SEASONAL INCIDENCE OF *METEORUS AUTOGRAPHAE*[1] ON SOYBEAN LOOPER[2] LARVAE ON SOYBEAN IN SOUTH CAROLINA, AND THE INFLUENCE OF HOST DENSITY ON PARASITIZATION[3]

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ABSTRACT

The seasonal incidence of *Meteorus autographae* Muesebeck (Hymenoptera: Braconidae) on larvae of the soybean looper, *Pseudoplusia includens* (Walker) (Lepidoptera: Noctuidae), in soybean fields in South Carolina was monitored at two locations during 1981, 1982, and 1983. In most instances, parasitism of soybean looper larvae by *M. autographae* was detected 7 to 14 days after soybean looper larvae were first found in the fields. During this three-year study, maximum parasitism of soybean looper larvae by *M. autographae* within a season ranged from 4.6 to 19.8%. In the laboratory, numbers of hosts parasitized per 24 hours by *M. autographae* increased with each successive increase in host density. At a host density of 40 larvae per 1.75-liter cylindrical container, an average of 26 hosts were parasitized by one *M. autographae* during 24 hours. Percent parasitism remained about the same (64 - 70%) at all host densities.

Key Words: *Meteorus autographae, Pseudoplusia includens,* soybean looper, parasitoid, parasitism, larval mortality, biological control, seasonal incidence, soybean.

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INTRODUCTION

Meteorus autographae Muesebeck is a member of the parasitoid complex which attacks several lepidopteran pests of soybean, including soybean looper (SBL), *Pseudoplusia includens* (Walker), in Louisiana (Burleigh 1971, 1972), Georgia (Beach and Todd 1985) and North Carolina (Deitz et al. 1976); corn earworm, *Heliothis zea* (Boddie), in Alabama (Watson et al. 1966); and green cloverworm, *Plathypena scabra* F., in Delaware (Whiteside et al. 1967), Missouri (Barry 1970), and Illinois (Roberts et al. 1977). During a two-year study in South Carolina in 1976 and 1977, *M. autographae* also was reared from field-collected larvae of green cloverworm, corn earworm, SBL, and velvetbean caterpillar, *Anticarsia gemmatalis* Hübner (Lepidoptera: Noctuidae) (McCutcheon and Turnipseed 1981). Certain aspects of the biology [i.e., developmental time, adult longevity, number of progeny produced per female, host range, host (SBL) instar range, etc.]

[1] HYMENOPTERA: Braconidae.
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of *M. autographae* were reported recently by Grant and Shepard (1984). However, little information is available regarding this parasitoid's seasonal incidence and possible importance in regulating populations of lepidopteran pests of soybean.

It is difficult to accurately assess the impact of a parasitoid species on an insect pest. Several researchers have stressed the disadvantages or difficulties encountered when hosts that are collected from the field are used to determine parasitoid incidence and impact on pest populations (Roach et al. 1979; Simmonds 1948; Van Driesche 1983). We understand and acknowledge these problems; however, in order to gain a basic understanding of the possible influence of a parasitoid species on a pest population it is important to obtain information about the incidence of parasitism on a host under field conditions.

The objectives of our study were to gain insight into the seasonal dynamics of *M. autographae* on larvae of the SBL in soybean fields in South Carolina and to assess the influence of host (SBL) density on parasitization by *M. autographae* under laboratory conditions.

MATERIALS AND METHODS

Seasonal Incidence

To monitor the seasonal incidence of *M. autographae* on SBL, we collected larvae from two locations in South Carolina during 1981, 1982, and 1983. A 0.4-ha soybean ('Bragg' - 1981, 1982; Coker 338 - 1983) field was located at the Sumter Area Agricultural Demonstration Project, Sumter, and a 4.05-ha soybean ('Bragg') field was located at the Clemson University Pee Dee Experiment Station, Florence. Standard agronomic practices were followed except that insecticides were not applied to these fields. We began sampling in July and ended in October. Two-hundred sweep-samples were randomly taken weekly with a standard sweep-net (37.5-cm diam) at each location. Larvae were placed on artificial media (Greene et al. 1976), taken to the laboratory, and held until death, pupation, or emergence of parasitoids. To estimate the density of SBL larvae, six shake-cloth samples (Boyer and Dumas 1969) were randomly taken on each sampling date by beating the foilage over a 1.2 × 1.0-m cloth laid between the soybean rows. However, shake-cloth samples were not taken at the Sumter location in 1981; densities of SBL larvae were estimated from sweep-net samples.

