# Biology and dynamics of Snellenius maculipennis (Szepligeti) (Hymenoptera: Braconidae), a larval parasitoid of castor semilooper, Achaea janata (Linnaeuus) (Lepidoptera: Noctuidae)

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# Biology and seasonal dynamics of *Snellenius maculipennis* (Szépligeti) (Hymenoptera: Braconidae) a larval parasitoid of castor semilooper, *Achaea janata* (Linnaeuus) (Lepidoptera: Noctuidae)

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**ABSTRACT:** **Biology and seasonal dynamics of *Snellenius maculipennis* (Szépligeti), a solitary larval endoparasitoid of castor semilooper, *Achaea janata* (Linnaeus) were studied in the laboratory and field. The egg + larval, pupal and adult periods lasted 6.25 ± 0.96, 5.08 ± 0.90 and 3.5 ±1.02 days, respectively. Under laboratory conditions the parasitoid completed its life cycle in 14.83 ± 2.88 days. Host larvae showed reduced feeding in the first 5 - 6 days after parasitisation till the exit of the grub from the host body for pupation. After parasitoid exited, the host larvae survived up to 4 - 6 days but exhibited complete feeding cessation leading to drastic reduction in growth. The parasitoid was found active from August to October and the peak parasitism across three years ranged from 68 to 96 per cent. Three years pooled data on larval counts and number of parasitized larvae per plant recorded at weekly interval revealed a linear relationship between them. Two species of hyperparasitoids, *viz. Mesochorus pilicornis* (Cameron) (Hymenoptera: Ichneumonidae) and *Brachymeria secundaria* (Ruschka) (Hymenoptera: Chalcididae) were recorded on *S. maculipennis* for the first time. The extent of hyperparasitism was between 26 and 38 per cent during August to October. The nature of exit hole on the cocoons of *S. maculipennis* was described to record the level of hyperparasitism under field conditions. Compatibility study with *A. janata* granulosis virus revealed that 69 per cent of parasitized larvae collected from virus treated plots showed presence of viral infection. The potential of *S. maculipennis* in the natural biological control of *A. janata* and the need for its conservation have been discussed.**

**KEY WORDS:** *Achaea janata*, biological control, granulosis virus, hyperparasitoids, *Snellenius maculipennis*, seasonal dynamics

## INTRODUCTION

Castor semilooper, *Achaea janata* (Linnaeus) is an important defoliator and a serious pest in most of the castor growing areas of the country. It also feeds on tender capsules and causes yield loss ranging from 5 to 90 per cent depending on larval density and crop stage. In nature, it is regulated by a larval parasitoid *Snellenius* (=*Microplitis*) *maculipennis* (Szépligeti) (Khan, 1946; Gaikwad and Bilapate, 1989; Somasekhar *et al.*, 1992). Phylogenetic studies among the genera of Microgastinae by Patric and James (1999) using modern molecular biology tools revealed a very close relationship between *Microplitis* and *Snellenius*. Hence they could be considered as

synonyms and the preferred name is *Snellenius*. This paper presents detailed information on the biology, seasonal dynamics and hyperparasitoids of *Snellenius maculipennis* and its compatibility with a viral bio-pesticide with reference to its host, *A. janata*.

## MATERIALS AND METHODS

Field experiments were conducted at the Hayathnagar Research Farm, CRIDA, Hyderabad during the *kharif* seasons of 2001-2003. Castor (cv. DCS-9) was sown in a plot measuring 1000 $m^2$. Sowings were completed with the onset of first monsoon showers and the dates of sowings were June 8, June 21 and July 14 during the years 2001, 2002 and 2003, respectively. The field was divided into 100 equal quadrats of 10 $m^2$ sizes. No insecticide spray was given throughout the crop season. Activity of the larval parasitoid *S. maculipennis* and its host *A. janata* was monitored throughout the season by recording observations from 3 quadrats at weekly interval and per cent parasitization worked out. Field parasitization was identifiable by the presence of parasitoid cocoon attached to the host body. Cocoons were field collected every week and observed in the laboratory for emergence of either *S. maculipennis* adults or hyperparasitoids in individual glass vials. Extent of hyperparasitism was worked out.

In addition to field collection of parasitoid cocoons, weekly samples of second and third instar semilooper larvae were collected from 5 plants each from three additional quadrats and were reared in the laboratory to record parasitization due to *S. maculipennis*. Cocoons were separated from the host body and placed in glass tubes for emergence. Adult parasitoids were transferred to glass tubes (4 adults per tube) of size 20 x 3.7cm. Fifty per cent honey solution was streaked on the inner walls of the tube as adult food. For three consecutive days, 10 semilooper larvae (3-day-old) were introduced into the tube for exposure to *S. maculipennis* adults for 24 hours. Host larvae were then reared on fresh castor leaves till their death. Simultaneously healthy semilooper larvae of similar age but unexposed for parasitization were reared for comparison. Observations on host feeding and growth were recorded. Durations of egg + larval, pupal and adult stages of the parasitoid were recorded. The temperature in the rearing room was maintained at 27 ± 1°C and relative humidity at 60 ± 10 per cent.

