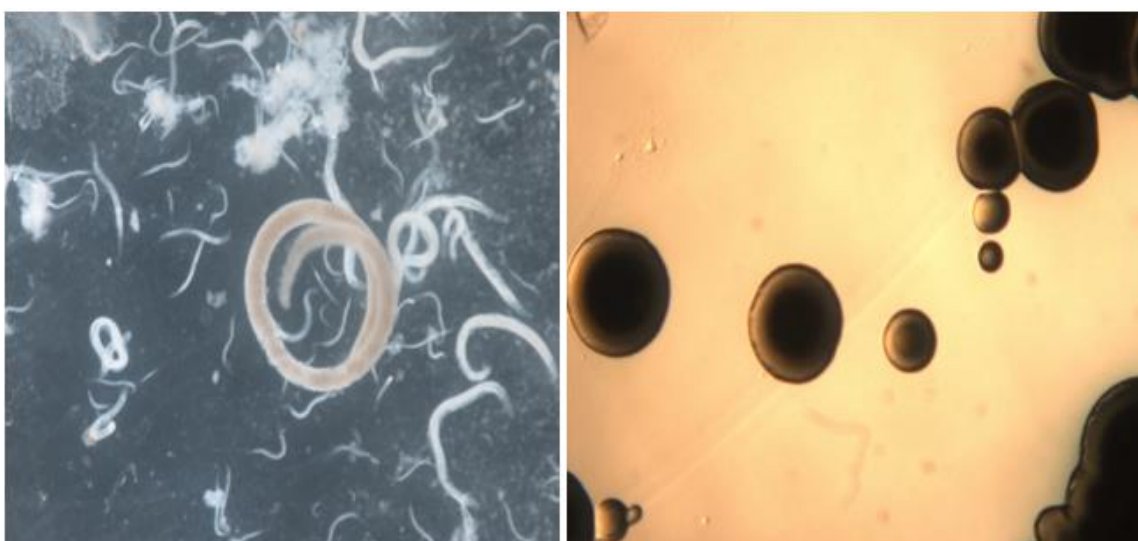
The purpose of our study was to determine the efficiency of using entomopathogenic nematodes *Steinernema carpocapsae* isolate "Zi" (Germany) and strain *Steinernema carpocapsae* (Israel) were studied against *Halyomorpha halys* (Stink bug) (BMSB) and their use for biological pest control. Today *Halyomorpha halys* as dangerous pest insect is widespread almost throughout all regions of Georgia.

Among agro-technical measures, the fighting with unwanted weed plants, moderate irrigation, extra nutrition of the plant, etc. are used. The application of chemical methods also occurs in fighting against stink bug (*Halyomorpha halys*), which must be carried on the basis of the State Catalogue of pesticides permitted for use in Georgia and consulting with appropriate service [1-3]. New safe biological means or suspensions of entomopathogenic nematodes give the best result in stink bug (*Halyomorpha halys*) control. These pathogens were introduced from Israel and Germany [4,5].



Figs. 1,2:- Application of *Steinernema carpocapsae* isolate "Zi"(Germany) and *Steinernema carpocapsae* (Israel) against the *Halyomorpha halys*

As is known, entomopathogenic nematodes belongs to *S.carpocapsae* genus of *Steinernema carpocapsae* isolate "Zi"(Germany) and *Steinernema carpocapsae* (Israel) is associated with bacteria *Xenorhabdus*, Joint action of bacterium and nematodes leads to insect mortality which plays an important role in the regulation of the number of harmful insects. These species of nematodes are distinguished by safety to humans and the environment and they are effective biological agents for biological control of pests. The following cycle is characteristic for the development of *S.carpocapsae*: egg, four juvenile stages and the adult form. After covering with cuticle - protective film of the second stage juveniles, the nematodes stop feeding, leave the dead host and carry with them reproductive bacterium for infestation of a new host. Nematodes penetrate the hemolymph of a living host, inject into it symbiotic bacteria which causes insect mortality in approximately 24-72 h. Nematodes produce amphimictic population (nematodes of male and female genus) in the host intestinal.



