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Research on the Biological Properties of Scatella Tenuicosta Bennison in Seedling Production

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Abstract. This paper systematically described the biological properties of Scatella tenuicosta for the first time. The experiment result indicated that when temperature was set 20 ℃ from 7 am to 19 pm and 16 ℃ from 19 pm to 7 am, rhythmically across light day and dark night with 90% relative humidity, the development process of Scatella tenuicosta was as follows, egg period 2.8±0.7 d, larvae period 15.7±1.9 d, pupa period 4.5±1.5 d. The lifetime of adult male generally lasted 4 d or 5 d, the adult female 14-17 d, the longest even up to 22 days, including 14 day-long oviposition period. During the growth period of watermelon grafted seedlings (December to next March), 1 or 2 generations of Scatella tenuicosta would harm the seedlings, and 5 or 6 generations throughout the whole year. Besides, high temperature and drying environment would be conducive to the occurrence and threatening of the Scatella tenuicosta.

Introduction

Scatella tenuicosta Bennison originally are small insects feeding on the moss in humid environment such as streams or ditches. However, with the rapid development of modern facility agriculture, the constant warm and humid environment in greenhouse provides Scatella tenuicosta Bennison with the suitable living condition. And it moved from its original habitat to the greenhouse, thus harming the tender root, stem and leaf of watermelon grafted seedlings and causing extensive lodging and death, and the damage rate of seedlings even reaches to 60-80 % sometimes. It gradually becomes a major pest to horticultural seedlings and brings great economic losses to Wuhan China.

In Spain and UK, some preliminary studies were conducted on the identification of this pest, its host plants, symptoms, sources and suitable growing conditions [1,2,3]. In China, only Hu Xue-you carried out taxonomical study of ephydridae in China[4]. However, no studies were reported so far on the morphology, biology, ecology and controlling methods of Scatella tenuicosta.

In order to effectively control the serious harm of Scatella tenuicosta to the seedlings in China's facility agriculture, we carried out the systemic research on its biological properties from 2010 to 2012, and the report is listed below.

Materials and Methods

Materials. *Pests.*Scatella tenuicosta, caught in Wuhan Weierfu Biological Technology Co., Ltd. in China.

Seedlings. The healthy watermelon grafted seedlings, the seedlings with pests, and the plastic hole trays are provided by Wuhan Weierfu Biological Technology Co., Ltd. and Wuhan Weinong Seedling Company.

Experimental Equipment.

Climatic cabinate. Model: HP1000GS-B. Manufacturer: Wuhan Ruihua Equipment co., Ltd.

Mesh cover to rear insects. Sixty mesh nylon screens were tailored into a cover with the length 108 cm, width 38 cm and height 45 cm, in order to adapt to the interior of climatic cabinate. And it had a break above in the middle, could be separate into two rooms by cardboard when needed.

Stereomicroscope. Model: XTB-1. Manufacturer: Jiangnan Optical Instrument Factory, China.

Yellow sticky traps. Specification: 20 cm·25 cm. Manufacturer: Beijing Zhongjiesifang Biotechnology Co., Ltd.

Methods. Four artificial climate plant growth chambers were divided into four groups, and temperature was set 20℃ from 7 am to 19 pm and 16℃ from 19 pm to 7 am, rhythmically across light day and dark night with 90 % relative humidity. The temperature, humidity and light conditions were controlled the same with those in greenhouses. And then we observed the development stages of Scatella tenuicosta from egg, larvae, pupa to adult and cleared the development of pest states compared with that in greenhouses. The observation in laboratory was synchronized with that in greenhouses, starting from sowing in greenhouse in early December and ending in next April when seedlings could be moved out of greenhouse.

