

THE PHEROMONE TRAP CATCH OF HARMFUL MOTHS IN CONNECTION WITH SOLAR ACTIVITY FEATURED BY Q-INDEX

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Abstract The paper deals with connections between solar flare activities and pheromone trap collection of harmful moth species. The authors have worked out the pheromone catch data of Spotted Tentiform Leafminer (*Phyllonorycter blancardella* Fabricius, 1781), Peach Twig Borer (*Anarsia lineatella* Zeller, 1839), European Vine Moth (*Lobesia botrana* Denis et Schiffermüller, 1775), Oriental Fruit Moth (*Grapholita molesta* Busck, 1916), and Plum Fruit Moth (*Grapholita funebrana* Treitschke, 1846) as were operated for the period of 1988 and 1993-2007 in Borsod-Abaúj-Zemplén County (Hungary). The 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 number of catches is considerably lower.

Keywords: harmful moths, pheromone trap, Q-index, solar flares

Introduction and review of literature

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 (Smith and Smith, 1963). 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 evaluate the daily flare index (Özgüç and Ataç, 1989).

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

Earlier (Örményi, 1966) calculated and published the flare activity numbers based on similar theoretical principles ("Flare Activity Numbers") for the period of 1957-1965.

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 (Tóth and Nowinszky, 1983).

Materials and methods

The Q-index daily data for the period 1988 and 1993-2007 were provided by Dr. T. Ataç B.Ü. Kandilli Rasathanesi.

In 1988 pheromone traps were operating in Borsod-Abaúj-Zemplén County (Hungary –Europe) at 9 villages. An additional one trap operated between 1993 and 2007. These traps attracted 5 Microlepidoptera species altogether, in some of the years using 2-2 pheromone traps for each species, however, in other years not all 5 species were monitored. Catch data of the collected species is displayed in *Table 1*. We examined the trapping data of these species depending on the Q-indexes.

Table 1. Number of examined individuals caught by pheromone trap and number of observing data

Species	Number of individuals	Number of data
Spotted Tentiform Leafminer <i>Phyllonorycter blancardella</i> Fabricius, 1781	51 805	1766
Peach Twig Borer <i>Anarsia lineatella</i> Zeller, 1839	6 873	1913
European Vine Moth <i>Lobesia botrana</i> Denis et Schiffermüller, 1775	20 240	2320
Oriental Fruit Moth <i>Grapholita molesta</i> Busck, 1916	12 673	2299
Plum Fruit Moth <i>Grapholita funebrana</i> Treitschke, 1846	27 679	3250

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.

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.

Results and discussion

The connections between Q/Q averages and daily catches of examined species are presented in Fig. 1 – 5.

From the results several important consequences could be drawn.

The figures 1-5 show that in those days, in which the Q /Q average value exceed the species-characteristic value, a significant decline the pheromone trap catching result. The number of Spotted Tentiform Leafminer (*Phyllonorycter blancardella* Fabr.), Peach Twig Borer (*Anarsia lineatella* Zeller), and European Vine Moth (*Lobesia botrana* Den. et Schiff.), begins to decrease when Q values are higher then averages for swarming periods. As opposed to this the number caught of the Oriental Fruit Moth (*Grapholita molesta* Busck) and Plum Fruit Moth (*Grapholita funebrana* Tr.) starts decreasing already when the Q value attains the half of average value of the swarming period.

