

OBSERVATIONS REGARDING THE CELERY FLY (*EULEIA HERACLEI* L.) IN LOVAGE (*LEVISTICUM OFFICINALE* W.D.J. KOCH) CULTURE FROM VEGETABLE RESEARCH AND DEVELOPMENT STATION BACAU

Gabriel-Alin Iosob, Tina Oana Cristea

Key words: *celery fly, crop pests, Diptera, garden crop, Levisticum, leaf-miners, Tephritidae*

INTRODUCTION

Lovage (*Levisticum officinale* W.D.J. Koch) is a perennial plant that is part of the *Apiaceae* family. It is mainly used as a spice in several regions in Europe, including Romania. Used for both the food and pharmaceutical industry, the plant is considered by many specialists a medicinal plant than spice due to bioactive properties it has (Girard and Fischer 2018; Spréa et al. 2020). Vegetable Research and Development Station Bacau (VRDS Bacau) cultivates several lovage plots of the Rarau variety (fig. 3.).

The variety is developed and patented by the VRDS Bacau and sums up to approximately 1.3 hectares. In the spring of this year, were made observations regarding the pests of lovage crops and was identifying larvae of a diptera from the family *Tephritidae*.

This family comprises about 5.000 species described, for now, worldwide (David, Ramani, and Singh 2019). Insects of this family have economically important because some species are considered harmful causing significant damage to crops and some are used as biocontrol agents in weed control. They are also among the most interesting insects from a biological point of view due to the patterns on the wings, shapes, and colors (Norrbom 2004). *Euleia heraclei* L. belongs to the family *Tephritidae* and it is an insect still relatively unknown, whose larvae live as miners in the leaves of *Apiaceae* (Girard and Fischer 2018). The adult shows a characteristic drawing on the wings and can reach a body size of 5 -7 mm. The female is slightly larger than the male. The head shows compound eyes with metallic green reflections. The abdomen is mostly ovoid, at females it ends with a sclerified ovipositor. The adult shows seasonal dimorphism, the summer colors being lighter and the spring and autumn colors darker even black.

They are good flyers and can easily find new crops for laying eggs even if the rotation of the crops in the field has been achieved (Küttik and Özasan 2006; Krivosheina and Ozerova 2016; Girard and Fischer 2018)

Three scientific names are used in the literature for this species:

- *Acinia heraclei* L. (Keilin and Tate 1943)
- *Philophylla heraclei* L. (Desroches 1972; Leroi 1972, 1973; Călin 2005)
- *Euleia heraclei* L. (Gratwick 1992; Pintilioaie 2010; Krivosheina and Ozerova 2016; Girard and Fischer 2018)

But in recent years the most used scientific name for this diptera is *E. heraclei* L.

Females of the species *E. heraclei* L. lay the egg, with the help of the ovipositor, in the foliar tissue of the host plant. After scarring of the foliar tissue, the egg is perfectly insulated (Leroi 1973). The larva is legless, lacks a distinct head and is white or cream in color and lives in mines that it digs into the foliar tissue of the host plants. They go through three stages of development and two moltings. The mature larva leaves the mine and pupates in the soil. If the full development of the larva cannot be carried out in the same mine, under certain conditions, the larva can leave the primary mine and migrate to another leaf where it makes a new mine, called a secondary mine. Also, if the mines are close, they can intersperse, and the larvae continue their development without an apparent interaction between them (Leroi 1973; Girard and Fischer 2018). Due to the way of feeding, by forming mines in the parenchyma, the larvae are especially harmful to the crops like celery, parsnips, and lovage (Keilin and Tate 1943).

MATERIAL AND METHODS

Observations in the lovage culture:

In the spring of 2021 were made observations in the lovage crop of VRDS Bacau regarding the presence of pests. Mines of the larvae of the species *E. heraclei* L. were observed on the leaves (fig. 4.) of plants and data were recorded for the frequency (F%) and intensity of the attack (I%).

