Acta Zoologica Academiae Scientiarum Hungaricae 48 (Suppl. 1), pp. 151–155, 2002

EUROPEAN COMMON COCKCHAFER (MELOLONTHA MELOLONTHA L.): PRELIMINARY RESULTS OF ATTRACTION TO GREEN LEAF ODOURS

IMREI, Z. and M. TÓTH

Plant Protection Institute, Hungarian Academy of Sciences
H-1525 Budapest, Pf. 102, Hungary, E-mail: h2371tot@ella.hu

A synthetic mixture of typical compounds from green-leaf odours [(3*Z*)-3-hexenyl acetate : (3*Z*)-3-hexen-1-ol : benzaldehyde : (2*E*)-2-hexen-1-ol : 1-hexanol; 100:20:10:1:1] or freshly damaged oak leaves (*Quercus sessiliflora* SALISB.) were tested for field attraction using funnel traps in Hungary. Males of the European common cockchafer *Melolontha melolontha* L. (Coleoptera, Scarabaeidae, Melolonthinae) were significantly attracted to both baits, confirming recent findings of RUTHER *et al.* (2000) on the closely related *M. hippocastani* FABR. The phenomenon that volatiles from damaged leaves from host plants are attractive towards adult males seems to be widespread in the genus *Melolontha*. The present results may form a good basis for starting the development of a monitoring trap for *M. melolontha*.

Key words: *Melolontha melolontha*, Coleoptera, Scarabaeidae, Melolonthinae, field trapping, attractant, green-leaf odours

INTRODUCTION

In the Carpathian Basin the two most important pest scarabs from the genus *Melolontha* are the European common cockchafer (*Melolontha melolontha* L.) and the forest cockchafer (*M. hippocastani* FABR.) (ENDRŐDI 1956, HOMONNAY & HOMONNAYNÉ-CSEHI 1990). Recently, RUTHER *et al.* (2000) published novel data on the chemical communication of *M. hippocastani*. Baits of damaged leaves of both host (*Carpinus betulus* L. and *Quercus rubra* L.) and non-host (*Prunus serotina* EHRH.) tree species attracted *M. hippocastani* significantly better to traps in the field than intact leaves of the same species or unbaited traps. Also, a mixture of synthetic compounds, which mimicked the headspace of damaged *P. serotina* leaves performed significantly better than the unbaited traps (RUTHER *et al.* 2000).

The present tests were undertaken to study whether the same phenomenon occurs also in the closely related *M. melolontha*. In the experiments damaged oak leaves and a synthetic mixture of typical compounds from green-leaf odours were tested in funnel traps during the swarming flight of the common cockchafer in Hungary. In the present paper we report on captures of *M. melolontha*. Data on other chafers will be presented elsewhere.

MATERIALS AND METHODS

Test site

Trapping tests were performed at Telki (Pest county, Hungary), ca. 20 km from Budapest, at the edge of a mixed oak forest, where many cockchafers of Tribe V (SZELÉNYI 1950) could be seen swarming and feeding on the leaves. Tests were carried out between May 4–June 6, 2001. Sets of traps (one of each treatment in the given test) were put out in a line by the edge of the forest, at a height of ca. 2 m, on branches of forest trees. Traps within one set were ca. 10 m from each other; distances between sets ranged from 50–200 m. Traps were inspected on every second or third day, when captured beetles were counted, sexed and were removed from the traps.

Trap types

The VARb trap was the standard funnel trap used by the Budapest laboratory for catching scarab spp. (TÓTH *et al.* unpubl.). The trap consisted of a plastic funnel (top opening outer diameter: 13 cm, funnel hole diameter: 3 cm, height of funnel: 16 cm), under which a transparent plastic round catch container was attached by a rubber band. On top of the funnel a sheet of plastic (10×16 cm) was attached vertically reaching across the top opening of the funnel. The dispenser was suspended from the vertical plastic sheet, and the bait was hung in the middle of the funnel opening, at ca. 1 cm higher than the level of the upper edge of the funnel.

VARb3 was a modification of the VARb trap. The main difference between the two trap designs was that in case of the VARb3 trap the top funnel opening was enlarged by attaching transparent plastic sheets to the trap body, so that the inner diameter of the top funnel opening was ca. 20 cm.

The above two trap types were operated in parallel, since VARb was often used in several earlier experiments on other beetle pests (TÓTH *et al.* unpubl.), while VARb3 is a slightly modified design for capturing larger beetles.

Chemicals

The synthetic mixture of green leaf odours (GLmix) was a simplified version of the mixture described by RUTHER *et al.* (2000). It contained (3*Z*)-3-hexenyl acetate (100), (3*Z*)-3-hexen-1-ol (20), benzaldehyde (10), (2*E*)-2-hexen-1-ol (1) and 1-hexanol (1).

