ANALYTICAL STUDY OF THE COLORED TRAPS EFFECTIVENESS IN MONITORING *EPICOMETIS HIRTA* (PODA, 1761) IN RAPESEED CROPS

Ana - Maria Vîrteiu, Mihaela Rof, Ioana Grozea*

University of Life Sciences "King Mihai I" from Timisoara, Department of Biology and Plant Protection

*correspondence address:
University of Life Sciences "King Michael I" from Timisoara
119 Calea Aradului, 300645, Timişoara, Timiş
Phone: 0256277009
Fax: 0256200296
E-mail: anamariavarteiu@usab-tm.ro

doi.org/10.54574/RJPP.15.05

Abstract: In our country, the growing demand for rapeseed, both for the production of biodiesel, but especially for the food sector, together with the European Union's restrictions on genetically modified soybeans crops were the engine for the expansion of areas cultivated with rapeseed. The practice of super-intensive agriculture, together with farmers' orientation to profit, have had major consequences on biodiversity, causing a higher incidence of pests and an increased virulence of diseases. In this context, in recent years, in western Romania, where the rapeseed crops are extended over very large areas, an increase in pest populations was observed, mainly *Epicometis hirta* during the flowering period, producing great damage in years of invasion, reducing the crop yield. This paper presents the results of comparative studies regarding the effectiveness of different chromatic traps with attractant solution in monitoring the *E. hirta* species in 2021 in a rapeseed experimental field located at a farm in the Carani area (45°54′33″N/21°9′38″E), Timiş County. The number of individuals collected with blue colored traps was higher than in the case of those collected with white traps and statistically significant differences were found ($p=0.009 < 0.05$).

Keywords: *Epicometis hirta,* colored traps, effectiveness, attractant solution

INTRODUCTION

Epicometis hirta is the most important insect of the subfamily *Cetoniinae* (Hurpin, 1962; Homonnay & Homonnayné-Csehi, 1990). This is a Palaearctic species spread throughout Europe, especially in temperate parts, North Asia and North Africa. It is also present in North America and the Middle East (Vasiliev, 1974), except Australia.

The species *E. hirta* (Coleoptera: Scarabeidae) is a polyphagous pest causing significant damage by feeding on the reproductive organs of various plant species of agricultural importance such as fruit trees, rapeseed, wheat and ornamental plants (Milenkovic & Stanisavljevic, 2003). The studies on this pest in our country refer to the biology (Bucur & Roşca, 2011), ecology (Manole et al., 2009; Tălmaciu & Tălmaciu, 2011) and damage on plants of steppe peonies (*Paeonia tenuifolia* L.) in the Zău de Câmpie reserve (Guler, 2009) and in rapeseed crop in Secuieni, Neamţ County (Trotus et al., 2015). *E. hirta* has also been found frequently in western Romania in fruit orchards, rapeseed crops, but also in the meadows near them, with an increased aggressivity and a tendency to excessive polyphagy (Petanec et al., 2016).

Considering that the adult beetles can depreciate up to 70% of the flowers of some economically important plant species (Kutinkova & Andreev, 2004; Ražov et al., 2009), the potential impact of pesticides on honeybees and other pollinating insects during the flowering period, the fact that the use of chemical measures against adults is limited, and that the use of coloured traps and attractants for mass trapping of adults is accepted as an alternative control method (Knudsen et al., 1993; Toth et al., 2003; Vuts et al., 2010), the purpose of this work was to evaluate the effectiveness of coloured pan traps with floral attractant solution in monitoring this species.

MATERIALS AND METHODS

Description of the investigated area. The research in this study was carried out in a rapeseed experimental field located at a private farm in the Carani area (45°54′33″N/21°9′38″E), Timiș county in 2021 (Figure 1).