Laboratory observations:

50 attacked leaves were collected and transported to the laboratory for larval growth and determination of the species. For larvae, pupae, and adults observations were made at the Optika SZM-2

electronic stereomicroscope and the photos were taken using the Optika C-B5 camera and processed on the PC using the Optika Digital Camera software. The determination of the species was made according to the specialized literature available in the international databases at present after the studies carried out by Keilin and Tate (1943), Kütük and Özasan (2006), Krivosheina and Ozerova (2016).

RESULTS AND DISCUSSIONS

After recording the data from the lovage culture, Rarau variety, it was found that the F% of the larvae for *E. heraclei* L. species was 96% and the GA% was 3.92%.

As regards the leaves attacked on the plant, it is observed in figure 1 that 36% of the plants had two attacked leaves, followed by 28% of plants that had one leaf/plant attacked, 20% of the plants had three

leaves attacked, 12% of lovage plants had 4 leaves attacked and only 4% of the observed plants have not been attacked by the *E. heraclei* L.

At the time of collection (31 – May - 2021), the larvae (fig. 5.) were in the third stage of development (mature larvae). The larva is apod, acephalic, and white with green shades. The digestive tube can be easily observed through the transparent epidermis (fig. 6.). Mature larvae measure an average of 6 mm long. Girard and Fischer (2018), in their study, reported similar sizes of mature larvae. After about four days, from the attacked leaves transported in the laboratory, the larvae came out from mines and they pupate outside (fig. 8.). At this stage, the pupae were counted to see how many community larvae were. It can be seen in figure 2 that a percentage of 68% of the attacked leaves had two larvae in the same mine. Krivosheina and Ozerova (2016), relate that in one common mine may be 2–3 larvae inside.

