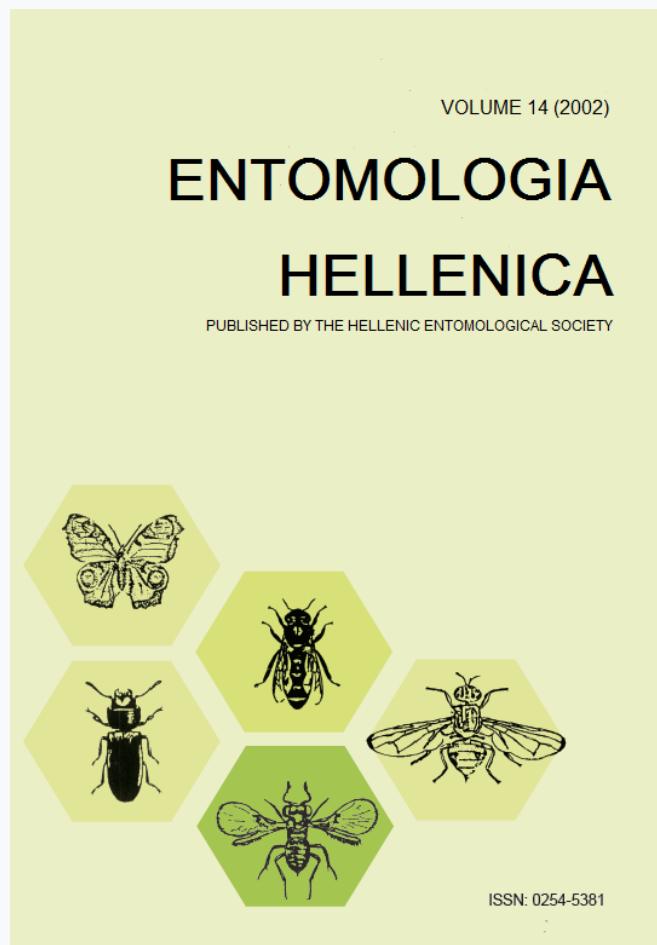


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Leaf Preference of *Heliothrips haemorrhoidalis* (Thysanoptera: Thripidae) on *Viburnum tinus*

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ABSTRACT

The leaf preference of larvae, pupae and adults of *Heliothrips haemorrhoidalis* (Buché) (Thysanoptera: Thripidae), a serious pest of several ornamental plants, were studied on *Viburnum tinus*. Leaves were sampled for thrips from the base, middle and distal end of viburnum twigs at weekly intervals from April 11 to September 15, 2000. The population of this thrips was observed at high levels of between 10 to 76 thrips per leaf, till the middle of June when it sharply declined to zero, probably due to high temperatures. Higher populations developed on the basal than on the middle leaves. The lowest populations were recorded on the distal leaves. The predator *Orius vicinus* (Ribaut) (Hemiptera: Anthocoridae) was recorded in low numbers and therefore its effect on thrips populations was considered negligible.

Introduction

Heliothrips haemorrhoidalis Bouché (Thysanoptera: Thripidae) is a New World species occurring in subtropical and tropical areas and is now widespread in much of Europe, North Africa and Palestine (Bodenheimer, 1951; Denmark, 1999).

It is a highly polyphagous species and its host range includes citrus, avocado, mango, guava, *Vitis* spp., and many ornamental plants like viburnum, azalea, magnolia, ficus, hibiscus, dahlias, phlox, orchids, begonia, cyclamen, evonymus, and also species of Euphorbiaceae and Liliaceae. It also attacks tea, coffee, cocoa, and even *Pinus* spp., acacia, myrtus, pistacia and oak (Bodenheimer, 1951; Mound, 1976; Denmark, 1999).

The female is elongate, 1.3-1.7 mm long, dark brown-black in colour with reticulated body (Bodenheimer, 1951). This species reproduces parthenogenetically giving only female offspring

whereas males are unknown (Buffa, 1911; Bodenheimer, 1951).