Figure 1.Experimental field location, Carani 2021, rapeseed oil crop (Source: Google Maps, 2022)

Carani is located on the border between the high Piedmont plain of sub-hill glaciers, called the Vingai Plain, and the low Torontal plain. Characteristic for the relief of the area is the small difference between the heights and gentle slopes of the plain and includes as the main formations, piedmont plains, with fan terraces, low plains, flood plains, areas with micro depressions and cones of dejection (Stroia et al., 2021). According to Robu et al. (2016), the area under study is characterized by vertisoils and gleyic soils with medium fine and fine granulometric compositions, poor physical and hydro-physical, but favourable chemical properties, large quantities of humus and nutrients reserves, high degree of alkali saturation and high cation exchange capacity. The climate is temperate-continental. The average annual temperature is approximately 10ºC, the warmest month being July, and the coldest February, resulting in an average thermal amplitude of 22.7ºC, below that of the Romanian Plain, which attests to the beneficial influence of oceanic air masses. The number of days with favourable temperatures for the optimal development of crops, i.e. those with averages above 15ºC, is 143/year, between May 7 and September 26. The active temperature, totalling 2761ºC, ensures very good conditions for the maturation of cultivated plants, including some of Mediterranean origin.

Survey on E. hirta adults. The experimental field for the evaluation of the efficacy of chromatic traps with attractive solution in monitoring the adults was designed in randomized block in 3 replications with a total area of 3600 m^2 (7 x 150 m plot size, a path of 1,0 m width around each plot). The rapeseed hybrid used was the Umberto hybrid from KVS.

The adults were collected with coloured pan traps with atraHIR attractant solution, produced by the Ana Ripan Institute of Chemistry Cluj-Napoca (Figure 2), first series being installed on 15 April before flowering. The pans were painted in blue and white with UV-reflecting-colour. The observations were performed for a period of 35 days, from the first flower opening stage (BBCH code 50/55) until the first pod and seed development stage (BBCH code 69/71), with a collecting periodicity of every 3 days. According to the method established by Wikströmet al., 2009, a pan had 20 cm diameter, 30 cm depth, 0.5 L volume and was filled with 300 ml water and 2 ml of atraHIR attractant dissolved in it. The floral attractant was changed every 24 hours. A few drops of detergent were added to the water to conserve the beetles and decrease the surface tension. One set of pan traps consisted of two pans, one in each color, placed on a steel stick. Three sets of pan traps were placed in each trial at the same height as the vegetation and in places that were considered representative for the research experience (Grozea et al., 2008, 2009).

Figura 2. Aspects in the experimental fields: white and blue pan traps with atraHIR attractant

Meteorological data: Average daily temperatures, atmospheric humidity and precipitation during the study period were obtained from the headquarters of the National Institute of Meteorology - Timisoara Meteorological Station.

Data analysis: Statistical calculations were performed with IBM-SPSS-Statistics. The determined descriptive statistical elements were: means, standard deviations, minimum and maximum values, linear, cubic, quadratic, and logarithmic correlations.

RESULTS AND DISCUSSION

Epicometis hirta is a diurnal insect that uses both chemical and visual cues to locate its host plants (Toth, 2009). In this sense, one of the objectives of this paper was to highlight the effectiveness of coloured traps (visual stimuli) with floral attractant (chemical stimuli) in the adults' mass capture. A total of 236 adults were attracted to the coloured traps during the present study (Table 1). From the table 1 it was found that the number of individuals collected with blue colored traps was higher (163 beetles) representing 69.07% than in the case of those collected with white traps (73 beetles) representing 30.93%, statistically significant differences were found ($p=0.009 < 0.05$).

Out of the beetles captured in the blue traps, most of them (73 beetles) were captured in the first series of traps (C1) located near an apple plantation, compared to second series (C2) of traps (52 specimens) which were located in the middle of the field and the third series (C3) of traps (38 specimens) located at the edge of the experimental field.

Table 1. The number of *E. hirta* adults collected in blue and white traps in rapeseed oil, Carani 2021

Traps	No of traps	No of adults	Average	Variance		
Blue traps C 1	10	73	7.3	32.9		
Blue traps C 2	10	52	5.2	14.4		
Blue traps C 3	10	38	3.8	10.4		
Total adults		163	5.43			
White traps C 1	10	18	1.8	3.06667		
White traps C 2	10	17	1.7	3.78889		
White traps C 3	10	38	3.8	15.2889		
Total adults		73	2.43			
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	225.133	5	45.0267	3.38358	0.00989	2.38607
Within Groups	718.6	54	13.3074			
Total	943.733	59				

In recent years, many colours of traps, from yellow and neon yellow to coral, brown, pink, green and blue, have been evaluated to find the colour preference of *E. hirta* species (Tóth et al., 2009; Vuts et al., 2012; Trotuș et al., 2015). Kozár (1972) noted that light blue traps are most effective for mass collection of blossom feeder adults, while other studies have highlighted the blue colour, without mentioning shade, as the most attractive (Toth et al., 2005). In the case of studies carried out by Schmera et al. (2004) it was showed that the beetle of *E. hirta* was attracted to yellow, blue and white colours, without revealing significant differences between colours. Contrary to these results, Aydin (2011) mentioned that the chromatic susceptibility of the *E. hirta* species to white and blue colors (light and dark) presented statistically significant differences, both shades of blue being good attractants for the adults of the species. Our results obtained in this study, for white and blue coloured traps, are in accordance with the groups that found a preference for the blue colour.