Figs. 3, 4. *S. carpocapsae* isolate "Zi"(Germany), *S. carpocapsae* (Israel) and their symbiotic bacteria *Xenorhabdus*

II. MATERIALS AND METHODS

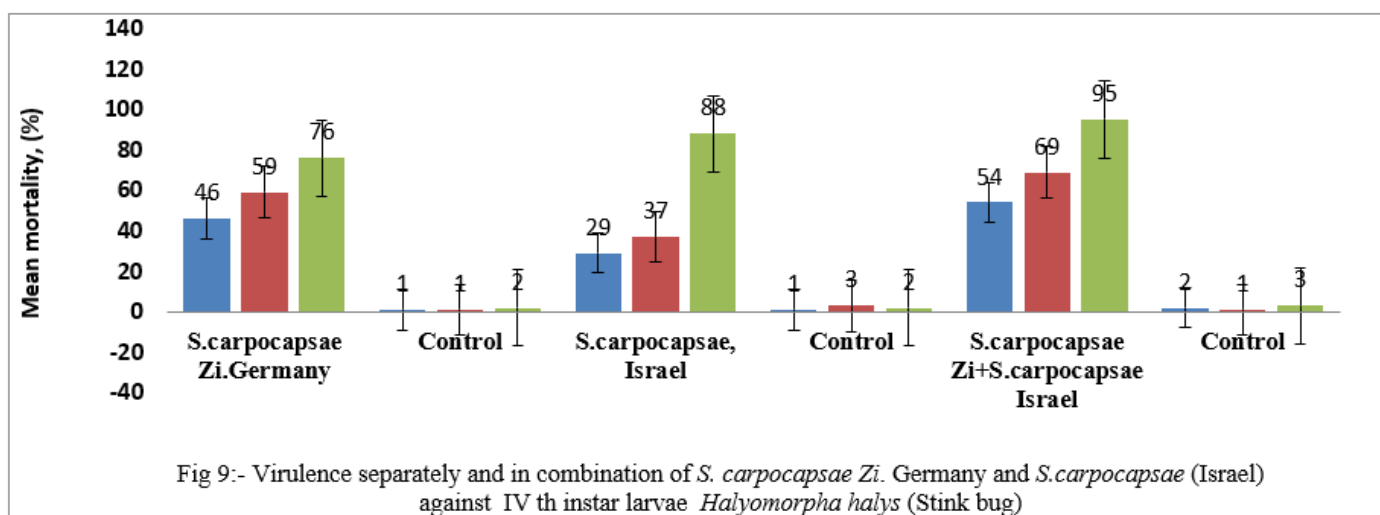
Prior to the use of entomopathogenic nematodes in the experiment, their cultivation occurred in an incubator at 24-25°C on last-instar larvae of large wax moth (*Galleria mellonella*) using the appropriate method (Kaya, Stock 1997). Suspensions obtained as a result of cultivation were kept in a refrigerator at 4-6°C. Acclimatization of nematodes proceeded under the conditions of room temperature 24-25°C. The use of the obtained biomass was possible 6-10 h later. To determine the efficiency of *S. carpocapsae* Zi (Germany) and *S. carpocapsae* (Israel) in conditions of room temperature 24-25°C and 75% humidity for trial were used pest-grown form of imago. Mortality rate of individuals was determined by Abbott's formula (Abbot, 1925) [6,8]. Our study aimed to determine the efficacy of entomopathogenic nematodes *S. carpocapsae* isolate "Zi" (Germany), and *S. carpocapsae* (Israel) for biological control of stink bug (*Halyomorpha halys*), in laboratory conditions. Experiments were conducted in a 10 cm Petri dishes. During the 14-day study period 300 adult brown marmorated stink bugs (*Halyomorpha halys*) were collected inside in hazelnut plantations. They were placed on each Petri dish. The trial used *S. carpocapsae* isolate "Zi" (Germany), and *S. carpocapsae* (Israel) of 500 infective juveniles/ml. Insect mortality was examined on 3, 5, 7 days after treatment [5,6,7,8].