H. haemorrhoidalis passes through two larval stages, a prepupal and pupal before reaching adulthood.

H. haemorrhoidalis live and feed on the lower surface of leaves, resulting in a white-gray discoloration of the upper leaf surface. They can also feed on fruits causing similar symptoms. On the infested areas where colonies develop many small black dots can be seen. These are the droplets of black liquid which fall off the tip of larvae abdomen (Bodenheimer, 1951; Blank and Gill, 1997; Faber and Phillips, 1998; Denmark, 1999).

According to Rivnay's (1935) study the optimal temperature range for reproduction occurs between 20-28°C. For preimaginal development the optimal range is 16-26°C. The temperature threshold for its development has been estimated as 11°C (Rivnay, 1935) and 13.2°C (Del Bene et al., 1998).

In Greece this species is a known pest of citrus (Issaakidis, 1936; Pelekassis, 1962). In 1999, we recorded this species in high numbers on shrubs of *Viburnum tinus* L. (Caprifoliaceae) in the

TABLE 1. Percentages of the total, larval, pupal and adult population of *Heliothrips haemorrhoidalis* found on leaves from the top, middle and basal part of *Viburnum tinus* twigs from April 4 to June 28, 2000, in the Campus of Agricultural University of Athens.

Sampling date	Total (%)			Larvae (%)			Pupae (%)			Adults (%)		
	Top	Middle	Base	Top	Middle	Base	Top	Middle	Base	Top	Middle	Base
11-4-2000	7 a*	40 b	54 b	7 a	39 b	54 b	0 a	40 b	60 c	27 a	55 b	18 c
17-4-00	4 a	36 b	59 c	5 a	40 b	55 b	0 a	11 b	89 c	14 a	14 a	71 b
24-4-00	5 a	59 b	36 c	5 a	68 b	27 c	1 a	36 b	63 c	14 a	44 b	42 b
2-5-2000	0 a	27 b	73 c	0 a	33 b	67 c	0 a	33 b	67 c	0 a	18 b	81 c
6-5-00	5 a	8 a	87 b	0 a	0 a	100 b	6 a	0 b	94 c	9 a	20 b	70 c
15-5-00	6 a	41 b	53 b	0 a	33 b	67 c	0 a	30 b	70 c	10 a	46 b	44 b
22-5-00	9 a	37 b	55 b	0 a	22 b	78 c	5 a	45 b	50 b	16 a	47 b	37 b
29-5-00	12 a	48 b	41 b	5 a	53 b	42 b	0 a	20 b	80 c	24 a	43 b	33 b
5-6-2000	6 a	44 b	50 b	6 a	44 b	50 b	8 a	38 b	55 b	17 a	37 b	46 b
12-6-00	3 a	33 b	64 c	4 a	36 b	60 c	0 a	14 b	86 c	4 a	46 b	50 b
19-6-00	16 a	49 b	36 b	16 a	48 b	36 b	0 a	74 b	26 c	25 a	50 b	25 c
28-6-00	5 a	26 b	69 c	6 a	18 b	75 c	0 a	33 b	67 c	0 a	57 b	43 b
Mean (%)	7 a	37 b	56 c	4 a	36 b	60 c	2 a	31 b	67 c	13 a	40 b	47 b

* Percentages in a row followed by different letters are significantly different (chi-square test, $P < 0.05$)

campus of the Agricultural University of Athens (A.U.A.). Leaves of those shrubs had the upper surface extensively discolored lowering their aesthetic value.

The life cycle of *H. haemorrhoidalis* on viburnum has been studied by Del Bene et al. (1998) in Italy, near Florence, and they found this species completed four generations. They suggested a damage tolerance of five thrips (larvae and/or adults) per leaf.

The aim of the present work was to study the leaf preference of *H. haemorrhoidalis* on *V. tinus*.

Materials and methods

This study was carried out by taking leaf samples from 25 *V. tinus* plants, about 1.5-2 m high, situated in the campus of A.U.A. at weekly intervals from April 11 to September 15, 2000. On each sampling date up to and including May 6 ten young twigs, 30-40 cm long, from ten randomly selected plants were chosen. From each twig three leaves, one from the distal end (from the upper third of the twig), one from the middle and one from the base (from the lower third of the twig) were collected. From May 15 onwards, the number of twigs selected was doubled to twenty. The leaves collected from the three different positions on each twig were put into individual polyethylene bags, transferred to the laboratory and then, shortly after were examined under a stereomicroscope for the presence of thrips individuals. The number of the larvae, prepupae, pupae and adults of *H. haemorrhoidalis*, as well as the number of natural enemies on each leaf, were recorded.