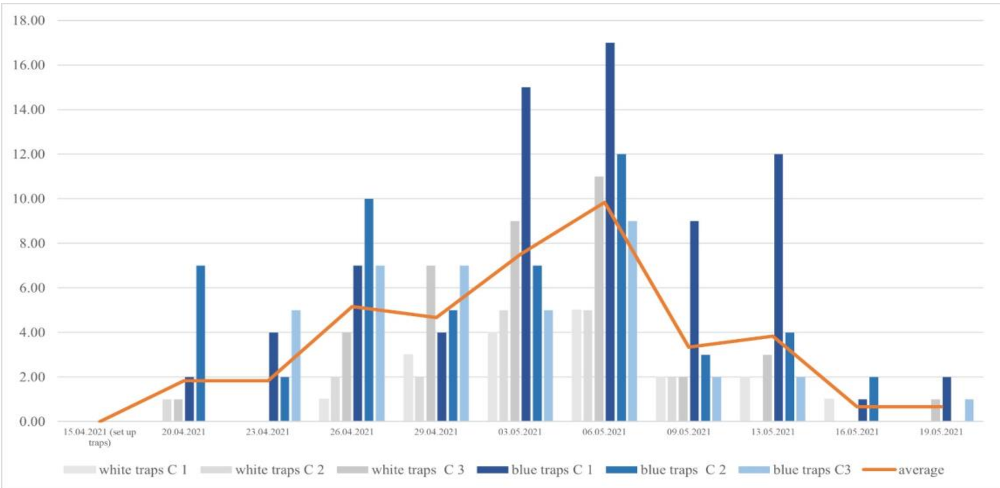

Figure 2. The diagram of *E. hirta* adults/trap/collecting date in the rapeseed oil, Carani, 2021

Another aspect highlighted in this research was the time of collecting the pest beetles. The largest number of specimens was trapped in the first 24 hours after the installation of the pan traps which corresponded to the change of the trap/floral attractant. Therefore, this study confirms that *E. hirta* uses visual (colour) and chemical stimuli (in this case floral attractant) to identify the host plant. The combined use of chromatic visual and chemical cues is widespread in the collection/monitoring of diurnal insect species such as Orthoptera (Szentesi et al., 1996), Diptera (Epsky et al., 1995), Coleoptera (Smart et al., 1997), but also of Lepidoptera species with nocturnal activity (Rojas & Wyatt, 1999).

Schmera et al. (2004) demonstrated that the best results in monitoring the *E. hirta* species were obtained using a combination of the blue coloured trap and a floral attractant (cinnamyl alcohol + transethanol in a 1:1 ratio).

The chemical stimuli, the binary floral attractant consisting of (E)-cinnamyl alcohol and (E)-ethanol similar to those used in the present experiment under the name atraHIR, was also used by Toth et al. (2005) with excellent results. The same types of traps were also used by Gezer & Ozpinar (2015) in fruit tree plantations, the authors demonstrating that the highest number of adults were collected by using blue traps + floral attractant, but using two shades of blue (light and dark blue); recommended for the detection and monitoring of *E. hirta* in apple plantations being the dark blue traps + floral attractant, while in cherry plantations the best results were obtained by the light blue traps + attractant. Our results are similar to those of Gezer & Ozpinar (2015) in rapeseed oil crop, but only the dark blue colour was included in our research.

In relevant literature, there are studies that highlight the white trap as being the most effective in capturing *E. hirta* adults compared to those of different shades of blue (Aydin, 2011). The results of some studies in different geographical conditions in Central and Eastern Europe do not coincide with each other, therefore we can consider that the colour sensitivity of the blossom feeder beetle may be related to the phenophase of the host plant.

