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STUDY ON BIOLOGY OF ONION THRIPS, *THRIPS TABACI* LINDEMAN (THYSANOPTERA: THRIPIDAE) ON CUCUMBER (VAR. SULTAN) IN LABORATORY CONDITIONS

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Abstract: Onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae), is a major pest of greenhouse crops in Iran. It is one of the major limiting factors affecting yield of cucumber. A study on the biology of this pest was carried out in laboratory condition (25±1°C, 70±5% RH and 16:8 h (L: D) photoperiod) on cucumber (var. Soltan) in 2007. This survey showed that *T. tabaci* completed the life cycle from 18 to 21 days. Duration of life cycle including egg, L_1, L_2, prepupa, pupa and adult was 2.82±1.33, 1.95±1.42, 4.12±0.92, 1.03±1.44, 1.97±0.91 and 14.4±3.13 days. Females could produce about 26.82±5.56 eggs. Thrips sex ratio progeny revealed no presence of males, since only females emerged. Knowledge on the biology of this insect pest would contribute to a better understanding of the relationships between the crop and the environment, and knowledge on this insect pest biology would allow establishing control strategies in a future integrated pest management program (IPM).

Key words: *Thrips tabaci*, biology, cucumber, laboratory, Iran

INTRODUCTION

The onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae), is a worldwide pest of vegetable crops. It ranges from tropical and subtropical areas into the temperate regions. *T. tabaci* is an important pest of field and greenhouse crops all around the world. It causes damages directly by feeding and indirectly by transmitting tomato spotted wilt virus (TSWV), but only the larval stage can transmit this virus (Sakimura 1963). It is difficult to control this pest with insecticides because of its small size and cryptic habits (Theunissen and Legutowska 1991; Parker *et al*. 1995; Lewis 1997; Legutowska 1997; Richter *et al*. 1999).

Onion thrips in Iran was first found in 1938 (Afshar 1938). Believed to have originated in the Mediterranean region, the onion thrips is a cosmopolitan, world wide species. Onion thrips feeds on many cultivated crops as well as on uncultivated plants, at least of 25 families (Shelton and North 1987). This species is highly polyphagous; it attacks the cucumber, onion, leek, tomato, potato, tobacco, peach, cabbage, lucerne and many ornamental plants. *Thrips tabaci* causes serious damage on cultivated crops, mainly family Alliaceae, like onion and garlic (Lu and Lee 1985) and on family Brassicaceae, like radish, cabbage and cauliflower (Mustafa 1986; Shelton *et al.* 1998) in many parts of the world. Feeding of *T. tabaci* destroys the epidermal cells of onion, causing the leaf whitening (Ghabn 1948). Adults and larvae suck the contents of subepidermal cells. The male is very rare (Nault *et al*. 2006). Reproduction is entirely parthenogenesis (Zimmerman 1948).

In some parts of the world *T. tabaci* populations are composed of females. Females can produce about 80 eggs. This reproductive aspect is very important, because a single *T. tabaci* population can be generated in very short time (Zimmerman 1948; Yakhontov 1967).

MATERIALS AND METHODS

The biology of *T. tabaci* in laboratory condition was carried out at 25±1°C, 70±5% RH and 16:8 h (L:D) photoperiod on cucumber (var. Soltan) in 2007. The stock culture of *T. tabaci* was maintained on cucumber leaf disk. The uniformly aged *T. tabaci* individuals were obtained by using rounded plastic cages, 5.5 cm in diameter, and with a meshed hole in the lid to allow air exchange. The rounded plastic cages were filled with a 0.5 cm-thick-layer of 0.7% water agar. Freshly excised cucumber leaf discs of 5 cm in diameter were placed upside down onto the water agar. Ten adult *T. tabaci* females were picked up

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from the stock culture and placed on the cucumber leaf discs for 24 h in each rounded plastic cage for investigation of egg laying. The rounded plastic cages were kept in climatically controlled chambers. The females were gently transferred to new similarly prepared cages. The eggs obtained in the old cages were reared further until the thrips reached the age desired for the experiments. Each experience had 10 repeation and lastly, data analyzed by SAS (SAS Institute Inc. 1985). For identification of this species, adults were treated in AGA (a mixture of 10 parts of 60% ethyl alcohol with 1 part of glycerin and 1 part of acetic acid), dehydrated and after mounted in Hoyer's medium on microscope slides. In this species belonging to suborder Terebrantia, the third and fourth instars were inactive, do not feed, and had external wings; the third instar is called the prepupa, and the fourth the pupa (Borror *et al*. 1989). We used this characters for identification of stages in biology.