Data were plotted over time and the percentage of the total thrips population, as well as that of lar-

vae, pupae or adult found on the distal, middle and base leaves for each sampling date, was calculated. These percentages were compared using chi-square to test differences in the abundance of thrips in relation to position of the leaves on the twigs.

Results

Individuals of *H. haemorrhoidalis* were recorded on all sampling dates from April 11 until June 28. However, from July 4 onwards until the end of the sampling period on September 15, no thrips were found on the leaves. The population consisted mainly of larvae while pupae and adults were recorded in low numbers (Fig. 1a). The population developed on the lower surface of leaves of viburnum. No leaf drop was observed.

At the beginning of the sampling period, April 11, a large population density of larvae (71.5 larvae per leaf) was found which declined on May 2 and increased again in the next sampling reaching a maximum on June 5 (40.8 larvae per leaf). The number of pupae was low with a maximum on April 24 (8.3 pupae per leaf). Adults were recorded on all sampling dates with relatively higher numbers in the second fortnight of May reaching to a maximum of 2.95 adults per leaf on May 29.

The results of the statistical analyses of the percentages of the total population and also that of larvae, pupae and adults on the leaves from the top, middle and base of the twigs are given in Table 1. The results showed that in all cases (total population or population of larvae, pupae or adults) significant differences were found among the percentages of the population found on leaves taken from the different positions (top, middle and

base) on each sampling date. In all sampling dates the percentage of the population found on the leaves from the top was significantly lower than that on the middle with the exception of one sampling date in each of total, larval, pupal and adult population (Table 1). However, for all sampling dates the percentage of the population on the top leaves was significantly lower than that on the base leaves (Table 1). The percentage of the total population found on middle leaves was significantly lower than that on base leaves on 5 out of the 12 sampling dates, in larvae on 6, in pupae on 9 and in the adults on 3 sampling dates. Only on one sampling date in each of total, larval and pupal population and on 2 sampling dates of adult population, the percentage found on middle leaves was significantly higher than that on the base leaves (Table 1). The comparison of the mean percentages of all sampling dates of each of

the total, larval, pupal and adult population showed that the percentage of the population on the base leaves was significantly higher than that on middle leaves in all cases, except from that of adults where no significant differences were recorded (Table 1).

The only natural enemy of *H. haemorrhoidalis* observed, was the predator *Orius vicinus* (Ribaut) (Hemiptera: Anthocoridae) recorded in very low numbers.

During this study, *H. haemorrhoidalis* population caused extensive silver-gray discoloration of the upper leaf surface whereas on lower surface leaves had many brown-black spots. Moreover, in heavy infestation, brown-black spots occurred also in the upper surface.