The results in this research complement and at the same time support the results already existing in the literature, whereby the effectiveness of the coloured traps in combination with the floral attractant atraHIR, is the most effective monitoring solution during the flowering period for rapeseed without affecting the useful pollinating organisms.

The influence of climatic factors (temperature and atmospheric humidity) on the dynamics of *E. hirta* populations in western Romania (Carani, Timiș County) was another objective of this research (Figures 3 and 4).

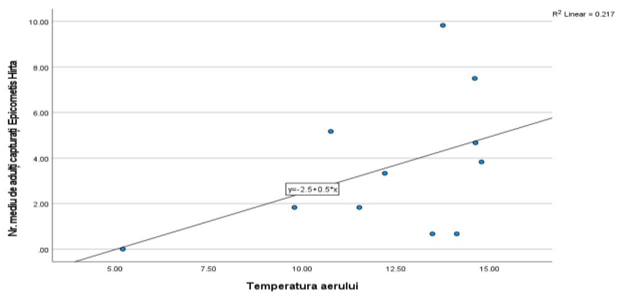

Figure 3. Correlation between average number of *E. hirta* adults and air temperature during April to May 2021 at Carani experimental field

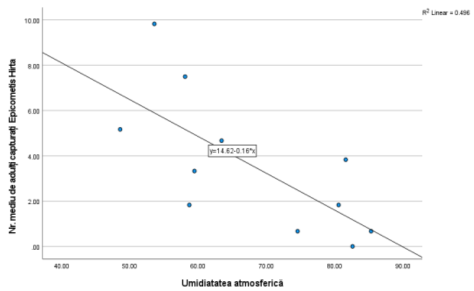

Figure 4. Correlation between average number of *E. hirta* adults and atmospheric humidity during April to May 2021 at Carani experimental field

Analyzing the influence of temperature and atmospheric humidity on the dynamics of the average number of *E. hirta* adults, it was found that most specimens ($\bar{x}$=9.83) were recorded on May 6, when an average temperature of 14.6°C and an atmospheric humidity of 58% were reached. If we analyze the captures recorded in the months of April and May, when the adult flights took place, we observe a positive correlation for temperature R^2=0.217 (Figure 3) and a negative correlation for humidity R^2 = 0.496 (Figure 4). This means that the dependent variable (the number of captured *E. hirta* adults) is conditioned in proportion of 22% by the first independent variable (air temperature), and 50% by the second independent variable (atmospheric humidity); thus we can say that there is a direct connection between the intensity of the flight and the atmospheric temperature and humidity.

Following the two ANOVA tests performed, $p<0.05$, related to the correlation with atmospheric temperature and humidity, we found a highly significant relationship ($p<0.001$, 99.9% confidence) between the number of *E. hirta* adults collected and the climatic factors (temperature and humidity).

The climate changes of the past few years have greatly affected host plants/ phytophages (e.g. rapeseed/*E. hirta*) interactions (MacDonald, 2010), the damage level depends to the greatest extent on the density of blossom feeder beetles population, but also on the mass of the inflorescences and the rate of their development during feeding. These processes are closely related to the weather conditions during April-May (the feeding period of the adults).

In our study in the climatic conditions of Carani (West of Romania) in 2021, the flight of *E. hirta* adults started on April 23 and lasted until May 16, when the last adults were recorded. A progressive and continuous increase can be observed, during 22 days, until 6 May, when the maximum peak was recorded, this period corresponding to the period of maximum flowering of rapeseed plants. After this date, there was a slow decrease and after 13 May the decrease becomes sudden. Comparing our data with those of Trotuș et al. (2015) in the climatic conditions of Secuieni (East of Romania), we can observe some similarities, thus the flight of adults and the mass attack of the *E. hirta* species overlapped over the period between the formation of the first inflorescences and the first siliques, highlighting the interdependence relationship between the food source during the damage phenophase and an increase in the number of specimens.

The dynamics of the adult population is an indicator for the optimal time to apply chemical treatments, but in the case of rapeseed, the overlap of the flowering period with the maximum threshold of *E. hirta* adults makes it difficult for chemical control, and alternative methods are encouraged to protect the useful fauna pollinators.