RESULTS AND DISCUSSION

1. Diagnosis of *Thrips tabaci* Lind. (Fig. 1)

Characteristics seen under microscopic examination included: 7-segmented antennae, I pale, II–VII yellowish brown, III–V with pale bases; antennal segements III–IV had forked sense cones; two pairs of ocellar setae; pronotum with two pairs of posteroangular setae; posterior fringe cilia on forewings wavy; forewings with 4–6 distal setae; tergite II with 3 lateral marginal setae; tergite VIII with a complete comb; ctendia present on abdominal segments V–VIII; sternites lack accessory setae. *T. tabaci* could be distinguished from other *Thrips* spp. by the closely spaced rows of microtrichia on the pleurotergites (Moritz *et al*. 2004).

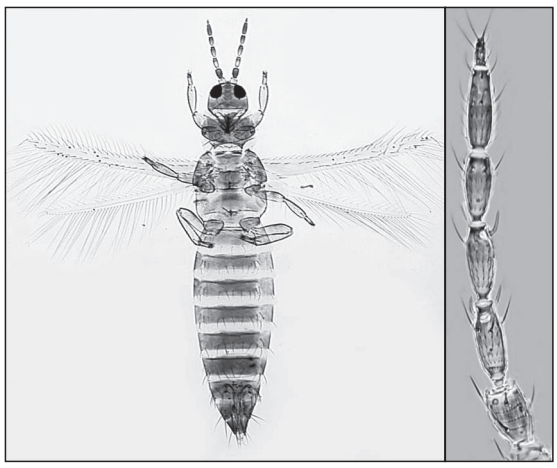

Fig. 1. *T. tabaci*, adult and antennae (female)

2. Life cycle of *T. tabaci* L. (Table 1 and Figs. 2–8)

Life stages of the onion thrips include egg, two larval instars, two pupal instars, and the adult. The adult, egg, and two larval stages were found on the hosts. The pupa is an inactive stage; it occurs in the soil or among leaf litter.

Eggs. Females had an ovipositor with saw-like structure that helped to make an incision in plant tissue for egg laying. Eggs were placed singly just under the epidermis of succulent leaf of cucumber, flower, stem or bulb tissue. Eggs were elliptical, approximately 0.25 mm in length. They were whitish at deposition and change to an orange tint as development continued (Bagheri *et* al. 2002; Arrieche *et al*. 2006). Hatching occurred in 2.82±1.33 days in laboratory conditions (Table 1, Fig. 2).

Table 1. Life stages of *T. tabaci* on cucumber (var. Soltan) under 25±1°C, 70±5% RH and 16:8 h (L:D) photoperiod in laboratory conditions

Life stage [day]	Mean±SE
Egg laying	26.82±5.56
Egg hatching	2.82±1.33
L1	1.95±1.42
L2	4.12±0.92
Prepupa	1.03±1.44
Pupa	1.97±0.91
Adult	14.40±3.13

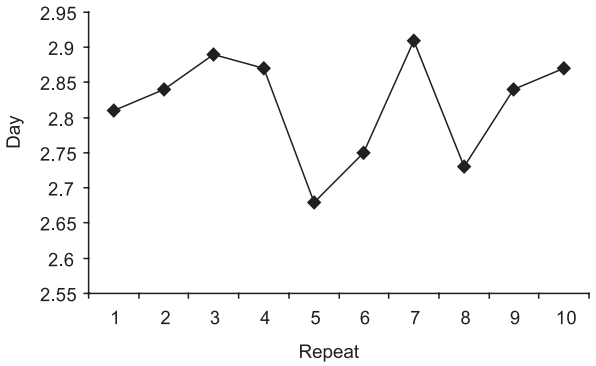

Fig. 2. Process of egg hatching of *T. tabaci* per day in 10 replicate

Larvae. There were two larval stages. Larvae were whitish to yellowish. L1 development was completed in about 1.95±1.42 days and L2 was 4.12±0.92 respectively (Table 1 and Figs. 3–4).