Influence of Host Density on Parasitization

SBL larvae obtained from a stock laboratory colony were reared on artificial media and used as hosts. A colony of *M. autographae* was maintained in the laboratory as described by Grant and Shepard (1984).

The influence of host (SBL) density on parasitization by *M. autographae* was assessed in the laboratory at 27 ± 2°C, 60 ± 10% RH, and a photoperiod of L:D 15:9. SBL larvae (late-second- or early-third-instars) were provided as hosts at densities of 10, 20, 30, or 40 per 1.75-liter cylindrical polystyrene container (15 replicates per density). The respective density of SBL larvae and one lima bean bouquet (78 cm^2) were placed into each container with one female parasitoid for 24 hours. Larvae were then removed, individually placed into media cups, and held until death, pupation, or emergence of the parasitoid.

Data were subjected to an analysis of variance procedure. When significant ($P \leq 0.05$) differences were found, Duncan's multiple range test was used to determine significant ($P \leq 0.05$) differences among the means. Means were determined from raw data, and these means were used to fit regression equations for density of hosts on the numbers of hosts parasitized by *M. autographae* per 24 hours.

RESULTS

Seasonal Incidence

During 1981 near Florence, SBL larvae were first collected on 26 August. Mean numbers of SBL larvae per row-m increased as the season progressed until 29 September when a peak density of 9.8 larvae per row-m was observed (Fig. 1A). Percent parasitism by *M. autographae* reached a maximum of 19.8% on 2 September, decreased slightly, and maintained a level of ca. 10% parasitism for the last two sampling dates (Fig. 1A). Maximum percent parasitism prior to build-up of looper populations may have been caused by the presence of alternate hosts such as green cloverworm and corn earworm larvae which occurred earlier in the season and also are attacked by *M. autographae*. Percent parasitism by *M. autographae* was difficult to assess on 22 and 29 September because ca. 40 to 50% of all collected SBL larvae were killed by entomopathogens [primarily *Nomuraea rileyi* (Farlow) Sampson]. Diseased larvae may have died before the successful emergence of *M. autographae*. We did not dissect diseased larvae to determine the presence of immature parasitoids.

During 1982 near Florence, SBL larvae were present ca. 4 weeks earlier than in 1981 (Fig. 1B). Numbers of SBL larvae reached a maximum density of ca. 20 larvae per row-m on 11 August, and declined steadily thereafter; SBL larvae were not found in the field after 9 September. Percent parasitism by *M. autographae* reached a peak of 9.2% on 18 August, and declined to 0.5% on 9 September. The highest percent parasitism occurred one week after the peak density of SBL larvae.

During 1983 near Florence, populations of SBL were non-existent in the soybean field and therefore data were not obtained for that location.

During 1981 near Sumter, populations of SBL larvae reached a density of ca. two larvae per sweep-net sample on 21 September (Fig. 2A). Percent parasitism by *M. autographae* reached a maximum of only 4.6% parasitism on 29 September, ca. one week after the densest population of SBL larvae.

During 1982 near Sumter, populations of SBL larvae also were present ca. 3 to 4 weeks earlier than those in 1981 (Fig. 2B). Densities of SBL larvae peaked at ca. 16 larvae per row-m on 25 August, and declined steadily thereafter. This peak in SBL density occurred within 14 days of the peak observed at Florence during 1982. Percent parasitism of SBL larvae by *M. autographae* was variable reaching a maximum of 8.5% on 14 September. Mortality of SBL larvae caused by *N. rileyi* and *Entomophthora gammae* (Weiser) on 3 and 9 September possibly reduced expression of parasitism by *M. autographae*. On these dates, mortality of SBL larvae due to entomopathogens was 72.4 and 56.9%, respectively.

During 1983 near Sumter, populations of SBL larvae followed a similar trend to that observed during 1982; peak populations occurred early in the season (Fig. 2C). A maximum density of 11.8 larvae per row-m was found on 29 August.