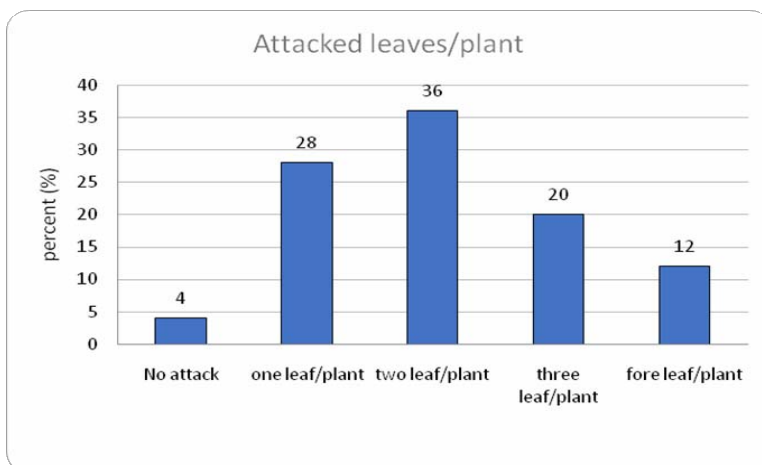


Figure 1. Percentage of lovage leaves attacked by *E. heraclei* L. on plant

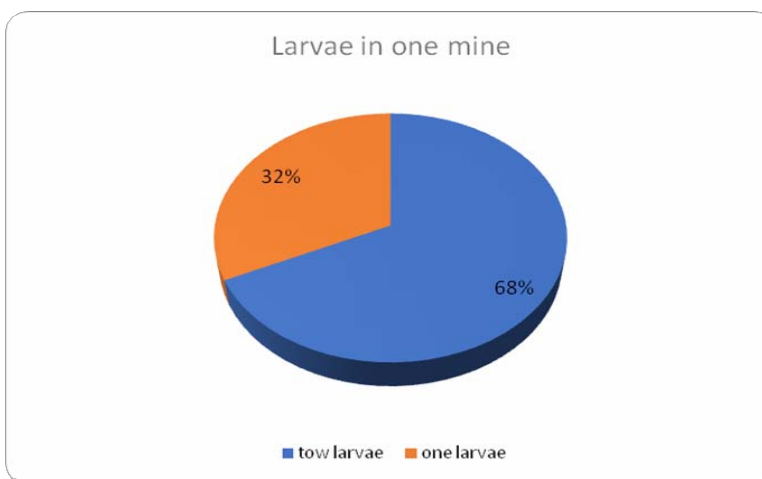


Figure 2. Percentage of larvae of the species *E. heraclei* L. per mine on leaf

Pupa of the species *E. heraclei* L. is oval, compact, segmented, pale yellow in color, and measures about 3 mm in length (fig.7.). Krivosheina and Ozerova (2016) related in their study that puparium had a length about 5 mm and 2mm width. After about 21 days adults appeared (fig. 9.). They have a brownish body color, a length of about 5 mm, and a wingspan of about 9 mm. The measurement is similar to Gratwick's (1992) and Girard and Fischer's (2018) description from their studies. The abdomen is large, ovoid. The wings show a characteristic drawing. The legs are yellowish. The eyes are round and blue-greenish in color (fig. 10.).

The determination was made especially according to the model on the wings of the adult specimens (fig. 11.), according to the literature available in the international databases at present date, after the studies carried out by Keilin and Tate (1943), Kütük and Özaslan (2006), Krivosheina and Ozerova (2016).

Other pests identified in the lovage crop in the spring of this year were: *Aphis fabae* Scop. (fig. 12.), *Thrips tabaci* Lin. (fig. 13.), *Graphosoma italicum* Müller (fig. 14.).



Fig. 3. Lovage culture (*Levisticum officinale* W.D.J. Koch) Rarau variety cultivated at SCDL Bacău – original photo



Fig. 4. Mine produced by the larva sp. *E. heraclei* L. in the field, lovage culture – original photo



Fig. 5. Preparation of the larva *E. heraclei* L. for observations on the stereomicroscope – original photo



Fig. 6. *E. heraclei* L. larva seen at the stereomicroscope – original photo



Fig. 7. *E. heraclei* L. pupa stage – original photo



Fig. 8. Observations on *E. heraclei* L. pupa stage counted to see how many community larvae were – original photo



Fig. 9. Macroscopic observations of adult sp. *E. heraclei* L. – original photo



Fig. 10. Observations at the Optika SZM-2 stereomicroscope (head detail) – original photo



Fig. 11. Observations on the characteristic pattern on the wings *E. heraclei* L. seen at the Optika SZM-2 stereomicroscope – original photo

Other pests identified in the lovage crop in spring of 2021 at VRDS Bacau



Fig. 12. Colony of *Aphis fabae* Scop. on a lovage plant in the field – original photo



Fig. 13. *Thrips tabaci* Lin. seen at the Optika SZM-2 stereomicroscope – original photo



Fig. 14. *Graphosomaitalicum* Müller on a lovage plant in the field – original photo

CONCLUSIONS

The knowledge about the Diptera species in the fauna of our country, especially those from the *Tephritidae* family is not complete and in the case of more thorough research, they may show that in Romania are more species than those described so far.

Although the frequency of larvae on lovage plants was quite high (96%) the degree of attack was quite low (3.92%), but there is a need for closer monitoring of the populations of Diptera of the species *E. heraclei* L. by placing yellow traps for more effective pest management in lovage crops.

This study contributes to the knowledge of the biodiversity of the Romanian fauna regarding the dipters from the *Tephritidae* family and to the identification of the species *E. heraclei* L., as well as

to the preferences of this species for host plants used in laying eggs.

ABSTRACT

A species of fruit flies in the genus *Euleia*, family *Tephritidae* was found in lovage culture at the Vegetable Research and Development Station Bacau (VRDS Bacau). The species of fly was *Euleia heraclei* (Linnaeus, 1758). Called celery fly, this insect is considered harmful because the larvae are mining inside and destroying the leaves of celery, lovage, carrot, parsnip, etc. The attacks, usually, start in May, this is the first generation, but scientific studies report that the second generation of larvae is more destructive. At VRDS Bacău, this insect was identified on the lovage leaves in the spring of 2021,

the frequency (F%) was 96% and the degree of attack (GA%) was 3.92%.