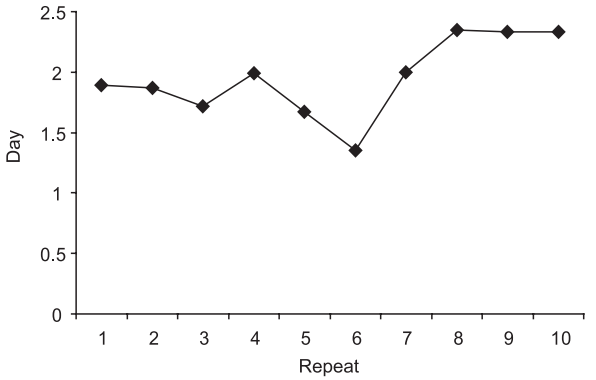

Fig. 3. Process of L_1 of *T. tabaci* per day in 10 replicate

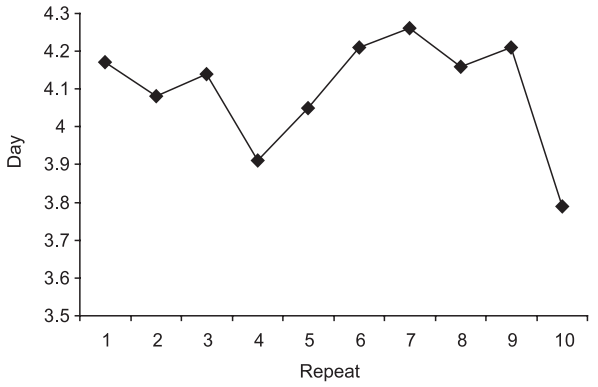

Fig. 4. Process of L_2 of *T. tabaci* per day in 10 replicate

Prepupa and pupa. There were two inactive, non-feeding stages called prepupa and pupa. They occurred primarily in the soil. Combined prepupal and pupal development is completed in 1.03±1.44 and 1.97±0.91 days (Table 1, Figs. 5–6).

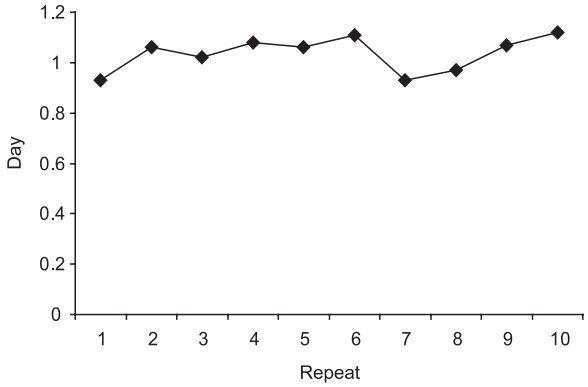

Fig. 5. Process of prepupa of *T. tabaci* per day in 10 replicate

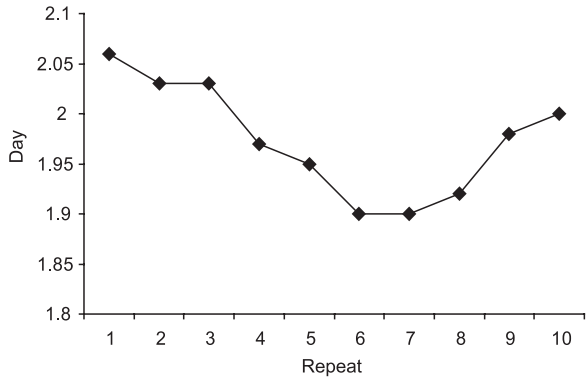

Fig. 6. Process of pupa of *T. tabaci* per day in 10 replicate

Adults. Adults were about 0.9 mm long. Their body color ranged from pale yellow to light brown; males were exceedingly rare. Adult development was completed in about 14.4±3.13 days (Table, Fig. 7). Females live for 12 to 17 days and each of them could lay about 26.82±5.56 eggs. The egg was inserted by the female in soft plant tissue; it was slightly protuberant and visible to the unaided eye.