In a separate field experiment, compatibility of *S. maculipennis* with baculovirus was studied. *A. janata* granulosis virus (GV) aqueous preparation was applied @ 500 larvae equivalents (LE) per hectare when a high incidence of early instar semilooper was recorded in the field. One week after the spray, early instar larvae and also larvae with parasitoid cocoon intact on their body were collected from the virus treated plots. Haemolymph from each of the parasitized larvae was examined under phase contrast microscope (1500X) for the presence of virus inclusion bodies. The parasitoid cocoons that were attached to diseased larvae were maintained separately to record adult emergence of the parasitoid. The data obtained were analyzed statistically as per Snedecor and Cochran (1967).

## RESULTS AND DISCUSSION

### Biology

Laboratory studies on the biology of *S. maculipennis* revealed that invariably a single parasitoid emerged from each parasitized semilooper larva. Egg and larval stages were completed within the host in 6.25 ± 0.96 days. The final instar exited through an incision in the host body between the last pair of pro-legs on its lateral side. The parasitic grub is apodous, spindle-shaped and transparent. Soon after emergence, the grub started spinning silk around its body that was initially light grey coloured and later turned to brown. While spinning the silken thread, the grub wriggled slowly to the undersurface of the host and completed spinning within 5 hours. The cocoon on one side was firmly attached to the rear end of semilooper larvae and the other side to the leaf surface rendering its host immobile. Pupal and adult periods of *S. maculipennis* lasted for 5.08 ± 0.9 and 3.5 ± 1.02 days, respectively. Khan (1946) reported that the life cycle of *M. maculipennis* lasted 7 days, while Husain (1972) observed that it was 12-16 days. In

the present study it was observed that the parasitoid needed 14.83 ± 2.88 days to complete its life cycle. The differences in the developmental periods may be due to the differences in the environmental conditions.

Host larvae continued to feed after parasitization till the exit of the grub from the host body for pupation. However, the quantity of food ingested by the parasitized larva was less compared to a healthy individual of similar age. The mean leaf area consumed per larva per day after parasitization was 8.2 $mm^2$ as against 22.8 $mm^2$ for the same by a healthy larva. After parasitoid exited, the host larvae survived for 4-6 days but exhibited complete feeding cessation leading to drastic reduction in growth. The size and weight of 12 day-old parasitized larvae were 1.73 ± 0.12cm and 56.67 ± 15.28mg, respectively. The same in the healthy larvae of similar age was 5.48 ± 0.30 cm and 1105 ± 130.20 mg, respectively. The differences in size and weight could be due to feeding behaviour and failure of parasitized larva to undergo moulting beyond third instar stage. Cherian and Basheer (1947) and Husain (1972) also observed feeding cessation in *A. janata* larvae parasitized by *M. maculipennis*. The present study provided additional information on the quantity of food ingested by the parasitized larvae and the effect of parasitisation on growth and development of *A. janata*.

**Seasonal dynamics**

*S. maculipennis* was found active during August-October in all the three years of study. Peak parasitisation recorded in the year 2001 was during the end of September and in 2002 it was during middle of August and first week of October. Whereas, during the year 2003, parasitization levels were high from mid August onwards till the end of October. In all the three years of study it was interesting to note high semilooper population during the period preceding peak parasitization, and in the subsequent weeks there was reduction in host population density (Fig. 1). This explains the population regulation of semilooper by this important parasitoid. Khan (1946) also recorded heavy parasitization of *A. janata* by *M. maculipennis*. Cherian and Basheer (1947) and Jayaraj (1969) from Tamil Nadu observed 56.2 and 51.8 per cent parasitisation, respectively by *M. maculipennis* on *A. janata*. Rai and Jayaramaiah (1978) reported parasitism to the extent of 70-75 per cent in Karnataka, and Gaikwad and Bilapate (1989) found 43 to 66 per cent in Maharastra. Somasekhar *et al.* (1992) recorded the activity of *M. maculipennis* at Raichur between August and November and the peak parasitism of 68.2 to 72.2 per cent during second fortnight of September. In the present study, the host population levels started increasing from August first week onwards and attained peak during first to fourth week of September in all the three years of study. Whereas, the extent of parasitism varied from year to year but the peak parasitism over three years ranged from 68 to 96 per cent and was recorded during August to October (Fig.1). When weekly counts of larval population and number of parasitized larvae per plant pooled over three years period was plotted as scattered diagram, they are found to have a linear relationship, indicating density dependent nature of this parasitoid (Fig.2).