ACKNOWLEDGMENT

This work was supported by the Romanian Ministry of Research and Innovation grant, ADER 735 and ADER 25.2.2 projects developed by VRDS Bacau.

REFERENCES

1. CĂLIN, MARIA. 2005. *Ghidul recunoașterii controlului dăunătorilor plantelor legumicole cultivate în agricultura biologică* [Guide for the recognition of pest control of vegetable plants grown in organic farming] (Tipoactiv: Bacău).
2. DAVID, K. J., S. RAMANI, AND S. K. SINGH. 2019. Taxonomy and Diversity of Indian Fruit Flies (Diptera: Tephritidae). in, *Indian Insects* (CRC Press).
3. DESROCHES, P. 1972. Caractères distinctifs des pupes parasitées chez *Philophylla heraclei* L. et évolution dans le temps de ces caractères, *Entomophaga*, 17: 365-73.
4. GIRARD, P., AND S. FISCHER. 2018. Biology and management of the Celery fly in Lovage production, *Revue Suisse de Viticulture, Arboriculture et Horticulture*, 50: 332-43.
5. GRATWICK, MARION. 1992. Celery fly. in, *Crop Pests in the UK* (Springer).
6. KEILIN, D., AND P. TATE. 1943. The larval stages of the celery fly (*Acidia heraclei* L.) and of the braconid *Adelura apii* (Curtis), with notes upon an associated parasitic yeast-like fungus, *Parasitology*, 35: 27-36.
7. KRIVOSHEINA, M. G., AND N. A. OZEROVA. 2016. To the biology of celery fly *Euleia heraclei* (Linnaeus, 1758)(Diptera: Tephritidae)-pest of alien Apiaceae species in Moscow Region, *Russian Entomological Journal*, 25: 209-13.
8. KÜTÜK, MURAT, AND MEHMET ÖZASLAN. 2006. Faunistical and systematical studies on the Trypetinae (Diptera: Tephritidae) in the Turkey along with a new record to Turkish Fauna, *Munis Entomology & Zoology*, 1: 173-78.
9. LEROI, B. 1972. A study of natural populations of the celery leaf-miner *Philophylla heraclei* L. (Diptera, Tephritidae), *Researches on Population Ecology*, 13: 201-15.
10. LEROI, B. 1973. A study of natural populations of the celery leaf-miner, *Philophylla heraclei* L.(Diptera, Tephritidae) II. Importance of changes of mines for larval populations, *Researches on Population Ecology*, 15: 163-82.
11. NORRBOM, ALLEN L. 2004. Fruit Fly (Diptera: Tephritidae) Taxonomy Pages, Accessed 29.10.2021. <https://web.archive.org/web/20100709042209/http://www.sel.barc.usda.gov/diptera/tephriti/tephriti.htm>.
12. PINTILIOAIE, M. A. 2010. The First Record of *Euleia heraclei* (Diptera, Tephritidae) from Romania, *Вестник зоологии*.
13. SPRÉA, RAFAEL MASCOLOTI, ÂNGELA FERNANDES, TIANE C. FINIMUNDY, CARLA PEREIRA, MARIA JOSÉ ALVES, RICARDO C. CALHELHA, CRISTIANE CANAN, LILLIAN BARROS, JOANA S. AMARAL, AND ISABEL C. F. R. FERREIRA. 2020. Lovage (*Levisticum officinale* WDJ Koch) roots: A source of bioactive compounds towards a circular economy, *Resources*, 9: 81.

AUTHORS' ADDRESS

IOSOB GABRIEL-ALIN, CRISTEA TINA
OANA - Vegetable Research and Development
Station Bacau, Calea Bârladului street, no. 220,
Bacău, Romania
Corresponding author email:
iosob.gabriel@gmail.com