STUDIES ON ROVE BEETLES (Coleoptera: Staphylinidae) IN HUNGARIAN ORCHARDS ECOSYSTEMS

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ABSTRACT

Dominance and distributions of rove beetles in apple and pear orchards were studied in Hungary. *Omalium caesum, Sphenoma abdominale, Drusilla canaliculata, Palporus nitidulus, Dexiogyia corticina, Mocyta orbata, Oligota pumilio* and *Purrolinus laeticeps* were the species usually found with higher relative abundance in the orchard staphylinid communities. Although these species occurred in most of the orchards, their abundance varied considerably and their relative abundance in the total sample was under nine percent.

Considering the different soil types, staphylinid species were more frequently found in sandy or sandy-loam soils than in clay, but the difference was not significant. The staphylinids were frequently found in the conventionally treated and also in the abandoned plantations. The soil types, herb cover of the orchards and the treatments played role in forming the staphylinid communities in the orchards.

Key words: *Staphylinidae*, dominance, distributions, apple, pear, orchards, Hungary

INTRODUCTION

The Staphyilinidae are one of the richest families of the Coleoptera. Most species are predators. Little is known about the role of the Staphyilinidae in agricultural ecosystems in spite of numerous studies (Galli, 1985; Reede, 1985; Dennis et al., 1990; Dennis and Wratten, 1991; Andersen, 1991; Majzlan and Holecová, 1993; Perner and Malt, 2002).

Staphylinid beetles occur in apple orchards in central Europe (Reich et al., 1986). They can be used as beneficial insects in apple orchards in accordance with integrated pest management (Galli, 1985). They are relatively abundant in the Coleoptera assemblage in different geographical regions and under different chemical pest management regimens (Majzlan and Holecova, 1993). In our study, staphylinids accounted for 54% of the individuals for 23 beetle families encountered. Stalhylinids were particularly abundant in summer and in early autumn.

In field experiments, some insecticides such as Pirimicarb, Deltametrin and Dimethoat were less toxic to staphylinids than to other groups of predators such as carabids or spiders (Andersen, 1982; Good and Giller, 1991b). The staphylinid species most frequently encountered in these studies were *Anotylus sculpturatus, Aloconota gregaria, Tachyporus chrysomelinus* and *T. obtusus.*

*S*everal species of rove beetle aggregated in patches of aphids, and beetle populations increased in response to higher aphid populations (Bryen and Wratten, 1985). Gut dissection showed that *Tachyporus* spp. feed not only on aphids, but also on other arthropods, rust fungi, and other fungi (Sunderland et al., 1987). When fungi were more abundant, *Tachyporus* spp. *w*ere also more abundant, although the rate of predation on aphids decreased (Dennis and Wratten, 1991). Other species such as *Philonthus* spp. feed on wide range of arthropod prey, consuming on average of 200 aphids a day. Mycophagy has not been observed in *Philonthus* spp. (Good and Giller, 1991a).

Since 1976, faunal studies have been carried out to describe the species composition of arthropod assemblages in apple orchards in Hungary as part of the Apple Ecosystem Research Project. Mészáros et al. (1984) examined apple orchards in five localities. Markó et al. (1995) investigated *Coleoptera* communities in apple and pear orchards in three localities. Bogya et al. (1999) and Kutasi et al. (2004) present data on the species composition of Araneae and Carabidae in apple and pear orchards. Altogether, more than 2000 animal species have been reported to occur in apple and pear orchards in Hungary. However, the staphylinid fauna of the orchards has not yet been studied.

Little is known about the community structure, relative abundance, diversity and seasonal abundance of staphylinid beetle not only in apple and pear orchards, but also in other agricultural ecosytems in Hungary (Kutasi et al., 2001; Balog et al., 2003).

The aim of this study was to thoroughly survey species composition of the staphylinid beetles which occur in Hungarian apple and pear orchards, and to determine which species are most abundant.