**Hyperparasitoids**

Observations from more than 500 cocoons of *S. maculipennis* field-collected over two years revealed the presence of two species of hyperparasitoids. The red coloured wasp was identified as *Mesochorus pilicornis* (Cameron) (Hymenoptera: Ichneumonidae) and the black coloured wasp as *Brachymeria secundaria* (Ruschka) (Hymenoptera: Chalcididae). Both hyperparasitoid species are solitary in nature. The former was more predominant (26-38%) than the later (4%). The empty cocoons of *S. maculipennis* from which hyperparasitoids emerged were identified by a circular emergence hole on the lateral side at one end, whereas the cocoons from which *S. maculipennis* adults emerged were typical with a cap like opening at the tapering end. Thus, the nature of exit hole on the cocoons of *S. maculipennis* could be used to record level of hyperparasitism under field conditions. During September 2002, the hyperparasitism recorded on *S. maculipennis* due to *M. pilicornis* and *B.*

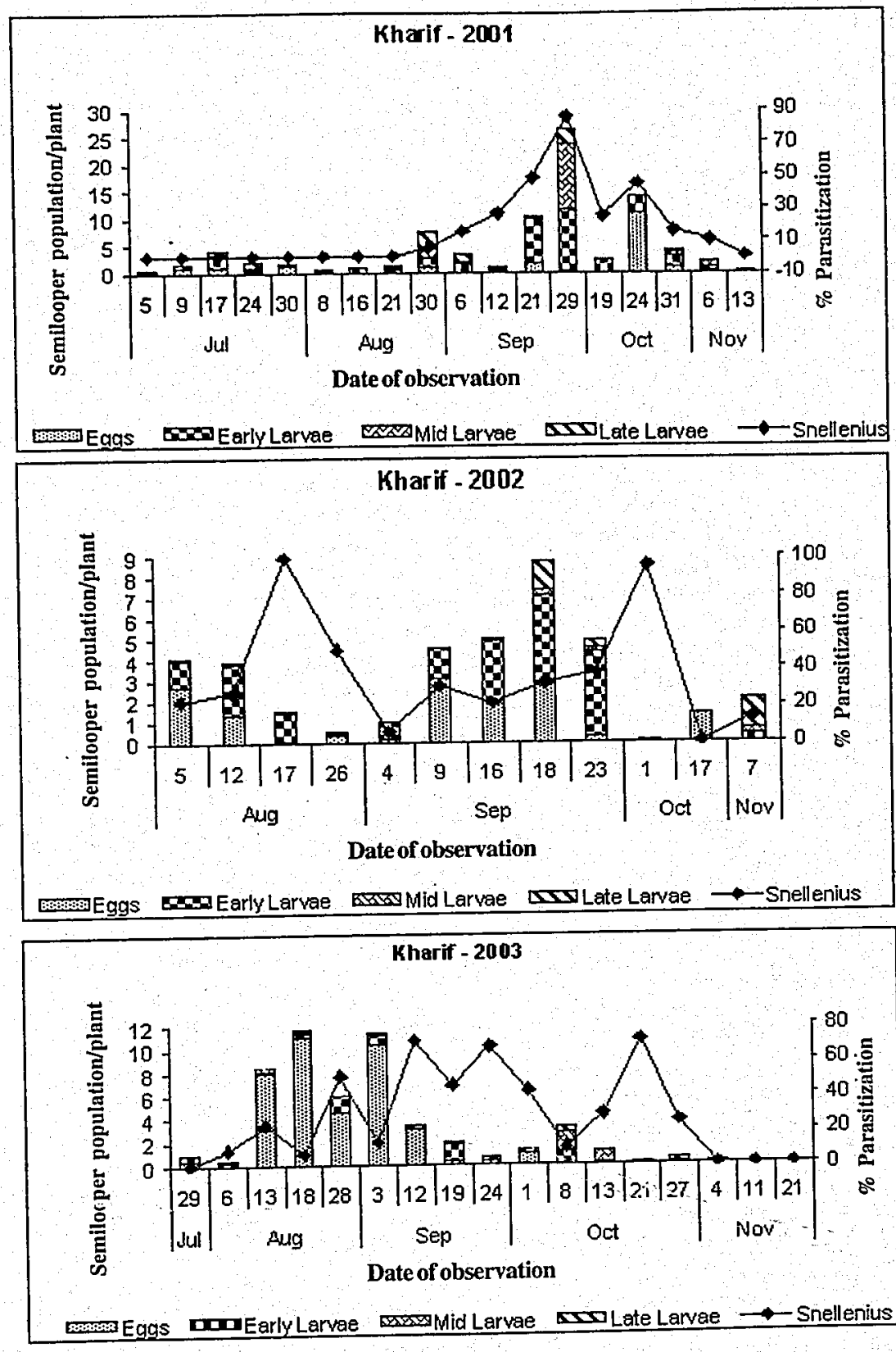


**Figure 1. Seasonal dynamics of larval parasitoid *S. maculipennis* and its host, *A. janata***

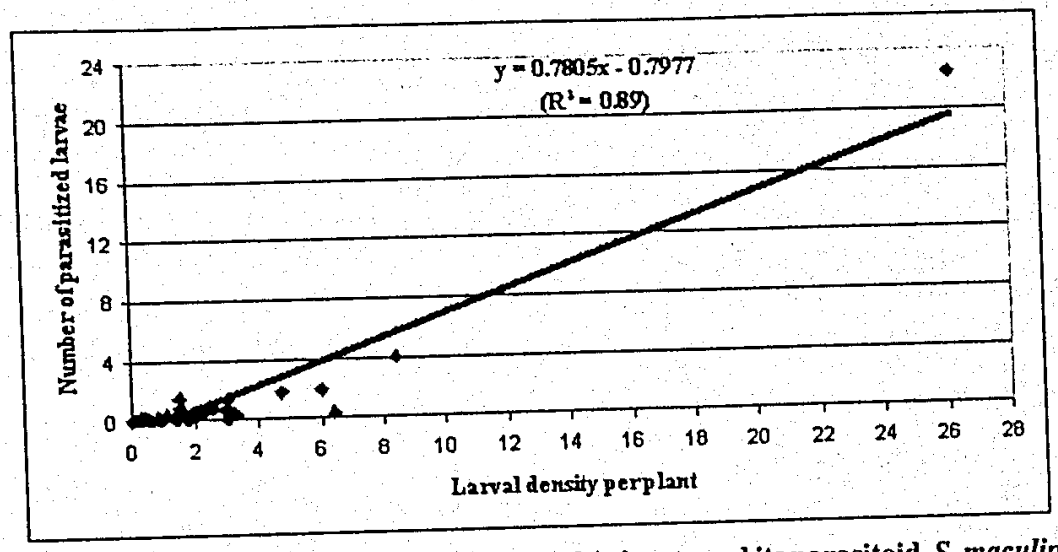


**Figure 2. Relationship between larval densities of *A. janata* and its parasitoid, *S. maculipennis***

*secundaria* was 28 and 4 per cent, respectively. Whereas, in the year 2003, only the *M. pilicornis* was recorded and the levels were 26 and 38 per cent during August and October, respectively. This is the first report on occurrence and dynamics of hyperparasitoids on *S. maculipennis*. Janzen *et al.* (2003) described hyperparasitism on a related species, *Microplitis espinachi* Walker. The ichneumonid wasp, *Acrolyta stroudi* Gauld, n.sp. and the chalcidid wasp *Conura convergea* Delvare, n. sp. hyperparasitized prepupae of *M. espinachi* soon after it emerged from its host caterpillar for pupation. However, another ichneumonid wasp, *Mesoschorus angustistigmatus* Dasch parasitized *M. espinachi* while still inside the host caterpillar in grub stage. Further investigations are needed to know the exact nature of hyperparasitism and host stage preference of the two hyperparasitoids, *M. pilicornis* and *B. secundaria*, reported on *S. maculipennis*.