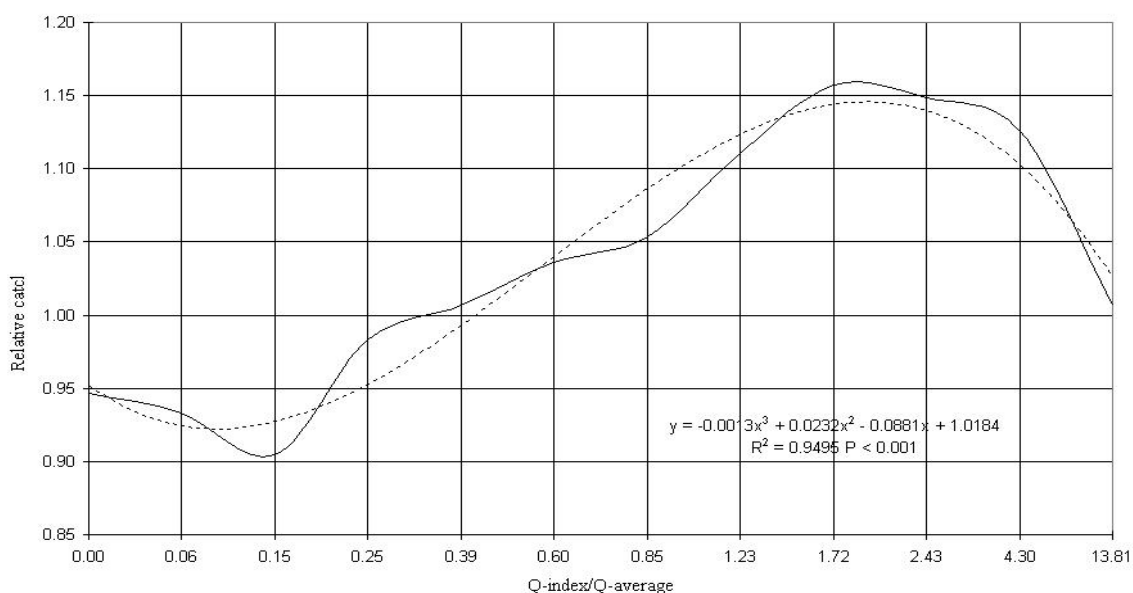


Figure 1. The pheromone trap catch of Spotted Tentiform Leafminer (*Phyllonorycter blancardella* Fabr.) in connection with the Q/Q average values between 1993 and 2007

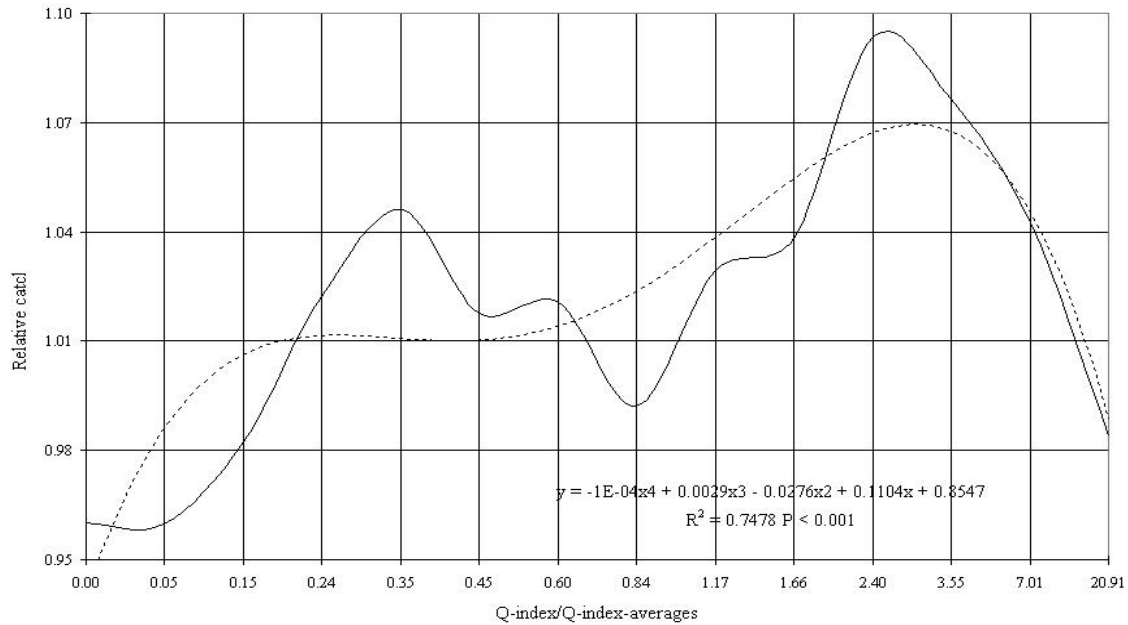


Figure 2. The pheromone trap catch of Peach Twig Borer (*Anarsia lineatella* Zeller) in connection with the Q/Q average values between 1993 and 2007