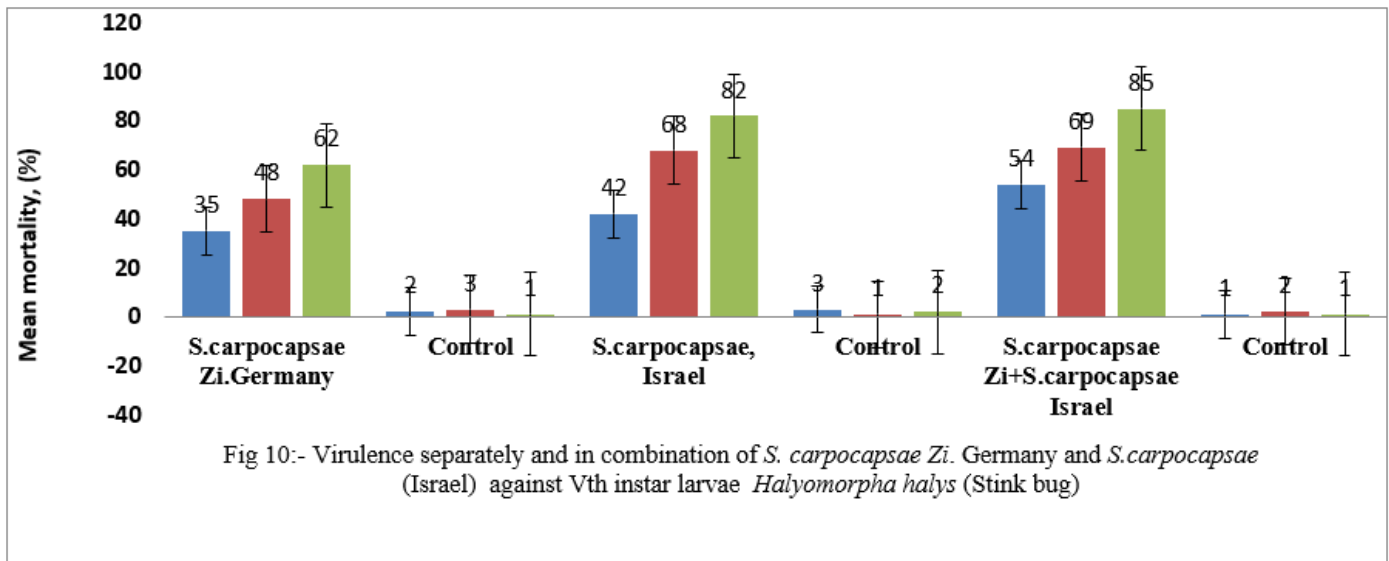


Figs 5,6,7,8:- Mortality of *Halyomorpha halys* caused by *S. carpocapsae* isolate "Zi" (Germany), and *S. carpocapsae* (Israel)

III. RESULTS AND DISCUSSION

The results have shown that the virulence of *S. carpocapsae* Zi (Germany) and *S. carpocapsae* (Israel) against *H. halys* insect mortality is higher than that of *S. carpocapsae* isolate "Zi", which depends on the time, type and concentration of the nematodes. On the 7th day after treatment with a nematode suspension 500 infective juveniles/ml of *S. carpocapsae* Zi (Germany) in the given trial reveals 46, 59 and 76% mortality rate whereas *S. carpocapsae* (Israel) 29, 37 and 88% respectively. In combination mortality rate it was 54, 69 and 95. The obtained results show that under laboratory conditions in combination efficiency of *S. carpocapsae* Zi (Germany) and *S. carpocapsae* (Israel) against IVth, and 5th instar larvae *H. halys* can be controlled by *S. carpocapsae* Zi (Germany) and *S. carpocapsae* (Israel) and therefore, future study is to be conducted in private houses, field and greenhouse conditions.





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