Discussion

H. haemorrhoidalis were abundant from the be-

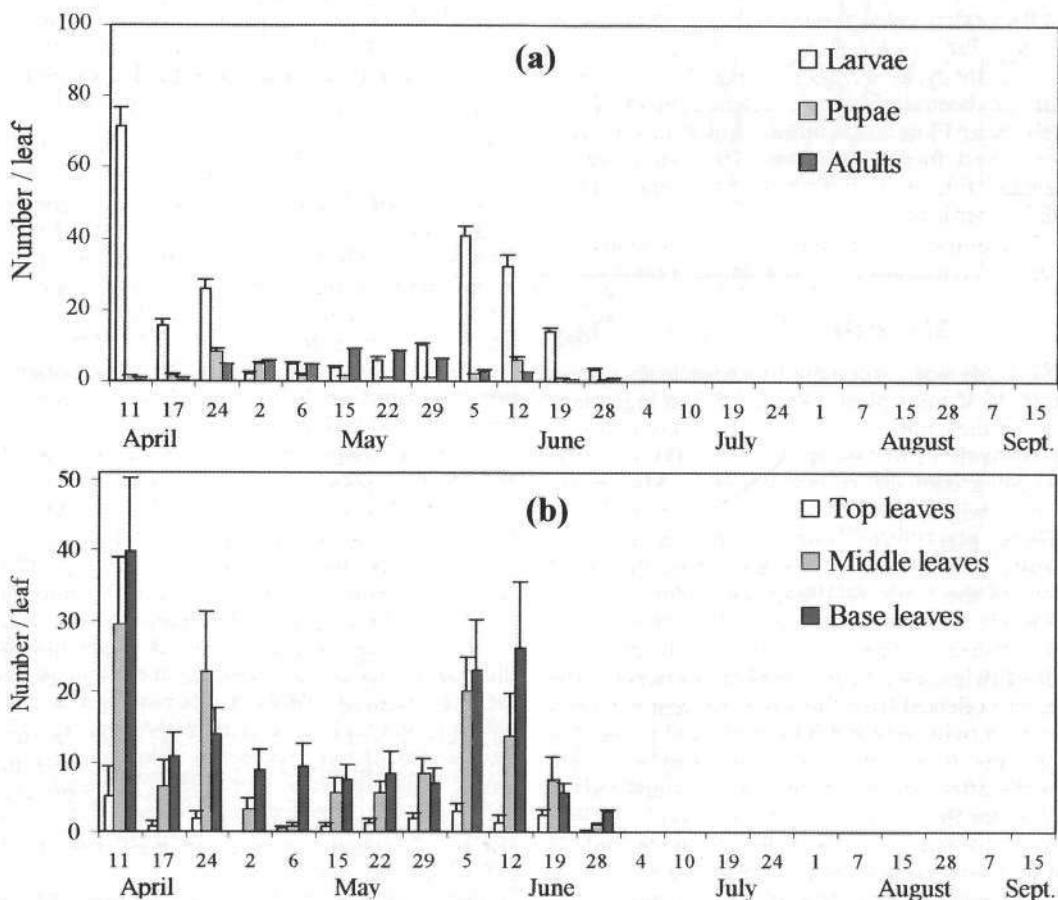


FIG. 1. Number of larvae, pupae and adults (a) and total number of population of *Heliothrips haemorrhoidalis* found on top, middle and base leaves (b) from twigs of *Viburnum tinus* in the campus of Agricultural University of Athens.

