

MATING, OVIPOSITION AND PUPATION OF *Scrobipalpuloides absoluta* (MEYR.) (LEPIDOPTERA: GELECHIIDAE)

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ABSTRACT

Behavioral aspects of *Scrobipalpuloides absoluta* (Meyrick) (Lepidoptera: Gelechiidae), an important pest of tomato in South America were studied. Flight activity was performed early in the morning under natural photophase. Mating occurred between 6:00 and 7:00 AM according to a diel rhythm. Females mated once a day and mating lasted, on average, 4 hours and 45 min, ranging from 1 hour and 30 min to 10 hours and 40 min. Eggs were mostly laid isolated on the plants from 6 AM to 6 PM. Clusters of 3 to 5 eggs were rare and peak of oviposition was detected between 3 and 6 PM. There was no oviposition preference for the upper or under surface of the tomato leaflet. Pupation occurred on the leaflets on fresh-market tomatoes or in the soil in a processing tomato plantation.

KEY WORDS: Insecta, Gnorimoschemini, *Lycopersicum esculentum*, tomato worm, diel rhythm.

RESUMO

Acasalamento, Oviposição e Empupamento de *Scrobipalpuloides absoluta* (Meyr.) (Lepidoptera: Gelechiidae)

Foram estudados os comportamentos de acasalamento e oviposição de *Scrobipalpuloides absoluta* (Meyrick) (Lepidoptera: Gelechiidae) em casa de vegetação telada. No campo, observou-se o empupamento das larvas nos cultivos do tomate rasteiro e estaqueado. Os adultos sob fotoperíodo natural apresentaram atividade de vôo no início da manhã. Os acasalamentos ocorreram entre 6:00 e 7:00 h, de acordo com o ritmo diário. As fêmeas acasalaram somente uma vez por dia e a cópula teve a duração média de 4h e 45 min, variando entre 1 h e 30 min a 10h e 40 min. Os ovos foram postos quase sempre isolados nas plantas

Received 10/19/93. Accepted 03/24/95.

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das 6:00 às 18:00h, com pico ocorrendo entre 15:00 e 18:00h. Grupos de três a cinco ovos foram raros. Não houve preferência pela superfície superior ou inferior dos folíolos. Em tomateiro estaqueado o empupamento ocorreu nas folhas; já no rasteiro, as larvas empuparam no solo.

PALAVRAS-CHAVE: Insecta, Gnorimoschemini, *Lycopersicum esculentum*, traça-do-tomateiro, ritmo diário.

INTRODUCTION

Throughout South America, the tomato worm, *Scrobipalpuloides* (= *Scrobipalpula*) *absoluta* (Meyrick), is a key pest in both fresh-market and processing tomato plants. The larvae of this insect are miners which destroy the leaflets mesophyll and the apical buds, stems, flowers and fruits of tomato plants.

Insecticides are not considered highly effective against this species because it developed resistance to these products (Moore 1983). Thus, knowledge of the courtship and mating habits of *S. absoluta* became important for future evaluation of sex pheromones as a tool for control strategy. According to Hickel & Vilela (1991), who studied the courtship behavior of *S. absoluta* under laboratory conditions, virgin females of this species exhibit a calling behavior sequence which is similar to that of other gelechiid species. This activity is matinal-crepuscular and occurs in response to an increase in light during the transition period of night to day. Individuals of this species mate more than once during their lifetime and the most prolific period of the females is for seven days after the first mating when they produce 76% of all the eggs laid (Imenes et al. 1990). Knowledge of many other features on the reproductive biology is lacking.

This research aimed to obtain more information on the mating behavior of this species under natural conditions on tomato plants, daily oviposition of couples isolated on cages or in greenhouses, and the pupating behavior of *S. absoluta* in the field as opposed to previous observations on caged insects.

MATERIAL AND METHODS

Bioassays on mating and oviposition behaviors of *S. absoluta* were conducted in a 4.8 x 5.5 x 21.6 m greenhouse at the Universidade Federal de Viçosa, Viçosa, Minas Gerais State, Brazil (20° 44'S. lat.; 42° 54'W. long. and 630 m alt.). Mating behavior was studied from 29 March to 6 June, 1989 and oviposition was investigated from 17 to 23 July, 1989.