MATERIAL AND METHODS

From 1998 to 2002, staphylinid beetle populations were examined in eleven apple orchards and three pear orchards in Hungary. The orchards are

located in woodland areas in moderately high mountains, in agricultural lowlands, and in areas which are regularly flooded.

In some of the orchards, pest management was carried out with broad spectrum insecticides, mainly organophosphates such as Ultracid 50 WP, Zolone 35 EC and Dimecron 50 WP. In other orchards, integrated pest management (IPM) was used. Abandoned orchards were also studied.

Samples were collected with covered pitfall traps 300 cm^3 in volume, 8 cm in diameter, and half-filled with a 30% solution of ethylene glycol. Ten pitfall traps were placed in the tree rows in each orchard. Five traps were placed in the center of the orchards, and five at the edges. Samples were collected in all orchards from April until October from 1998 to 2002. The traps were emptied twice a month.

Staphylinids were identified to the lowest taxonomic level possible. The works of Freude et al. (1964 and 1974) and Tóth (1982 and 1984) were used for identification.

The most common species in Hungarian orchards were determined by investigating the relative abundance of the species in the cumulative sample and the distribution of the species and then comparing their position in the dominance order in each of the fourteen orchards investigated (sum of the rank scores). The soil composition and pest management strategies were also studied.

RESULTS

Dominance and distributions

Altogether, 7841 individuals were collected belonging to 257 species and 11 subfamilies. Aleocharinae were also identified up to species level. More than 20% of the Hungarian staphylinid fauna were represented in the orchards.

In orchards with sandy and sandy-loam soil, 203 species and 5186 specimens were collected (83 species per orchard on average). In the orchards with clay soil, 146 species and 2567 specimens were collected (62 species per orchard on average).

In intensively managed commercial orchards were the following, 228 species were collected, eleven of which were abundant: *Dinaraea angustula, Palporus nitidulus, Omalium caesum, Dexiogyia corticina, Xantholinus linearis, Sphenoma abdominale, Oligota pumilio, Coprochara bipustulata, Mocyta orbata, Xantholinus longiventris* and *Tachyporus hypnorum*. These 11 species accounted for 56% of all staphylinids recorded in intensively managed commercial orchards.

In agricultural lowlands in Ujfehértó, we studied three apple orchards which were treated differently. In the conventionally treated orchard, 31 species and 169 specimens were collected. The dominant species were *Dexiogyia corticina, Mocyta orbata* and *Coprochara bipustulata,* which accounted for 58% of all staphylinids recorded there. In the IPM orchards, 21

species and 55 specimens were collected. The dominant species were *Styloxys insecatus, Coprochara bipustulata Dexiogyia corticina* and *Sphenoma abdominale,* which accounted for 52% of all staphylinids recorded there. In the abandoned orchards, 54 species and 519 specimens were collected. The dominant species were *Omalium caesum* and *Drusilla canaliculata*, which accounted for 49% of all staphylinids recorded there. In another abandoned orchard in Kecskemét, 84 species and 961 specimens were collected. The dominant species were *Drusilla canaliculata, Sphenoma abdominale* and *Paederus litoralis*, which accounted for 49% of all staphylinids recorded there.

Altogether, twelve species made up between 2 and 8% of the total sample in the fourteen apple and pear orchards investigated: *Dinaraea angustula, Omalium caesum, Drusilla canaliculata, Sphenoma abdominale, Palporus nitidulus, Dexiogya corticina, Xantholinus linearis, Coprochara bipustulata, Mocyta orbata, Oligota pumilio, Platidracus stercorarius*, and *Xantholinus longiventris*. These twelve species accounted for 56% of all staphylinids recorded (Fig. 1).