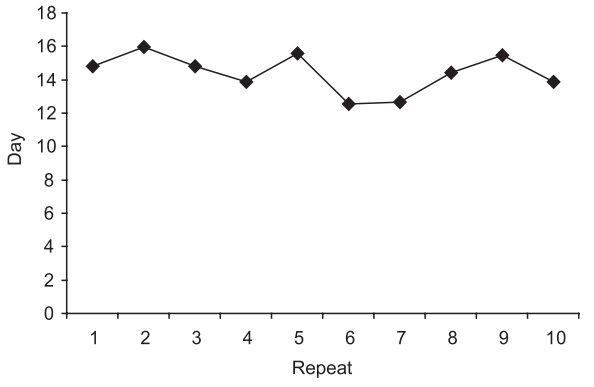

Fig. 7. Process of adult of *T. tabaci* per day in 10 replicate

In heated glasshouses, generations (up to 14 per year) succeed at a rapid rate. This species usually overwinters as females sheltering in the soil (Bagheri *et al*. 2002). The entire life cycle (egg to adult) required about 19 days (Fig. 8). Large populations are able to develop quickly under Iranian weather conditions where there are many overlapping generations throughout the year. Reproduction of this species in Iran is mostly through a process called parthenogenesis in which females are able to reproduce without mating. As a result, populations consist of females at a ratio of 1 male per 1000 females (Clausen 1978; Lewis 1997). The results of study on biology of this pest on onion host in Venezuela showed that the average development time of *T. tabaci* from egg to adult lasted 14.2±1.7 days (egg = 3.2±0.52; larvae I = 2.7±0.21; larvae II = 2.9±0.18; prepupae 1.9±0.33; pupae = 3.5±0.45 days). Also, average values for preoviposition, oviposition and postoviposition were 2.0, 8.0 and 2.0 days, while the average egg number laid per female during its life was 39±10.5. The average adult female longevity was 11.5±1.8 days (Arrieche *et al*. 2006). Life stages of *T. tabaci* on onion are longer than cucumber and it showed that host was important in biology of this pest; therefore, it could produce more generation on cucumber.

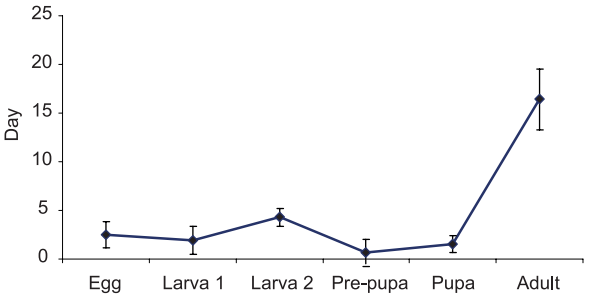

Fig. 8. Process of life cycle of *T. tabaci* from egg to adult on cucumber leaf

Larvae and adults were found mainly in the narrow space between the leaves of cucumber, in flowers and on the underside of foliage. Onion thrips fed by piercing individual cells and sucking the contents. These cells lose their normal color, and when many adjacent cells were damaged, the tissue appeared as whitish spots or silvery spots or streaks. Infested foliage was disfigured by many silvery marks corresponding to groups of empty cells.

This symptom was typically associated with the presence of specks of black frays. Flower petals might also become discolored and deformed. In the open, populations might be very large during hot, dry weather (Lewis 1997). Onion thrips prefered to feed on the young plant tissue on the newest emerged leaves. When the leaf grew, the previous damage produced by the thrips enlarged, leaving empty spaces in the surface of the leaf. The appearance of the damage was silvery patches. When damage was severe, these small patches could occupy most of the surface of the leaf and the plant could not adequately photosynthesize. The plant lost more water than normal through the damaged tissues and plant pathogens penetrate the injured plant easily. This pest is also important as a vector of tomato spotted wilt virus (TSWV). Only the larvae can acquire the virus (Lindorf 1932; Lockwood 1956; Zawirska 1980; Shelton and North 1987; Waterhouse 1987; Karadjova and Hristova 1998). Mostly in glasshouses, *T. tabaci* colonies could be very large and they could often cause very severe direct and indirect damage (Lewis 1997).

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POLISH SUMMARY

BADANIA NAD BIOLOGIĄ WCIORNASTKA TYTONIOWCA *THRIPS TABACI* LINDEMAN (THYSANOPTERA: THRIPIDAE) PROWADZONE NA OGÓRKU (ODM. SULTAN) W WARUNKACH LABORATORYJNYCH

Wciornastek tytoniowiec, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) jest najważniejszym szkodnikiem upraw szklarniowych w Iranie. Jest jednym z głównych czynników ograniczających plon ogórka. Badania nad biologią szkodnika przeprowadzono w warunkach laboratoryjnych [25±1°C, 70±5% RH i 16:8 h (L:D) fotoperiod] na ogórku (odm. Soltan) w 2007 roku. Wykazały one, że cykl życia *T. tabaci* wynosi od 18 do 21 dni. Cykl życia włączając fazy jaja, L_1, L_2, prepupy, poczwarki i osobnika dorosłego trwa odpowiednio 2,82±1,33, 1,95±1,42, 4,12±0,92, 1,03±1,44, 1,97±0,91 oraz 14,4±3,13 dni. Samice mogą znosić około 26,82±5,56 jaj. Badanie struktury potomstwa wykazało brak samców, wylęgały się tylko samice. Znajomość biologii tego szkodnika pozwoli lepiej zrozumieć zależności pomiędzy uprawą a jej środowiskiem. Wiedza taka jest niezbędna do opracowania, w przyszłości w ramach IPM, strategii zwalczania wciornastka tytoniowca.