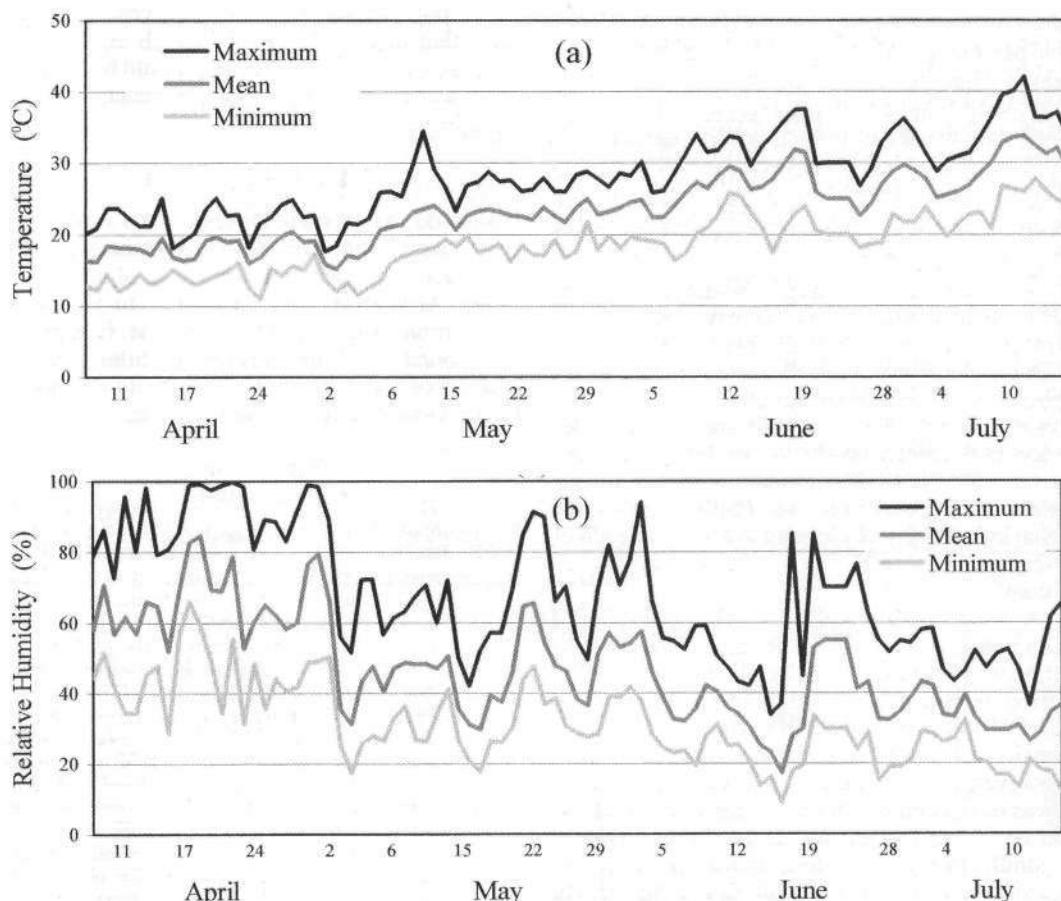


FIG. 2. Temperature (a) and relative humidity (b) in the campus of Agricultural University of Athens during the period when population of *Heliothrips haemorrhoidalis* existed on leaves of *Viburnum tinus*.

ginning of the sampling period (April 11), until the end of June. In July, populations fell to zero, and remained at that level until the last sampling date on September 15. In additional observations made at irregular intervals until December, on a few occasions an extremely low number of individuals were recorded. According to Bodenheimer (1951), the elimination of *H. haemorrhoidalis* populations in Palestine could be caused by a dry and hot wind occurring for a few days. Also, temperature higher than 33.5°C, together with low relative humidity (< 70%), is harmful to adults. Under such conditions pupae die before they become adults and eggs dry up (Rivnay, 1935). In the present study the virtual elimination of this thrips population followed high temperatures (mean temperatures of 31.9°C and 31.4°C and maximum temperatures of 37.4°C and 37.5°C on June 15 and 16, respectively) and low humidity

(mean humidity 17.5% and 28.1% on June 15 and 16, respectively) (Fig. 2). Those conditions were followed by a further period of even higher temperatures, from July 3 to July 10 (Fig. 2).

From the results of the present study *H. haemorrhoidalis* seems to complete two generations till middle of June (Fig. 1a). Therefore, in years when the climatic conditions favour its development this species can complete more generations in the area of this study. This is further supported considering that Del Bene et al. (1998) recorded 4 generations of this species on viburnum in Florence, whilst Bodenheimer (1951), based on calculations on its thermal requirements, found that in Palestine it could complete between 4 and 6, or even 7 generations annually.

In the present study, population densities of this pest were higher than the tolerance threshold of 5 thrips/leaf on *Viburnum* according to Del

Bene et al. (1998), however, leaf drop was not observed. This could be due to differences in the condition of the plants or to the different season and climatic conditions, since in the study of Del Bene et al. (1998) leaf drop of viburnum was observed in autumn during periods of high humidity. Leaf drop due to the damage of this thrips has also been recorded on ornamental plants (Denmark, 1999) while it has not been recorded on citrus (Bodenheimer, 1951).

According to the results in this study this species develops its population on the leaves of the basal part of the twigs of *V. tinus*. This finding agrees with the observations of other researchers that this species is found mainly on shady places of the canopy of citrus (Rivnay, 1935), and it does not develop populations on the upper leaves (Bodenheimer, 1951). As it was mentioned by Bodenheimer (1951) and Faber and Phillips (1998) this behaviour enables this species to avoid more effectively the adverse effects of extreme climatic conditions.