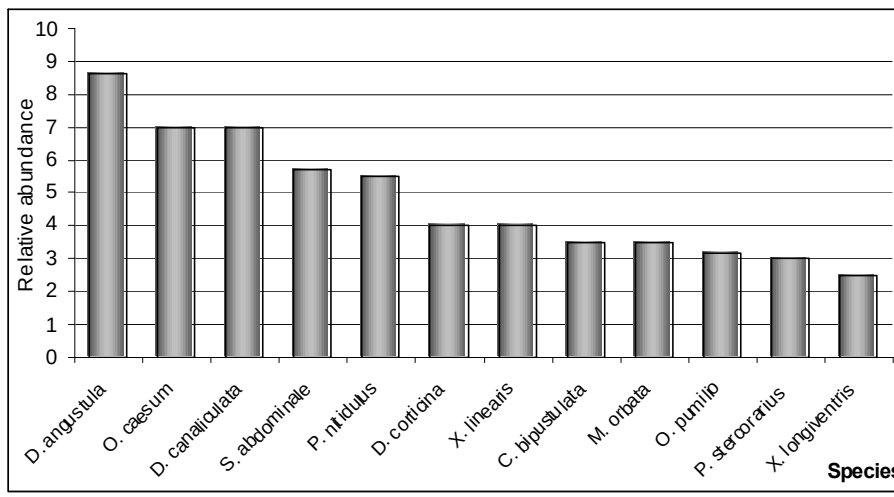

Figure 1. The relative abundance (%) of the dominant staphylinid species in the total samples collected in the fourteen apple and pear orchards investigated in Hungary

On the basis of the distribution of the species collected, the dominant species were at the same time the most widely occurring species and were always present in at least ten of the fourteen orchards investigated. Other subdominant species were also widely distributed and were always present in at least ten of the fourteen orchards investigated. The subdominat species were: *Philonthus carbonarius, Tachyporus hypnorum, Sepedophilus marshami, Mocyta fungi, Philonthus cognatus, Atheta crassicornis, Heterothops dissimilis, Hyponygrus angustatus* and *Purrolinus laeticeps* (Fig.

2). The area-abundance relationship of staphylinid species in the orchards is presented in Figure 3. Species which were found in seven or more orchards were never represented in the total catch in low abundance. On the other hand, all of the first eight species in the dominance order were found in more than ten of the fourteen orchards investigated (Fig. 3).

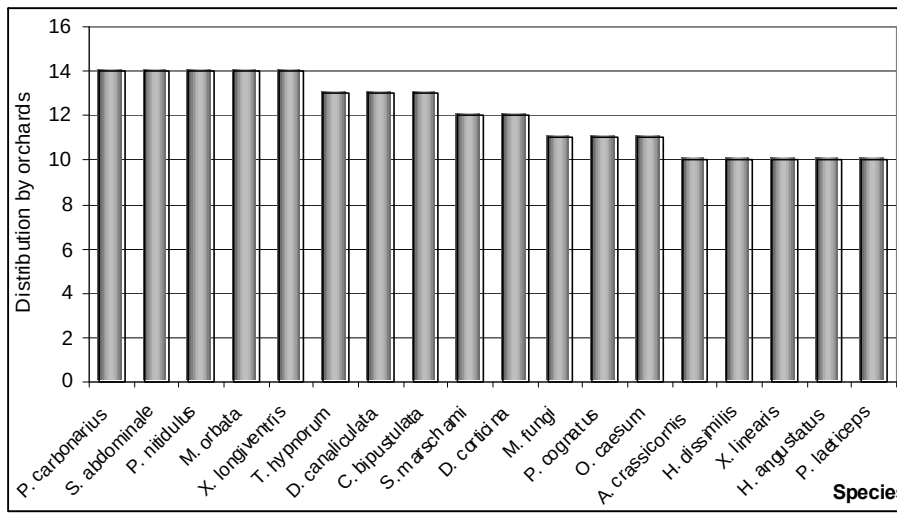

Figure 2. The distributions of the most widely occurring staphylinid species in Hungarian apple and pear orchards (frequency of occurrence). If species were collected in all fourteen orchards, its distribution value is 14

