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The Light-trap Catch of Horse Chestnut Leaf Miner (Cameraria ohridella Deschka et Dimić, Lepidoptera: Gracillariidae) Depending on the Solar Activity Featured by Q-Index

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Abstract: ***The paper deals with connections between solar flare activities and light-trap collection of Horse Chestnut Leaf Miner (Cameraria ohridella Deschka et Dimić 1986). The authors have worked out the light-trap catch data from a light-trap operated in Budapest Hungary, Europe. The data were taken from seven years between 1997 and 2006. Our results proved that the daily catches were significantly modified by the Q-index, expressing the different lengths and intensities of the solar flares. On days with high Q-index relative to the ones of the average swarming periods, the numbers of catches are considerably lower.***

Keywords: Cameraria ohridella, light-trap, Q-index, solar flares.

1. Introduction and Review of literature

1.1 The Horse Chestnut Leaf Miner

The *Cameraria ohridella* Macedonia miner was discovered in 1985. Species proved to be new to science (Dimić et al, 2000). The real origin of this harmful moth is unknown [1]. Presumably there was a human mediation, because relatives live only in North America and Asia. Now it can be reported from sycamores *(Acer pseudoplatanus)* in Hungary, as well [2].

The Horse Chestnut Leaf Miner in 1991 was observed in Hungary [3]. This species has spread rapidly to other countries in Europe [4], [5]. It was first discovered in Britain at Wimbledon in south-west London in 2002 [6].

In relation to the spread and way of life, the possibility of damaging the defense almost immediately started the research in Hungary [7]–[12], and across Europe: Austria 1989 [13], Hungary 1993 [14], Bohemia 1993 [15], Slovakia 1994 [16], Germany 1996 [17], Slovenia [18], Poland [19].

Three generations of this species can be investigated in swarming [20]–[23]

In the clime conditions in Romania, the Horse Chestnut Leaf Miner had four generations in 2000, and tree during 2001 – 2003, remaining in hiemal diapauses during pupae stage [24].

Dimić et al. [25] and Augustin et al. [6] also considered monophagous species of horse chestnut leaf miner (*Cameraria ohridella*). This monophagous species almost exclusively develops on white-flowered horse chestnut, *Aesculus hippocastanum* L.

Observations on the development of the Horse Chestnut Leaf Miner on red horse chestnut (*Aesculus x carnea* H.) were carried out in Poland, in 2001–2003 [22] and in Romania [26]. Three generations were recorded to lay eggs on the red horse chestnut leaves. Although the hatching larvae died after a short period of feeding in the plant's leaves and the species did not complete its development on this tree. The observed leaf damage was, therefore, negligible [22].

The Horse Chestnut Leaf Miner, *Cameraria ohridella* Deschka & Dimić was first found in the UK in 2002, and has since spread to most of south-east England and East Anglia. Its main host-plant is the white flowering horse-chestnut, *Aesculus hippocastanum* L., but the moth also damages other *Aesculus* species and sometimes sycamore and Norway maple [27].

Results of Péré [5] have shown that the *Cameraria ohridella* high numbers of eggs are laid on *Acer pseudoplatanus* when the trees are surrounded by horse-chestnut but that the majority of the larvae died in the first two instars.

In Hungary Horváth [28] examined the parasitoid community of *Cameraria ohridella*. Five Chalcididae species were stable members of the parasitoid community; however the Ichneumonidae and Braconidae species are very rare. Beforehand study of Lethmayer and Grabenweger [29] showed that only 1-5 % of the larvae and pupae were parasited by means of species Eulophidae (Chalcidoidae). About 6500 parasitoids (20 different species) from the fallen leaves collected in autumn and winter 1996 were examined from different sites in Vienna [30].

Grabenweger [31] suggests that the poor control of C. *ohridella* by natural enemies may partly be due to the poor synchronisation between the life cycles of the introduced host and native parasitoid wasps.

The predatory behaviour of workers of *Crematogaster scutellaris* (Olivier), acrobat ant, on larvae and pupae of horse chestnut leaf miner, *Cameraria ohridella* Deschka et Dimić, was observed for the first time in Northern Italy by Radeghieri]32].

Graberwegen et al. [33] concluded that the birds to be of greater importance as predators of *Cameraria ohridella* than arthropods.

The almost complete removal of leaves in autumn caused a significant reduction in infestation [34]. Similar results are communicated in the same year [35], [36].

The applicatin of syntheticchitin sythesis inhibitorswere effective on controlling of Horse Chestnut Leaf Miner [37], [38].

This could be controlled with foliar spraying or trunk injection of insecticides (endotherapeutical method) against the *Cameraria ohridella* [39], [40].