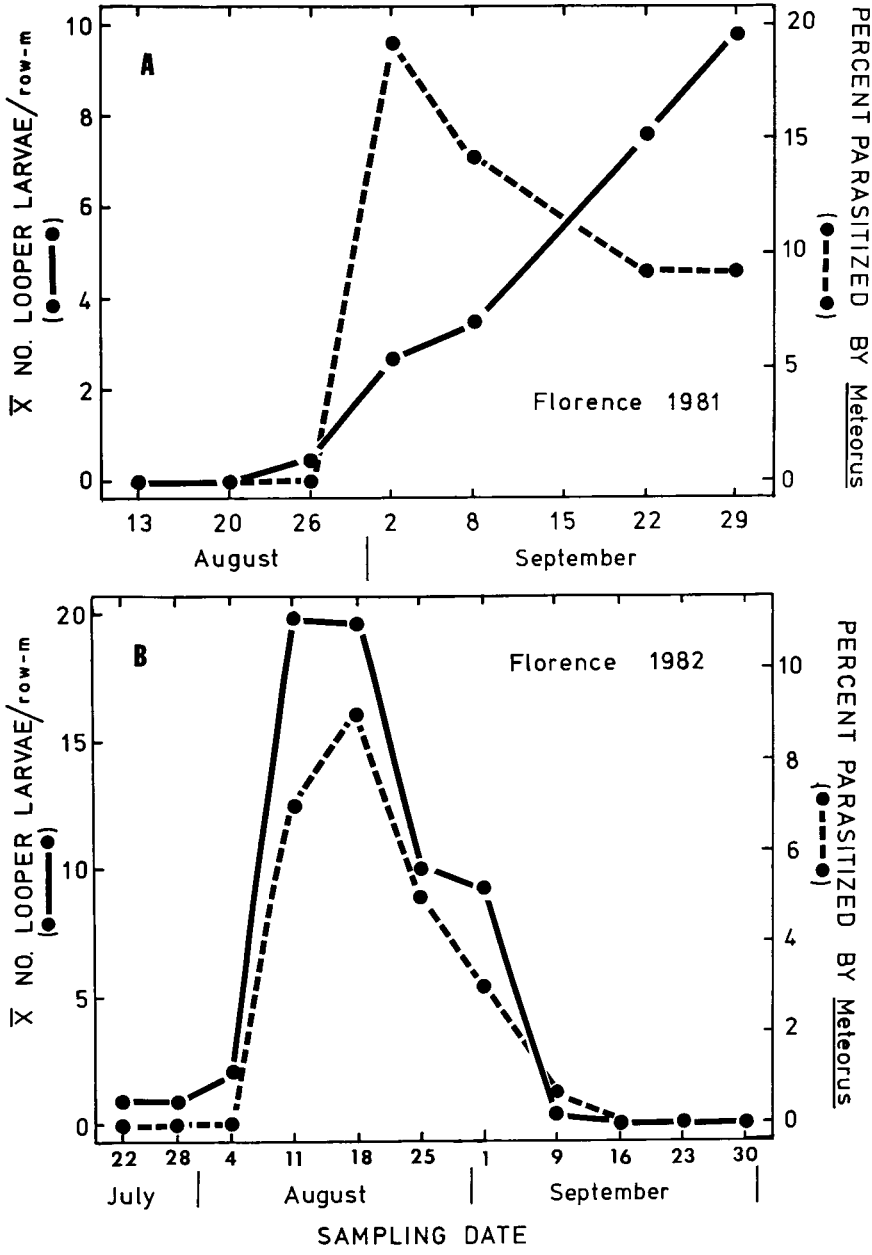

Fig. 1. Population density of *Pseudoplusia includens* larvae on soybean and seasonal incidence of *Meteorus autographae* on *Pseudoplusia includens* larvae near Florence, SC — A = 1981, and B = 1982.