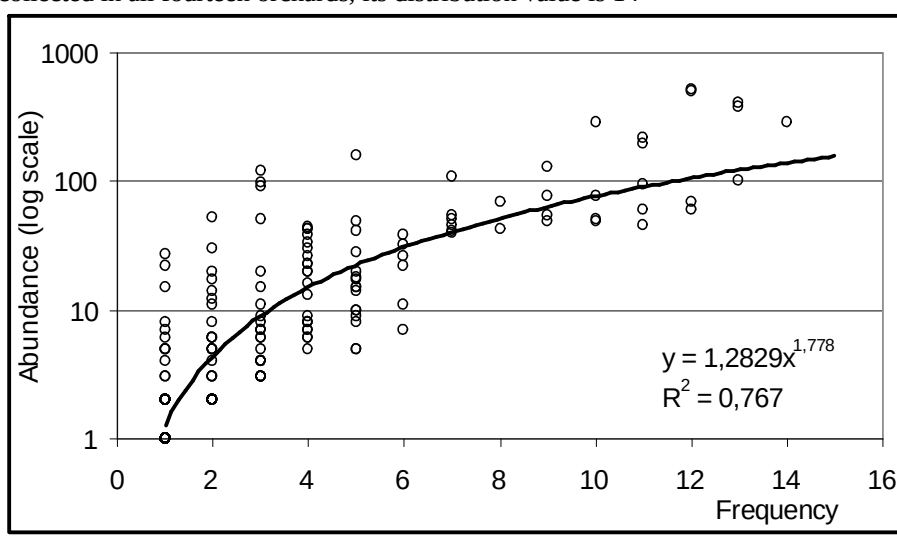

Figure 3. Relationship between the frequency of occurrence and the total abundance of orchard inhabiting staphylinid species in Hungary

The importance of a species in the staphylinid community in an orchard can be determined from its position in the dominance order. Giving different rank values for the different positions and adding the ranks for a species makes it possible to show how important the species is in orchard staphylinid communities in general. In many of the orchards, *Omalium caesum* was either dominant or subdominant (Tab. 1). The order of the species based on the sum of the rank scores (Tab. 1) is different from the order of the species based on relative abundance (Fig. 1) and distribution (Fig. 2). However, the most widely occurring species also had the highest rank values (Tab. 1).

Table 1. The most abundant species in the apple and pear orchards in Hungary (total rank scores)

Species	Sum rank
Omalium caesum	32
Sphenoma abdominale	27
Drusilla canaliculata	24
Palporus nitidulus	23
Dexiogyia corticina	21
Mocyta orbata	17
Oligota pumilio	15
Purrolinus laeticeps	15
Aleochara curtula	12
Xantholinus linearis	12
Coprochara bipustulata	9
Pseudocypus mus	8
Dinaraea angustula	7
Meneidophallus roubali	7
Ocypus olens	7
Philonthus carbonarius	7
Platydracus stercorarius	7
Xantholinus longiventris	7

Explanation: The most abundant staphylinid species in each orchard got rank score "7", the following species "6", etc. The seventh species in the dominance order got rank score "1" and the species with lower abundance than that got score "0". In the table the cumulative rank (sum rank) scores of the species were presented in decreasing order. The highest possible rank score, if a species were dominant in all of the fourteen orchards investigated, 14 x 7 = 98

Studies on species level

Dinaraea angustula was abundant in only one commercial apple orchard, probably because of frequent irrigation. In the cumulative samples, it was dominant, but its distribution was narrow and its total rank score was therefore low (Fig. 4).