CONCLUSIONS

1. *Epicometis hirta* was the most important pest of the rapeseed oil crops, in the flowering phenophase, in the western part of Romania in 2021.
2. Data in our study revealed a greater preference of *E. hirta* for blue coloured pan traps than white coloured traps.
3. We recommend the use of blue pan traps with floral attractant as a suitable monitoring tool and also as an ecological control method for *E. hirta*, alternative to the chemical one, maintaining the pest density below the threshold of economic damage, and in this way protecting the pollinating fauna.

REFERENCES

AYDIN, G. (2011). Plant phenology-related shift in color preference of *Epicometis (Tropinota) hirta (Coleoptera: Scarabaeidae: Cetoniinae)* adults - key to effective population monitoring and suppression. *Florida Entomologist*, 94, 4, 832-838.

BUCUR, A.; ROȘCA, I. (2011). Research regarding biology of rape pests. *Lucrări ştiinţ. UŞAMV Bucureşti*, Seria A, 54, 356-359

EPSKY, N.D., HEATH, R.R., GUZMAN, A., MEYER, W.I. (1995). Visual cue and chemical cue interactions in a dry trap with food-based synthetic attractant for *Ceratiscapitata* and *Anastrephaludens* (*Diptera: Tephritidae*). *Environmental Entomology*, 24, 6, 1387-1395.

GEZER, B., ÖZPINAR, A. (2015). Evaluation of different traps to determine of adults of *Tropinotahirta* (Poda) (*Coleoptera: Cetoniidae*) density in peach, apple, cherry and apricot. *COMU Journal of Agriculture Faculty*, 3, 2, 27-34.

GROZEA, I., CARABET, A., CHIRITA, R., BADEA, A.M. (2008). Natural enemies in control of invasive species Diabrotica virgifera Virgifera from maize crops. *Communication in Agricultural and Applied Biological Science*, 73, 3, 201-508.

GROZEA, I., STEF, R., CARABET, A, VIRTEIU, A.M, DINNSEN, S., CHIS, C., MOLNAR, L. (2009). The influence of weather and geographical conditions on flight dynamics of WCR adults. *Communication in Agricultural and Applied Biological Science*, 75, 3, 315 - 322.

GULER, O. (2009). *Atac produs de gândacul păros la rezervaţia de bujori de stepă de la Zău de Câmpie*. Agerprres.

HOMONNAY, F., HOMONNAYNÉ-CSEHI, É. (1990). *Melolonthidae*. In*:* T. Jermy and K. Balázs (eds):A Növény-védelmi Állattan Kézikönyve. III/A**.** Budapest: Akadémiai Kiadó. 156-215, Hungary.

HURPIN, B. (1962). *Super-Famille des Scarabaeoidea.* In: A.S. Balachowsky (ed.): Entomologie Appliquée al'Agriculture, Masson et Cie, Paris, 24-204.

KOZÁR, F. (1972). A new method of studying the swarming of *Epicometis hirta* Poda. *Acta Agronomica Academiae Scientiarum Hungaricae*, 21, 373-376.

KNUDSEN, J.T., TOLLESTEN, L., BERGSTRÖM, L.G. (1993). Floral scents - a checklist of volatile compounds isolated by head-space techniques. *Phytochemistry*, 33, 253-280.

KUTINKOVA, H., ANDREEV, R. (2004). Integrated pest management in sweet cherry (*Prunus avium* L.) orchards in Bulgaria. *Journal of Fruit and Ornamental Plant Research*, 12, 41-47.

MANOLE, L., TĂLMACIU, M., TĂLMACIU, N. (2009). Some aspects on the structure and abundance of species coleoptere for rapeseed crop autumn. *Analele Universităţii din Craiova*, Seria Agricultură Montanologie-Cadastru, 39, 216- 222.

MACDONALD, G. (2010). Global warming and the Arctic: a new world beyond the reach of the Grinnellian niche. *Journal of Experimental Biology*, 213, 855 -861.

MILENKOVIC, S., STANISAVLJEVIC, M. (2003). Raspberry pests in Serbia. Integrated plant protection in orchards - Soft Fruits. *IOBC/WPRS Bulletin*, 26, 2, 23-27.

PETANEC, D., MESTER, A., OKROS, A., HAMZA, S., MICU, L. (2016). Studies on external morphology of the species *Epicometis hirta* Poda in the western part of Romania. *Journal of Biotechnology*, 231, S61.