The compounds (2*E*)-2-hexen-1-ol, and (3*Z*)-3-hexenyl acetate were purchased commercially from Bedoukian Inc. (Danbury, USA), while (3*Z*)-3-hexen-1-ol, benzaldehyde and 1-hexanol from Sigma-Aldrich Kft. (Budapest, Hungary).

All compounds were >95% pure as stated by the suppliers.

Baits

The baits were made by administering 100 mg of the GLmix onto a 1 cm piece of dental roll (Celluron®, Paul Hartmann Ag. Heidenheim, Germany), which was placed into an airtight polythene bag made of 0.02 mm polyethylene foil. The dispensers were heat-sealed. and were attached to 8×1 cm plastic handler for easy handling when assembling the traps. Dispensers were wrapped singly in pieces of alufoil and were stored at –18°C until use.

For traps baited with damaged leaves of the natural host plant, oak leaves (*Quercus sessiliflora* SALISB.) were torn up by hand to 1–2 cm^2 pieces. After having removed the withered leaves, freshly prepared leaves (ca. 40 g) were regularly placed into the catch container of the traps when the traps were inspected.

Statistics

In statistical analyses, catches recorded at an inspection were regarded as replicates (results are given as means/trap/inspection). Capture data were transformed to (x+0.5)1/2 and differences between means were tested for significance by ANOVA followed by Games-Howell-test, or Student *t*-test, as appropriate. Statistical analyses were performed by the softwares StatView™ v.4.01 and SuperANOVA™ v1.11 (Abacus Concepts, Inc., Berkeley, USA)

RESULTS AND DISCUSSION

In the first tests, traps baited with the synthetic GLmix were consistently catching much more *M. melolontha* adults than the unbaited controls, in both tests using the VARb or VARb3 trap types (Fig. 1). All of the beetles in the traps were males.

In the second test, again larger numbers of beetles were recorded in the baited traps vs. unbaited, both when the bait was the synthetic GLmix, or artificially damaged oak leaves (Fig. 2). There was no significant difference between the catch of the two baited treatments, although numerically the catch in traps with damaged oak leaves was higher. In this test, as well, all the captured specimens were males.

The present preliminary results clearly suggest that odours from damaged leaves of the host plant exert a similar attraction towards male *M. melolontha* as it has recently been described for *M. hippocastani* (RUTHER *et al.* 2000). Consequently, this seems to be a general phenomenon in the chemical communication within the genus *Melolontha*.

Among leaf-feeding scarabs belonging to other subfamilies there have also been some examples described where plant odours emitted after

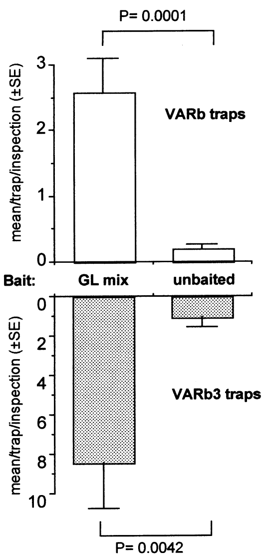

Fig. 1. Captures of male *M. melolontha* beetles in two types of funnel traps baited with GLmix or unbaited in Hungary. (VARb traps: May 7 – 18; a total of 88 beetles were captured in the test. VARb3 traps: May 14 – 18; a total of 114 beetles were captured in the test.) Significance: Student *t*-test

feeding damage acted as attractants. Adults of *Maladera matrida* ARGAMAN (Coleoptera, Scarabaeidae, Sericinae) have been shown to be attracted to injured host plants (HARARI *et al.* 1994). In the Japanese beetle (*Popillia japonica* NEWMAN) (Coleoptera, Scarabaeidae, Rutelinae), attraction of adults to damaged leaves of several host plant spp. has been reported (LOUGHRIN *et al.* 1995, 1996). Future research may show that the phenomenon is more widespread in scarabs as thought before.