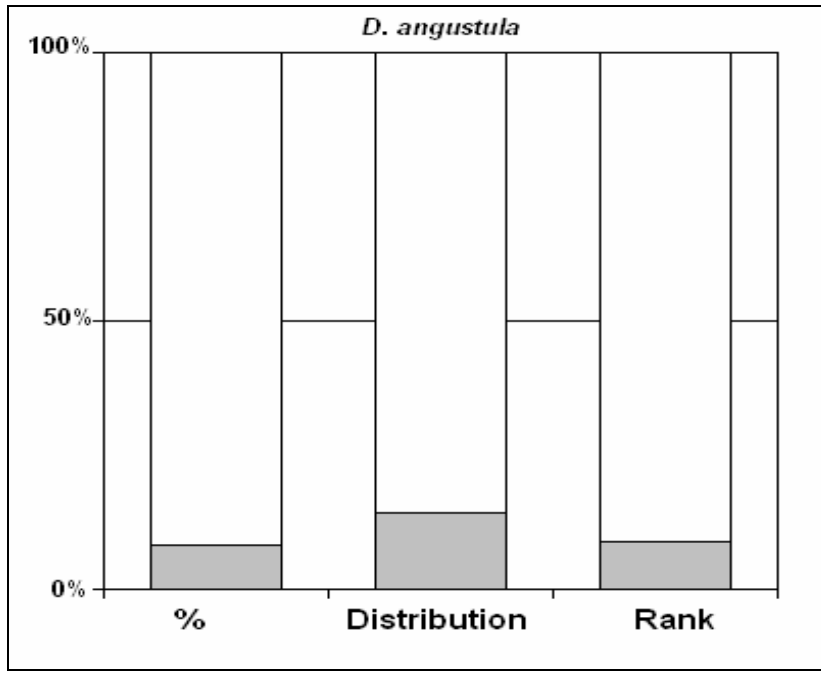

Figure 4. The abundance, distributions and total rank scores of the species *Dinaraea angustula*

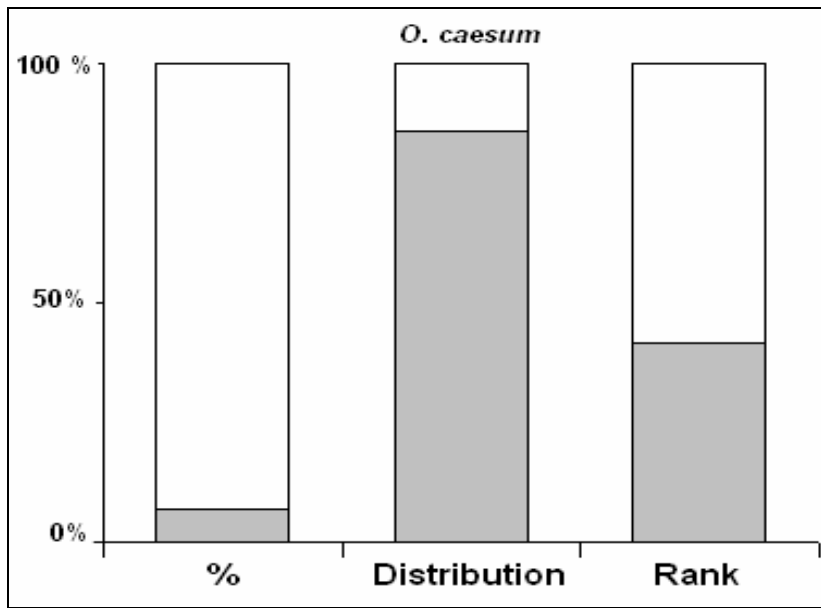

Figure 5. The abundance, distributions and total rank scores of the species *Omalium caesum*

On the other hand, *Omalium caesum* was common in many of the orchards and its relative abundance in the total sample was high. The distribution and the sum of the rank scores for this species were also high (Fig. 5). Similarly, *Drusilla canaliculata* was common in both the conventionally treated and abandoned apple orchards. It was dominant and its distribution and total rank scores were also high (Fig. 6).