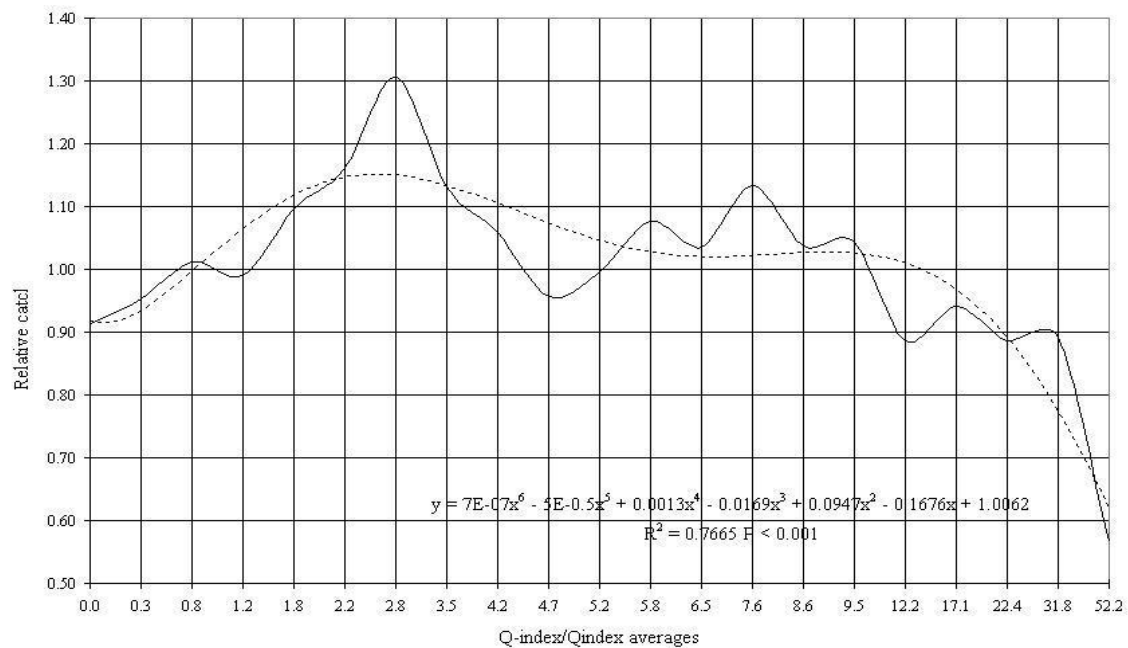


Figure 3. The pheromone trap catch of European Vine Moth (*Lobesia botrana* Den. et Schiff.) in connection with the Q/Q average values between 1993 and 2007