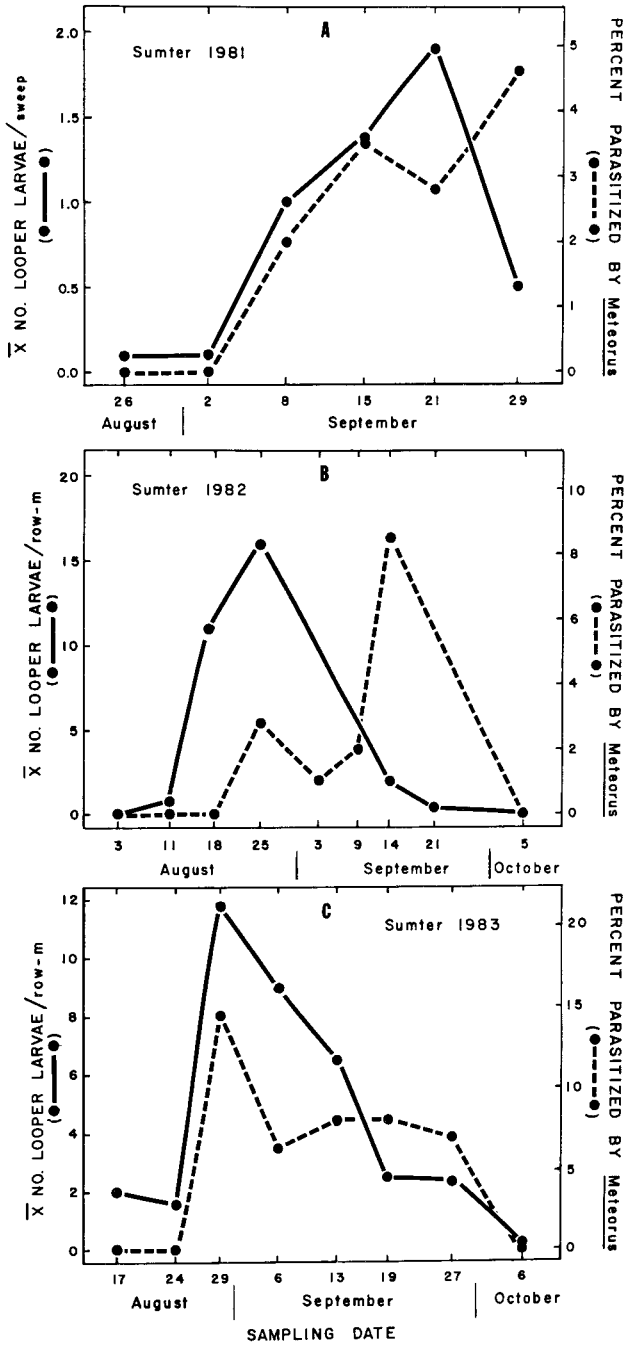

Fig. 2. Population density of *Pseudoplusia includens* larvae on soybean and seasonal incidence of *Meteorus autographae* on *Pseudoplusia includens* larvae near Sumter, SC — A = 1981, B = 1982, and C = 1983.

No SBL larvae were found after 6 October. Percent parasitism by *M. autographae* ranged from 14.3% (29 August) to 6.7% (27 September).

Influence of Host Density on Parasitization

When one female *M. autographae* was exposed to 10, 20, 30, or 40 hosts per 24 hours, a maximum of 10, 20, 28, and 38 hosts were parasitized, respectively. The mean number of hosts parasitized by *M. autographae* per 24 hours increased significantly with each successive increase in host density (Fig. 3). A linear relationship was revealed by regression analysis between the number of larvae parasitized per 24 hours by *M. autographae* and the density of the hosts ($Y = 0.65X + 0.51$, $r^2 = 0.99$, $P < 0.05$). At the lowest (10) and highest (40) host densities, an average of 7 and 26 hosts, respectively, were parasitized per 24 hours by one female *M. autographae.*