Mating Behavior Studies. Sixty couples of unknown age were observed at random when they initiated mating behavior on the canopy of the flowering fresh-market tomato plants, kept in vases at the greenhouse, for periods of 24h. During the dark period, observations were made under a 3 V red lamp which was used to minimize interference with the insect behavior. Couples were observed during 13 days (from 5:00 AM to 7:00 PM) and 13 nights (from 7:00 PM to 5:00 AM) not consecutively. Each day or night was considered a replicate. Mean temperature was 23.8°C (range of 23 to 25°C) and mean relative humidity was 75.4% (range of 65 to 83%).

Oviposition Observations. Fourteen newly emerged couples were isolated for oviposition studies. Each couple was maintained in a Petri dish of 100 mm diameter lined with filter paper and covered by a 200 ml acrylic and transparent cup. A cotton swab which was submerged in a 10% water-honey solution was placed inside each container for adult feeding, with one tomato leaflet as an oviposition substrate. The base of the leaflet was involved by a piece of wet cotton and then, placed on 10mm diameter plastic lid to avoid desiccation. Each leaflet was previously observed in the laboratory, under a stereoscopic microscope with 16X magnification, to make sure that the leaflet was free from *S. absoluta* eggs. The whole set was placed on a wooden bench in the greenhouse.

During the 24h observations, the couples were transferred every 3h to a new pot containing one leaflet, as previously described. The material was examined under stereoscopic microscope with 16X magnification. At night, when the couples were transferred, they were exposed to the red lamp during 1 min. Mean temperature was 14.3°C (range from 7.3 to 23.9°C) and mean relative humidity was 76.4% (range from 40 to 96%). The oviposition behavior was monitored during seven days after the first mating.

Pupation Studies. Pupation was studied in four tomato plantations; two of them were processing tomato plantations in an irrigated area on the Vale do São Francisco (at 9° 9'S. lat.; 40° 22'W. long. and 365.5m alt.) and the other two were fresh-market tomato plantations in São Paulo State (23° 6'S. lat.; 46° 15'W. long. and 624 m alt.). In the first two regions, observations were made from 8-15 October, 1989 and in the other areas, from August to November, 1990.

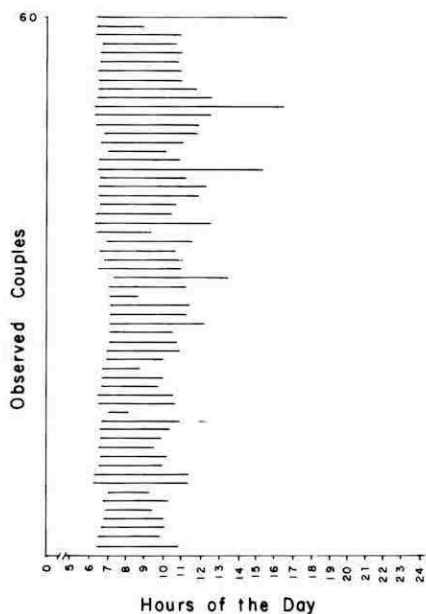


Figura 1. Mating time and mating duration of *Scrobipalpuloides absoluta* in greenhouse experiments. Each bar represents the beginning and the duration of mating for each couple (n=60).

RESULTS AND DISCUSSION

Mating Behavior Studies. The first flight which sets up the beginning of the dispersal activities of males and females *S. absoluta* occurred after 5:00 AM. Adults exhibited a diel rhythm for mating, which started during the first two hours of photophase. Mating did not occur during the night.

Females generally remain still on the canopy of the tomato plants and start the calling behavior as described by Hickel & Vilela (1991). Males always initiated flying in groups towards females at 5:45 AM and flight ended between 8:20 AM and 4:50 PM (on average at 11:00 AM). The average mating duration was 4h and 45 min., but it lasted from 1 h and 30 min to 10 h and 40 min. (Fig. 1). Each female copulated with a single male and mating was continuous. These results contrast with those of Bahamondes & Mallea (1969) who found the average duration of mating to be 15 min in the field. Although our experiments were set up in a greenhouse, these data are so different that this aspect deserves further investigation under field conditions.