Observation of egg development stage. In the climatic cabinate, the watermelon seedlings with larvae and healthy seedlings growing on the plastic hole tray are separated in 120 equal holes(Same below), which are put on the both sides of white porcelain on the upper, middle and under layer of the climatic cabinate. And specially-made mesh cover is used to cover all the watermelon grafted seedlings. When the adult pests appear in a large number, were drove into the other side of healthy seedlings. And then cardboard was inserted from the above, let adult pests mate and oviposit on the soil substrates on which the healthy seedlings lived. Every 6 hours, we took 4 planting holes on each layer out of the chamber and observed the changes until larvae hatched (Straticulate and punctiform coagulation accumulated on the substrate). Egg development stage refers to the number of the days that the larvae hatched out. We observed this stage on the upper, middle and under layer of the artificial climate plants growth chamber, which could be regarded as the repeated 3 times experiments, and the average value was taken (the same below).

Observation of larval stage.

We put 120 holes watermelon seedlings with just hatched larvae on the upper, middle and under layers of the second climatic cabinate, and every 24 hours, we took 2 holes from different layers to observe the larvae development in substrate and seedling root till the pupation. The number of days that the larvae develop into pupas is called the larval stage.

*Observation of pupa stage.*Those 120 holes watermelon seedlings seriously damaged by larvae and with waterlogging on roots were put on the upper, middle and under layers of the third chamber, and 4 of them are taken out every 24 hours to be checked and collected into the substrate of nutritive plate with mesh covered till adult emergence. The period from larvae to pupa is namely called pupa stage.

*Observation of adult stage.*Forty holes watermelon seedlings were put on the upper, middle and under layers respectively in the fourth climatic cabinate. According to the test method in egg development stage, we calculated the adult quantity after the adults had been gathered in the mesh cover of healthy seedlings, and then observed them every 24 hours till all the adults die, thus, the adult stage was calculated.

*Observation of the law of adult pest growth and decline.*One watermelon seedling greenhouse was selected as the observing target in Veierfu and Weinong Seedling Company respectively. Yellow sticky traps were hung at 0.5 m above seedbed; there were 250 Yellow sticky traps in the total 5000 m^2 seedbed of each greenhouse, one Yellow sticky trap every 2.5 m and 24 pieces uniformly distributed parallel. We checked the quantity of Scatella tenuicosta captured by Yellow sticky traps each day. The adults have been calculated would be marked in red to avoid duplicate record. Finally, by the statistical analysis, we found out the law of Scatella tenuicosta growth and decline.

Results

Morphological characteristics.*Adult.*Adult body was black with length about 4.0 mm. The males were slightly smaller than females. And each of them had two pairs of orbital bristles, one thick genalbristle, smoked wings with iridescent reflecting, five suborbicular pale white spots arranged in circle on each wing surface (Fig. 1. A).

*Egg.*Egg was about 0.4mm long, near olivary, white, thin reticulation on surface.

*Larvae.*Larvae were 0.6-12 mm long, footless and elongated. Transparent body wall, sepia intestine (The larvae feeding on humus in substrate) or colorless intestine (The larvae feeding on tender root and stem heart) or light green intestine（The larvae feeding on mesophyll of seedings） could be seen. First instar larvae had metapneustic type, 2nd and 3rd instar larvae were with amphipneustic type. One pair of black flat arthropod mouthparts with a row of serration were on its leading edge, and last two pieces of bone of mouthparts coalesced together, and feeding organ was flat shovel type (Fig.1.B).

*Pupa.*Pupa was about 3 mm-4 mm long, light brown, and there were two tapered ends and two black stomas at the end of the abdomen(Fig.1.C).