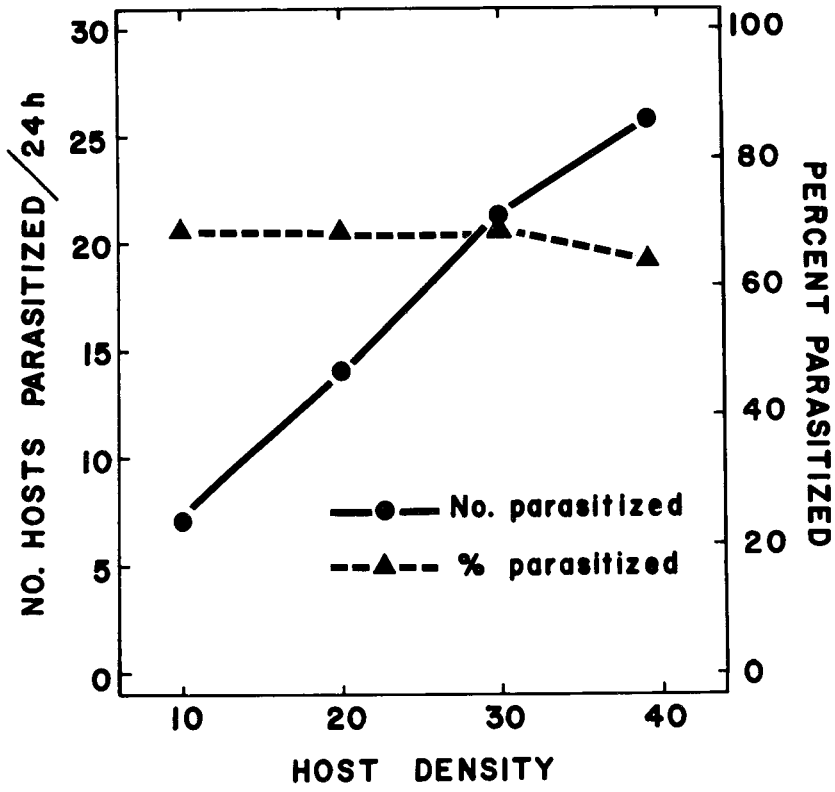

Fig. 3. Influence of density of *Pseudoplusia includens* larvae on parasitization by *Meteorus autographae* under laboratory conditions (27 ± 2°C, 60 ± 10% RH and a photoperiod of L:D 15:9) at Cherry Farm Insectary, Clemson, SC, November 1982 ($Y = 0.65X + 0.51$, $r^2 = 0.99$, $P < 0.05$, where Y = number of hosts parasitized per 24 hours and X = host density).

Percent parasitism of hosts by *M. autographae* was not significantly different among host densities. Percent parasitism was somewhat constant at each host density and ranged from ca. 64 to 70% at host densities of 40 and 10, respectively (Fig. 3). This relationship between host density and percent parasitism by *M. autographae* is important when considering the significance of this parasitoid against the SBL.

DISCUSSION

During this three-year field study, maximum parasitism of SBL larvae by *M. autographae* ranged from 4.6% near Sumter in 1981 to 19.8% near Florence in 1981. Percent parasitism of SBL larvae by *M. autographae* averaged 7.2% during 1983 at the Sumter location. *Meteorus autographae* cocoons and adults were observed frequently in the field at most locations. In fact, the density of unemerged *M. autographae* cocoons was ca. 4 cocoons/row-m on 25 August 1982 at the Florence location (Grant, unpublished data).

In most cases, parasitism of SBL larvae by *M. autographae* was detected 7 to 14 days after SBL larvae were first found in the fields. The presence of green cloverworm and corn earworm larvae as alternate hosts for this parasitoid in soybean fields early in the season may have caused an early build-up of *M. autographae.* In South Carolina, the four primary lepidopteran species found in soybean are the SBL, corn earworm, velvetbean caterpillar, and the green cloverworm (Carner et al. 1974), and each of these species has been reported as a host for *M. autographae. Meteorus autographae* was the most abundant parasitoid of corn earworm larvae collected from volunteer soybean during early season (3 - 16 May 1977) in South Carolina (McCutcheon and Turnipseed 1981). However, they reported that this parasitoid was only occassionally reared from corn earworm collected from soybean during the regular growing season.

Late in the season, percent parasitism of SBL larvae by *M. autographae* apparently may be confounded by disease incidence, as diseased larvae in our study usually died before the successful emergence of this parasitoid.

Augmentative releases of this parasitoid early in the season or conservation through the reduction of insecticides may enhance mortality by naturally-occurring populations of *M. autographae.* In addition to reducing pest populations, parasitization by *M. autographae* has been shown to reduce the amount of defoliation by this pest. Grant and Shepard (1984) reported that late-second to early-third instar SBL parasitized by *M. autographae* ceased feeding ca. 6 to 8 days after parasitization and consumed ca. 78% less foliage than nonparasitized larvae. As a single mortality factor, *M. autographae* may not have a major impact on SBL populations. However, in combination with other natural enemies, *M. autographae* may help to regulate SBL populations below the economic threshold. Further research (i.e., host-parasitoid-pathogen interaction, influence of insecticide usage and agronomic practices on adult populations) is necessary to gain additional insight into the influence of *M. autographae* and other natural enemies on the population dynamics of lepidopterous pests of soybean in South Carolina.

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