A very small number of *O. vicinus* were recorded indicating that their impact on its population was very low or negligible during sampling period. In Palestine, the effect of predators on the level of this thrips population on citrus was also considered of low importance (Rivnay, 1935). However, in other studies species of the genus *Orius* have been considered as important biological control agents of this thrips. In the study of Dennill (1992) *Orius thripoborus* (Hesse) was considered as a potential biological control agent of *H. haemorrhoidalis* on avocado while *Orius laevigatus* (Fieber) was the most effective among three predators in reducing the numbers of this thrips on several host plants (Brown et al., 1999).

In conclusion, the results of this study showed that *H. haemorrhoidalis* can be a serious pest of *V. tinus* reducing significantly its aesthetic value. Its population can reach high levels and natural enemies did not seem to have a significant impact on its population increase on the area of our study. However, an evaluation of the predator of this thrips could offer us essential knowledge for its possible use against thrips on viburnum or possibly on other ornamental plants. The results also showed that the decline in population of this species was associated with high temperature and low relative humidity coincide even for a few days. Therefore, the leaves should be examined for the presence of thrips before any control measures are taken since symptoms would be on leaves but not thrips population. Also, *H. haemorrhoidalis* shows a preference and develops

higher populations on the lower leaves. This indicates that this is the area to which any control measures, if they are necessary, should be applied, for a more environmental friendly management of this species.

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KEY WORDS: *Heliothrips haemorrhoidalis*, thrips, viburnum, ornamental, *Orius*, natural enemies.

**Προτίμηση του *Heliothrips haemorrhoidalis*
(Thysanoptera: Thripidae) για Φύλλα Διαφορετικής Ηλικίας
στο *Viburnum tinus***

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Η προτίμηση του *Heliothrips haemorrhoidalis* (Bouché) (Thysanoptera: Thripidae), που αποτελεί σημαντικό εχθρό πολλών καλλωπιστικών φυτών, για φύλλα διαφορετικής ηλικίας μελετήθηκε σε φυτά του καλλωπιστικού θάμνου *Viburnum tinus*. Για το σκοπό αυτό, από βλαστούς μήκους 30-40 cm, συλλέγονταν φύλλα από το ανώτερο, μεσαίο και κατώτερο τμήμα τους. Οι δειγματοληψίες διεξάγονταν ανά εβδομάδα από τις 11 Απριλίου έως τις 15 Σεπτεμβρίου 2000. Βρέθηκε ότι ο πληθυσμός του θρύπα αυτού διατηρήθηκε σε υψηλά επίπεδα (που κυμάνθηκαν από 10 έως 76 άτομα ανά φύλλο) μέχρι τα μέσα Ιουνίου οπότε και άρχισε η μείωσή του μέχρι που μηδενίστηκε στις 4 Ιουλίου. Οι υψηλές θερμοκρασίες που σημειώθηκαν από τα μέσα Ιουνίου και μετέπειτα ήταν πιθανώς η κύρια αιτία για το μηδενισμό του πληθυσμού του. Στις δειγματοληψίες από τις 4 Ιουλίου έως το τέλος της μελέτης αυτής δεν βρέθηκαν άτομα του *H. haemorrhoidalis*. Η ανάλυση των δεδομένων έδειξε ότι το *H. haemorrhoidalis* προτιμά να αναπτύσσει τον πληθυσμό του στα κατώτερα φύλλα και σε μικρότερο βαθμό στα μεσαία, ενώ στα φύλλα από το κορυφαίο τμήμα του βλαστού αναπτύσσεται σημαντικά μικρότερο ποσοστό του πληθυσμού του. Όσον αφορά τους φυσικούς εχθρούς βρέθηκε μικρός αριθμός ατόμων *Orius vicinus* (Ribaut) (Hemiptera: Anthocoridae). Γενικά, τα αποτελέσματα έδειξαν ότι σε περίπτωση που απαιτείται να γίνει αντιμετώπιση του εντόμου αυτού, το γεγονός ότι ο πληθυσμός του αναπτύσσεται κυρίως στα κάτω φύλλα θα πρέπει να λαμβάνεται υπόψη.