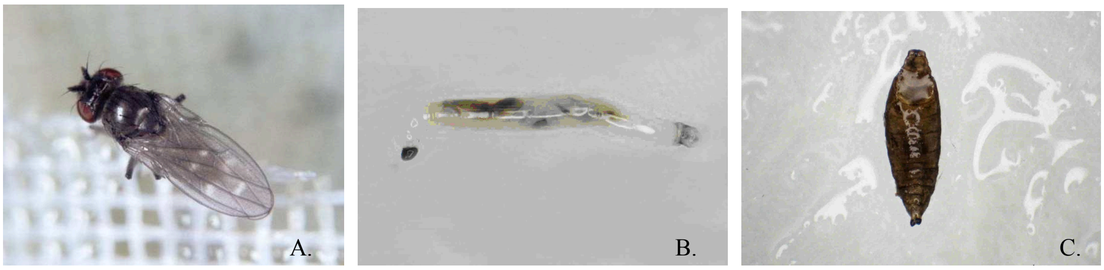

Fig.1 Morphological characteristics of Scatella tenuicosta

A. Adult; B. Larvae; C. Pupa

Habit and Occurrence Rule.*Egg*. When temperature was 16-20 ℃, the egg period lasted 2.8±0.7 d with the hatching rate up to 94.3%.

*Larvae.*The just hatched larva was small with length of 0.6mm, while the mature one was 10-12 mm long. When temperature was 16-20 ℃, the larvae period lasted 15.7±1.9 d. The larvae enjoy edliving in seedling substrate with rich humus and humidity environment. Young larvae fed on humus, while mature ones enterd rhizosphere of seedlings and fed on rhizosphere stems, leading seedling damping-off caused by germs invading (Fig.2.A). The larvae bored through stem pith upwards, finally leading the stem and leaf withered, and then the larvae continued their activities on another seedling or pupate under the topsoil. Besides, the larvae ate the leaf mesophyll near to the soil, causing yarn net blade then death (Fig. 2.B). Larvae natural mortality rate was only 5.5 % or so.

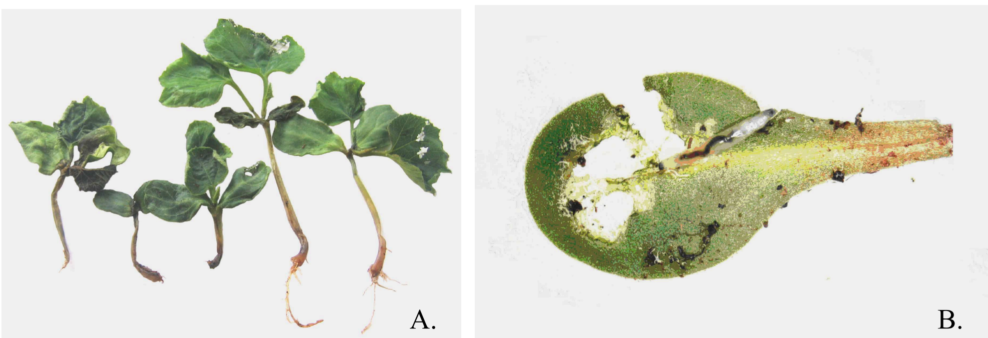

Fig. 2 The damage of Scatella tenuicosta larvae to grafting watermelon seedlings

A.The damaged seedlings; B. The damaged blade.

*Pupa.*When temperature was 16-20 ℃, pupa stage lasted 4.5±1.5 d. Pupation site was located in the topsoil near the sidewall of nutritive hole, pupa without cocoon.

*Adult.*Adult pest eclosion occured from the evening to the next morning with eclosin rate 78.5 %. The ratio of male and female was 1:0.37. After eclosion, the pest crawled and licked on the seedling substrate, flies fast among the blades and seedlings. During this period, the pest was sexually active and mates through knapsack mode. The male climbed on the female’s body, with its end of the abdomen bent like hook mating with the female. In addition, the adult female had the habit of multiple mating and spawning. Each one could spawn more than 200 eggs in 14 day-long oviposition period with the average of 18.6 eggs a day. When temperature ranged from 16 ℃ to 20 ℃, the lifetime of adult male generally lasted 4 or 5 days, the female 14days-17days, with the longest up to 22 days.