In both cases of *M. matrida* and *P. japonica* adults of both sexes were reported to be attracted to leaf odours. In contrast to this, in the present tests only males of *M. melolontha* were captured. This confirms earlier results on *M. hippocastani* by RUTHER *et al.* (2000), who suggested the scenario that at first males orient towards damage-induced green leaf volatiles allowing location of feeding conspecifics on the trees, then they distinguish between non specific leaf damage and damage caused by females through orientation to a female-produced sex pheromone. *M. melolontha* may use a similar scenario. Unfortunately, in the present study we were not able to investigate this aspect of chemical communication in *M. melolontha* because unmated females were not available in sufficient numbers. Very recently, one component from the supposed female-produced sex pheromone

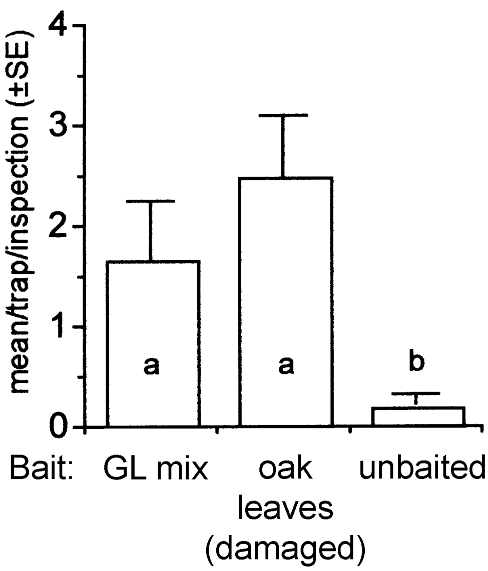

Fig. 2. Captures of male *M. melolontha* beetles in traps baited with GLmix, damaged oak leaves or unbaited in Hungary. (VARb traps; May 11 – 18; a total of 74 beetles were captured in the test.) Means with same letter are not significantly different at P=5% by ANOVA followed by Games Howell-test

has been identified as 1,4-benzoquinone in the forest cockchafer (RUTHER *et al.* 2001).

The numbers of *M. melolontha* caught by traps baited with natural oak leaves or synthetic plant compounds in this study were relatively low as judged by the number of swarming beetles at the test site. During the test period, hundreds of *M. melolontha* specimens were seen on each oak tree. Although low numbers caught suggest weak attraction, the present results may form a usable basis for further optimisation to develop a monitoring trap for *M. melolontha*.

*

Acknowledgements – The present paper is dedicated to TIBOR JERMY on his 85th birthday. The present study was partially supported by OTKA grant T 029126 of the Hungarian Academy of Sciences. The authors are indebted to T. TOLASCH and W. FRANCKE (Hamburg Univ., Germany) for suggestions and helpful discussion.

REFERENCES

ENDRŐDI, S. (1956) *Lemezescsápú bogarak, Lamellicornia.* Magyarország Állatvilága – Fauna Hungariae IX/4. Akadémiai Kiadó, Budapest. [In Hungarian]

HARARI, A. R., BEN-YAKIR, D. & ROSEN, D. (1994) Mechanism of aggregation behavior in Maladera matrida Argaman (Coleoptera: Scarabaeidae). *J. Chem. Ecol.* **20**: 361–371.

HOMONNAY, F. & HOMONNAYNÉ-CSEHI, É (1990) Család: Cserebogarak – Melolonthidae. (Family: Cockchafers – Melolonthidae.) Pp. 156–215. *In* JERMY, T. & BALÁZS, K. (eds) *A növényvédelmi állattan kézikönyve.* Vol. 3/A [Handbook of plant protection zoology], Akadémiai Kiadó, Budapest.

HURPIN, B. (1962): Super-famille des Scarabaeoidea. Pp. 24–204. *In* BALACHOWSKY, A. S. (ed.) *Entomologie appliquée à l'agriculture,* I. Masson et Cie, Paris.

LOUGHRIN, J. H., POTTER, D. A. & HAMILTON-KEMP, T. B. (1995) Volatile compounds induced by herbivory act as aggregation kairomones for the Japanese beetle (Popillia japonica Newman). *J. Chem. Ecol.* **21**: 1457–1467.

LOUGHRIN, J. H., POTTER, D. A., HAMILTON-KEMP, T. B. & BYERS, M. E. (1996) Role of feeding-induced plant volatiles in aggregative behavior of the Japanese beetle (Coleoptera: Scarabaeidae). *Environ. Entomol.* **25**: 1188–1191.

RUTHER, J., REINECKE, A., THIEMANN, K., TOLASCH, T., FRANCKE, W. & HILKER, M. (2000) Mate finding in the forest cockchafer Melolontha hippocastani mediated by volatiles from plants and females. *Physiol. Entomol.* **25**: 172–179.

RUTHER, J., REINECKE, A., TOLASCH, T. & HILKER, M. (2001) Make love not war: a common arthropod defence compound as sex pheromone in the forest cockchafer Melolontha hippocastani. *Oecologia* **128**: 44–47.

SZELÉNYI, G. (1950) A közönséges cserebogár Magyarországon. [The common cockchafer in Hungary.] *Ann. Inst. Prot. Plant Hung.* **5**: 63–69. [In Hungarian]

Received 10th May, 2001, accepted 20th December, 2001, published 14th February 2002