**Compatibility with viral bio-pesticide**

The results from the field trials on compatibility of *A. janata* Granulosis virus (GV) with *S. maculipennis* revealed that out of 78 parasitized larvae collected from plots treated with virus at 7 days after treatment, 54 were found (69.2 %) infected with the virus. All the parasitoid cocoons emerged from diseased larvae were healthy and yielded normal parasitoid adults similar to those obtained from larva with no infection of GV. This shows that GV could co-exist with *S. maculipennis* grubs in the same host without any detrimental effect on the parasitoid. Earlier studies on *Microplitis croceipes* and NPV of *Heliothis zea* revealed that endoparasitoid development and emergence was successful before virus killed the host (Eller *et al.*, 1988). The presence of GV inclusion bodies in haemolymph of *A. janata* larvae parasitized with *M. maculipennis* was also reported by Prasad *et al.* (2003). However, detailed parasitoid - virus interaction studies in terms of faster kill or food consumption behaviour in larvae affected by both GV and *S. maculipennis* needs further investigation.

It is important to conserve this parasitoid by avoiding pesticide sprays when their activity is at peak. Basappa and Lingappa (2002) reported steady increase in population of *S. maculipennis* in castor plots imposed with integrated pest management practices and the parasitoid activity was completely seized when only chemical insecticides were used. Hence it is suggested that when parasitization levels are more than 50 per cent, spray of synthetic insecticides should be avoided. The use of *A. janata* granulosis virus @ 500 LE per hectare, which was found safe to *S. maculipennis* should be encouraged.

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