However, it is striking that it cannot be found such publication that deals with the chestnut leaf-miner trapping, although the individuals can fly on artificial light in significant number. Only Szabóky [7] stated that the traps can be show the drawing of swarming. Reiderné et al. [41] investigated the number of specimens in conjunction with the moon phases.

In the present study we examined the effectiveness of solar activity (Q-index) on the collection of horse chestnut leaf miner.

1.2 The solar activity

As part of global solar activity flares, eruptions can be observed in the active regions of the solar surface, that are accompanied by intensive X-ray, gamma- and corpuscular radiations, that reach also the Earth and establish an interaction with its outermost atmosphere, producing thus changes in its electromagnetic conditions [42]. Solar flares are most powerful and explosive of all forms of solar activity and the most important in terrestrial effects. This idea led solar physicists to valuable the daily flare index [43].

Most daily flare activities are characterised by most authors by index Q that expresses the significance of flares also by their duration. Its calculation is made by the following formula:

$$Q = (i \times t)$$

where i = flare intensity, t = the time length of its existence.

The solar activity also exerts influence on life phenomena. In the literature accessible to the authors, however, no publication can be found that would have dealt with the influence of flares on the collection of insects by pheromone traps. Earlier we have published our studies and demonstrated the influence of hydrogen alpha flares No. 2. and 3. on light-trap catches [44].

2. Material and Methods

In this study we used to catch data of Jermy-type light trap operating in capital city of Hungary, Budapest (N47°28'95" and 19°09'56"). This trap catch showed for the first time the presence of the Horse Chestnut Leaf Miner (*Cameraria ohridella* Deschka & Dimić) in 1977. Starting this year a significant amount of insects was collected in this trap in every year. We have the available data to work up between years 1977-2006.

There were caught all together 3538 individuals by light-trap in the 467 nights.

The Q-index daily data for the period 1997-2006 were provided by Dr. T. Ataç B.Ü. Kandilli Rasathanesi. His help is here gratefully acknowledged.

From the catching data of the examined species, relative catch (RC) data were calculated for each observation posts and days. The RC is the quotient of the number of individuals caught during a sampling time unit (1 night) per the average number of individuals of the same generation falling to the same time unit. In case of the expected average individual number, the RC value is 1. The introduction of RC enables us to carry out a joint evaluation of materials collected in different years and at different traps [45].

Hereinafter referred to as the same method was used, this was already successfully used in one of our previous study [46].

At the values of Q-index showed considerable differences in course of the respective years, they were preferably expressed as percentages of the averages of swarming periods. We studied the influence of flare activities on the daily catches. To disclose the latter, the Q/Q average values were co-ordinated with the relative catch data of different observation posts for each day of the catch period. The Q/Q means values have been contracted into groups (classes), and then averaged within the classes the relative catches data pertaining to them.

3. Results and Discussion

The connections between Q/Q averages and daily catches of the Horse Chestnut Leaf Miner are presented in Figure 1.

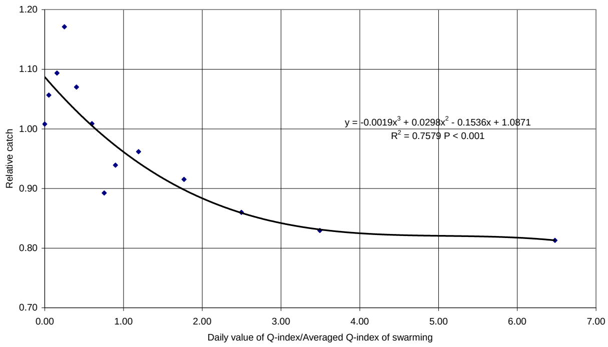

Figure 1 Light-trap catch of the Horse Chestnut Leaf Miner (*Cameraria ohridella* Deschka et Dimić) depending on the daily value of Q-index/Averaged Q-index of swarming (Budapest, 1997-2006)

From the results several important consequences could be drawn. The Figure 1 shows that in those days, in which the Q /Q average value exceed the swarming-characteristic value, a significant decline is in the light-trap catching result.

The light trap catch of Horse Chestnut Leaf Miner is high in the low values of Q/Qaverage, but in case of rising values decline sharply. The relationship with cubic parabola was best characterized.This result is significantly different from the results of our work has been cited. The number of harmful moths collected by pheromone traps, is also low in high values of Q/Qaverage, but in parallel to rising values initially slightly increases the relative catch value, and only later reduced. The reason for the discrepancy is believed the difference of two trapping method of dissimilarity may arise. It is, however, not excluded that species characteristics, may be the reasons for the differences.

Our previous and present results shows that the effectiveness of both light-trap and pheromone trap collection clearly reduce the strong solar activity.

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