ROBU, V., NIȚĂ, L., MIHUȚ, C., DUMA-COPCEA, A. (2016). Formation and characterization of soils influenced by groundwater and improvement measures. *Research Journal of Agricultural Science*, 48, 4, 363-368.

RAŽOV, J., BARIĆ, B., DUTTO, M. (2009). Fauna of the Cetoniid beetles (*Coleoptera: Cetoniidae*) and their damages on peach fruits in orchards of Northern Dalmatia, Croatia, *Entomologia Croatica*, 13, 2, 7-20.

ROJAS, J.C., WYATT, T.D. (1999). Role of visual cues and interactions with host odour during the host-finding behaviour of the cabbage moth. *Entomologia Experimentalis et Applicata*, 91, 59-65.

SCHMERA, D., TÓTH, M., SUBCHEV, M., SREDKOV, I., SZARUKAN, I., JERMY, T., SZENTESI, A. (2004). Importance of visual and chemical cues in the development of an attractant trap for *Epicometis (Tropinota) hirta* Poda (*Coleoptera: Scarabaeidae*). *Crop Protection*, 23, 10, 939-944.

SMART, L.E., BLIGHT, M.M., HICK, A.J. (1997). Effect of visual cues and a mixture of isothiocyanates on trap capture of cabbage seed weevil, *Ceutorhynchus assimilis*. *Journal of Chemical Ecology*, 23, 889-902.

STROIA, M., MAZĂRE, V., STROIA, C., OKROS, A., STROIA, L., (2021). Caractérisation Des Principaux Types Et Sous-Types De Sol Dans La Région De La Commune De Sînandrei, Timiș, *Conferinta Ştiinţa În Nordul Republicii Moldova: Realizări, Probleme, Perspective*, Ediția 5, 340-342.

SZENTESI, A., HOPKINS, T.L., COLLINS, R.D. (1996). Orientation responses of grasshopper, *Melanoplus sanguinipes*, to visual, olfactory and wind stimuli and their combinations. *Entomologia Experimentalis et Applicata*, 80, 539-549.

TĂLMACIU, M., TĂLMACIU, N. (2011). Aspects regarding the biodiversity of coleopterofauna in the rape crop. *Cercetări Agronomice în Moldova*, 64, 2, 51-58.
TÓTH, M., KLEIN, M.G., IMREI, Z. (2003). Field screening for attractants of scarab pests in Hungary (*Coleoptera: Scarabaeidae*). *Acta Phytopathologica et Entomologica Hungarica*, 38, 323-331.
TÓTH, M., IMREI, Z., SZARUKÁN, I., VOIGT, E., SCHMERA, D., VUTS, J., HARMINCZ, K., SUBCHEV, M. (2005). Chemical communication of fruit- and flower-damaging scarabs: results of one decade's research efforts. *Növényvédelem*, 41, 581-588.
TÓTH, M., VUTS, J., DIFRANCO, F., TABILIO, R., BARIC, B., RAZOV, J., TOSHOVA, T., SUBCHEV, M., SREDKOV, I. (2009). Detection and monitoring of *Epicometis hirta* Poda and *Tropinota squalid* Scop. with the same trap. *Acta Phytopathologica et Entomologica Hungarica*, 44, 2, 337-344.
TROTUŞ, E., POCHIŞCANU, S.F., NAIE, M. (2015). Gândacul păros al florilor (*Epicometes hirta Poda*), dăunător periculos al culturilor de rapiţă, *I.N.C.D.A. Fundulea*, 83, 179-187.
VÎRTEIU, A.M., GROZEA, I., STEF, R. (2014). Monitorizarea principalilor dăunători la cultura de rapiță, Raport de cercetare societate privată, 42 pp.
VASILEV, V.P. (1974). *Vrediteli seliskohoziaistvennîh kulitur i lesnîh nasajdenii*. Izd. "Urojai", Kiev, t. I-III
VUTS, J., SZARUKÁN, I., SUBCHEV, M., TOSHOVA, T., TÓTH, M. (2010). Improving the floral attractant to lure Epicometis hirta Poda (Coleoptera: Scarabaeidae, Cetoniinae). *Journal of Pest Science*, 83, 1, 15-20.
WIKSTRÖM, L., MILBERG, P., BERGMAN, K.O. (2009). Monitoring of butterflies in semi-natural grasslands: Diurnal variation and weather effects. *Journal of Insect Conservation*, 13, 203-211.