Adults of *S. absoluta* exhibited dispersal behavior, courtship and mating at the aural twilight, as previously observed (Imenes et al. 1990, Hickel & Vilela 1991). However, these observations differed from the current literature (Herrera 1963, Vargas 1970, Rázuri & Vargas 1975, Coelho & França 1987). These authors claimed that this species has crepuscular to nocturnal habits and stay protected under the tomato plant foliage during the day. However, they have not set up specific experiments to study the mating habits of *S. absoluta*.

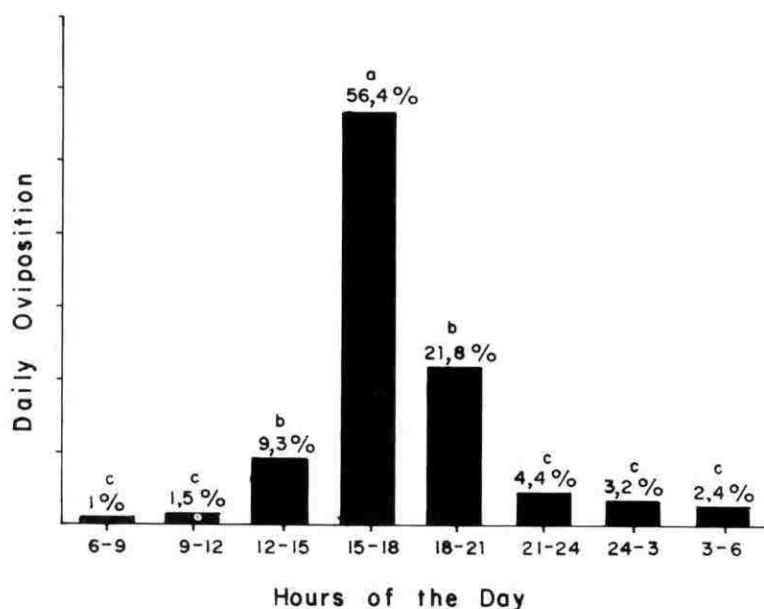


Figure 2. Daily oviposition periodicity of *Scrobipalpuloides absoluta* in greenhouse experiments (n=98). Percentages followed by the same letter do not differ by Duncan's multiple range test ($P < 0.01$).

Oviposition Observations. Similar to the mating, *S. absoluta* also presented a diel rhythm for oviposition, which was more frequent during the photophase (Fig. 2) and tended to occur mostly at about 4 h after the mating peak. From a total of 1.539 eggs collected, 49.8% were located on the upper surface while 50.2% were on the lower surface of the tomato leaflets. They were deposited singly, so that groups of three to five eggs were rare. These results are similar to those obtained by Bahamondes & Mallea (1969) under laboratory conditions.

Pupation Studies. In the irrigated processing tomato plantations of the Vale do São Francisco it was observed that the larvae pupated in the soil as opposed to what occurred in the fresh-market tomato plantation. In this place the larvae built a cocoon and pupated on the leaf surface or inside the mines. When pupation occurred in the soil the larvae never built the cocoon and generally were found at the soil surface under the foliage or at a depth of 1-2 cm. This behavior is probably related to the proximity of the processing tomato plants to the soil which offers adequate condition and protection for these pupae.

In the fresh-market tomato fields, it was observed a significant difference by the X^2 test ($P < 0.01$) in the frequency of *S. absoluta* pupae on the upper and lower surface of the leaves (15.3% and 84.7%, respectively for 1.634 collected pupae). Information on the pupating behavior of *S. absoluta* are rather controversial in the literature. According to Vargas (1970) and Quiroz (1976), in Chile, the larvae pupate in the soil involved by a cocoon made by soil particles and other fragments. Rázuri & Vargas (1975), in Peru, mentioned that when the larvae are fully developed, they leave the host plant and pupate on the soil surface, forming a cocoon. According to Coelho & França (1987) in the fresh-market tomato plants, pupation occurred more frequently in the leaves and rarely in the stems and fruits.

In conclusion, we observed some difference between our findings and reports in literature in time and duration of mating of this species. We also found that *S. absoluta* presents a diel rhythm of mating and oviposition and that it exhibits two types of pupation behavior whether on fresh-market or processing tomato plantations.

ACKNOWLEDGEMENTS

The first author wishes to express his gratitude for the grant provided by CAPES in the form of a scholarship. We also are grateful to those persons who contributed with the conduction of the experiments.

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