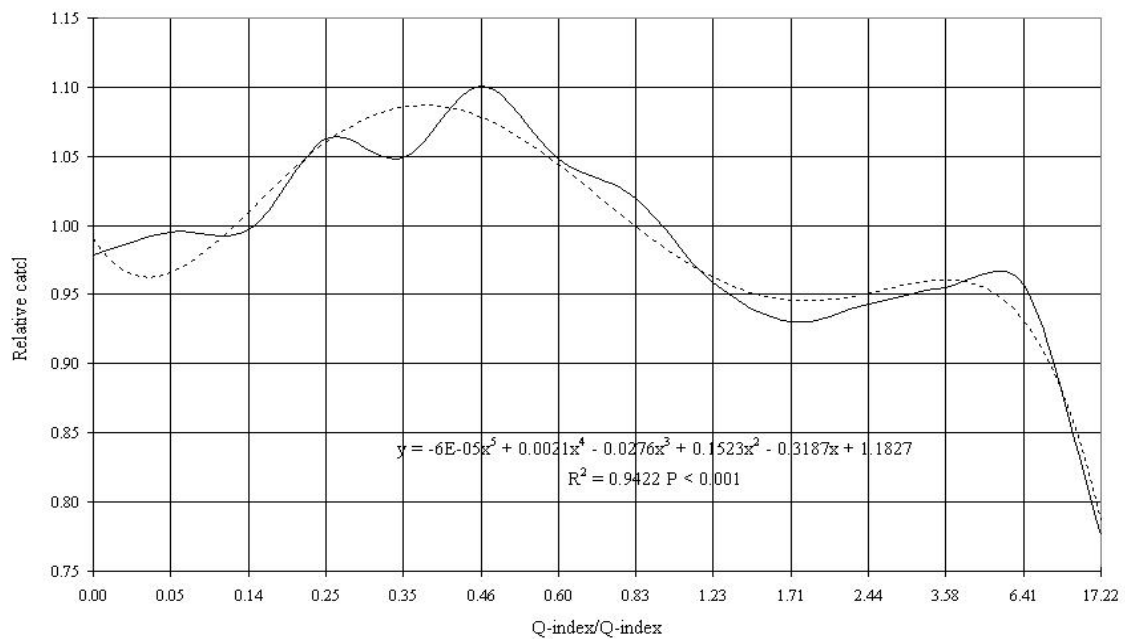


Figure 4. The pheromone trap catch of Oriental Fruit Moth (*Grapholita molesta* Busck) in connection with the Q/Q average values between 1993 and 2007

The changes of the Q-index modify the number of the harmful moths caught daily significantly according to our results. This fact is notable for the plant protection prognostic.

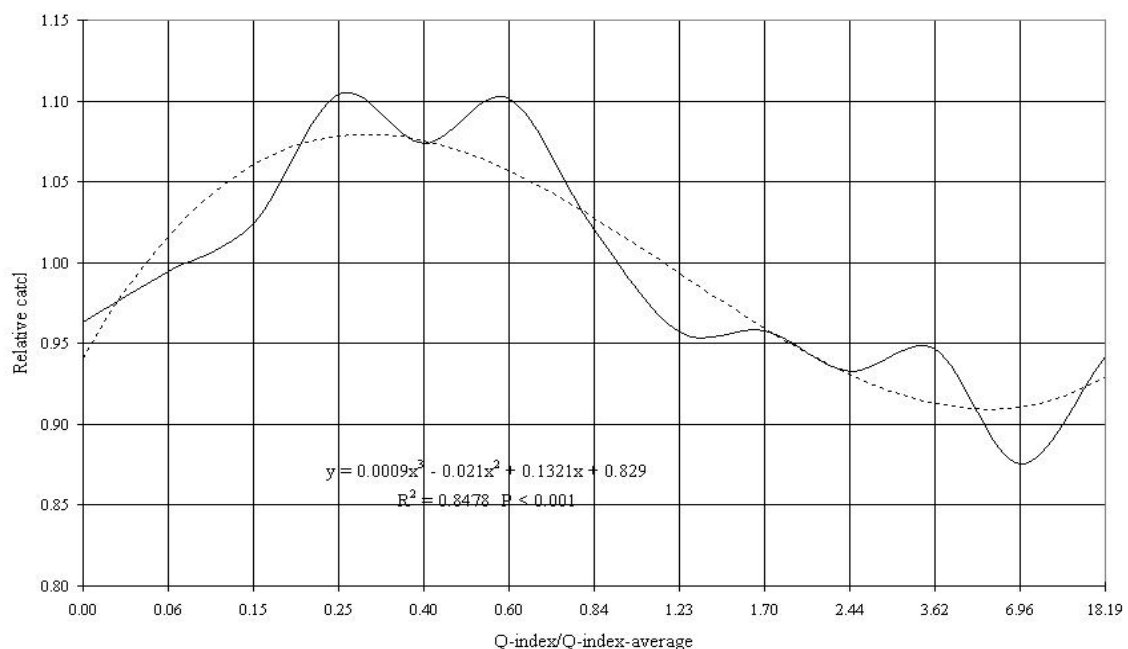


Figure 5. The pheromone trap catch of the Plum Fruit Moth (*Grapholita funebrana* Tr.) in connection with the Q/Q average values between 1993 and 2007

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