Yearly Development Rule. The survey result showed that maximum quantity of Scatella tenuicosta Bennison occurs in mid-January and mid-February when the first and second true leaf of two batches of watermelon grafted seedlings comes out, and the young stem with low lignification is vulnerable to the hatched larvae. Besides, the quantity peak occured in mid-May, late October and late December as well. (Fig.3)

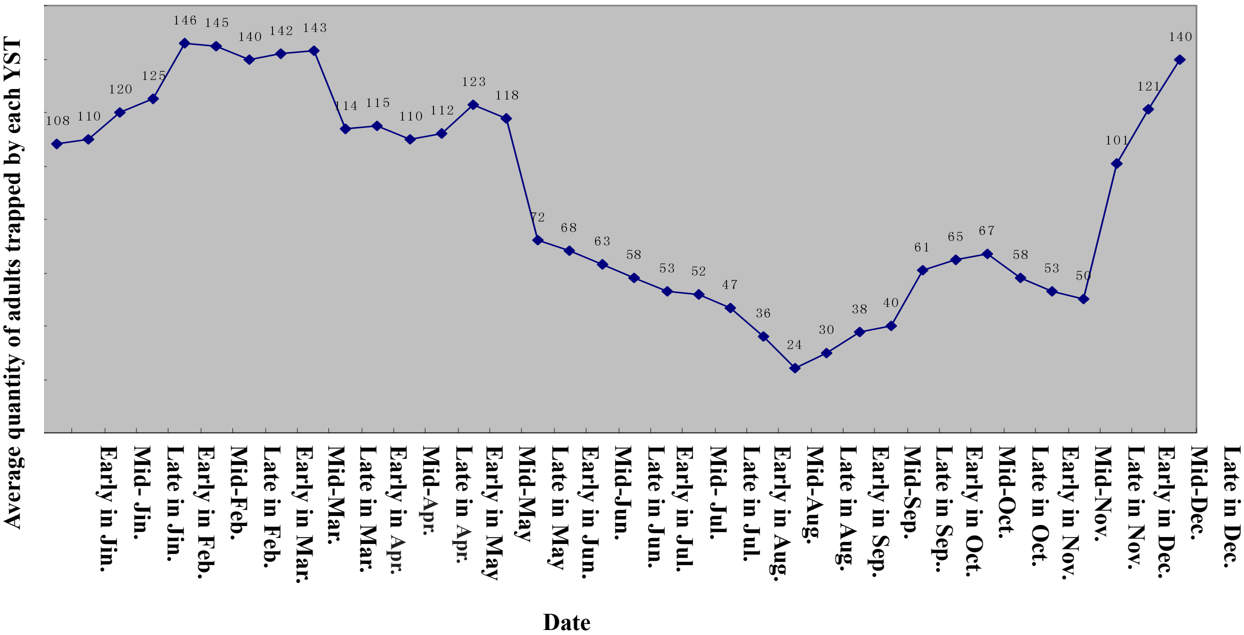

Fig. 3 The occurrence rule of Scatella tenuicosta

Discussion

The observation was conducted in artificial conditions when temperature was set 20 ℃ from 7 am to 19 pm and 16 ℃ from 19 pm to 7 am, rhythmically acrossed light day and dark night, with 90 % relative humidity. We observed and cleared the four development stages of Scatella tenuicosta for the first time. And the development process is as follows, Egg period 2.8±0.7 d, Larvae period 15.7±1.9 d, Pupa period 4.5±1.5 d. The lifetime of adult male generally lasted 4 or 5 days, the adult female 14-17days, the longest even up to 22 days, including 14 day-long oviposition period. The result was consistent with the observation in the greenhouse under the same condition, and the coincidence rate was 93.7 %.

According to the study of the development stages of Scatella tenuicosta and the observation of yearly development rule, during the growth period of watermelon grafted seedlings (December to next March), 1 or 2 generations of Scatella tenuicosta would harm the seedlings, and 5 or 6 generations throughout the whole year. High temperature and drying environment would not be conducive to the occurrence and threatening of the Scatella tenuicosta.

The study of living habit and development rule of Scatella tenuicosta provided the scientific support for making effective prevention and control project, including prevention method and time, etc.

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