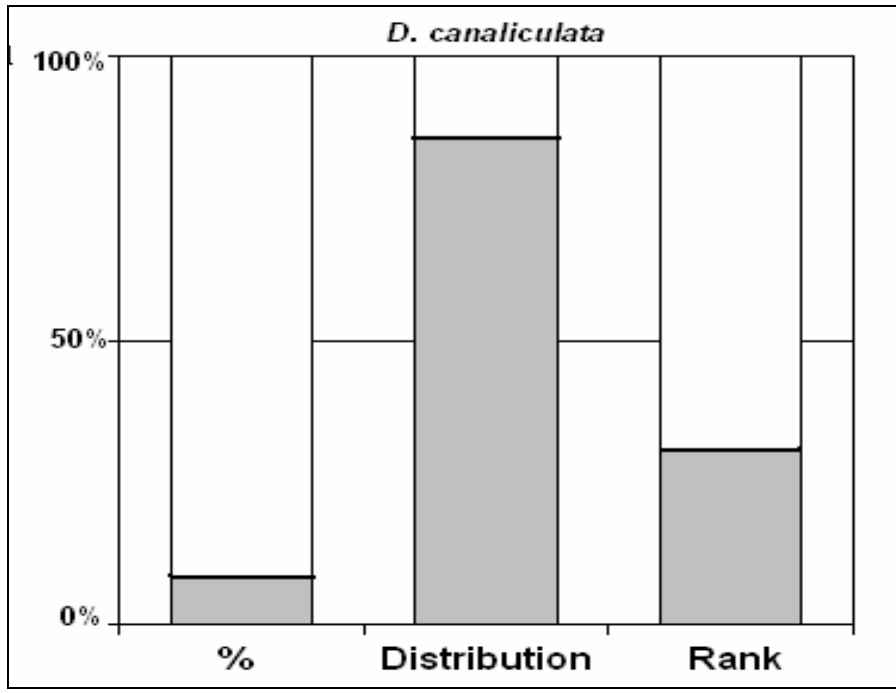

Figure 6. The abundance, distributions and total rank scores of the species *Drusilla canaliculata*

DISCUSSION

Most of the species mentioned in this study have been recorded to be common in agricultural fields throughout western Europe (Galli, 1985; Reede, 1985; Dennis et al., 1990; Dennis and Wratten, 1991; Majzlan and Holecová, 1993; Wardle et al., 1993; Heyer, 1994; Knopp, 1997; Krooss and Schaefer, 1998; Andersen, 2000; Perner and Malt, 2002).

Almost 22% of the Hungarian staphylinid fauna can be collected in Hungarian apple and pear orchards. During the survey, a total of 7841 specimens belonging to 257 species were collected with pitfall traps.

Staphylinid species were more frequently found in sandy or sandy-loam soils than in clay soils, but the difference was not significant. Soil composition had no significant effect on species composition.

Staphylinid species were frequently found not only in the abandoned orchards, but also in the conventionally treated productive orchards..

Further research is needed to lay the theoretical and practical foundations for protecting and exploiting *Staphylinidae* communities in orchard ecosystems.

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REFERENCES

Andersen A 1991. Carabidae and Staphylinidae (Col.) frequently found in Norwegian agricultural fields. New data and review. FAUNA SER. B 38: 65-76.

Andersen A 2000. Long term developments in the Carabid and Staphylinid (Col. Carabidae and Staphylinidae) fauna during the conversion from conventional to biological farming. J. APPL. ENT. 124: 51-56.

Andersen A. 1982. The effect of different dosages of isofenphos on Carabidae and Staphylinidae. SONDERDRUCK AUS. BD. 94: 61-65.

Balog A., Markó V., Kutasi CS., Ádám L., 2003. Species Composition of Ground Dwelling Staphylinid (*Coleoptera: Staphylinidae*) Communities in Apple and Pear Orchards in Hungary. ACTA PHYTOPATH. ENTOMOL. HUNG. 38(1-2): 181-198.

Bogya S., Szinetár Cs., Markó V., 1999. Species composition of spider (Araneae) communities in apple and pear orchards in the Carpathian basin, ACTA PHYTOPATH. ENTOMOL. HUNG. 34(1-2): 99-121.

Bryen K., Wratten S.D. 1985. The responses of polyphagous predators to prey spatial heterogenity: aggregation by carabid and staphylinid beetles to their cereal aphid prey. AGRIC. ENTOMOL. 12: 251-259.

Dennis P., Watten S.D. Sotherton N.W. 1990. Feeding behavior of the staphylinid beetle *Tachyporus hypnorum* in relation to its potential for reducing aphid numbers in wheat. ANN. APPL. BIOL. 117: 267-276.

Dennis P., Wratten S.D. 1991. Field manipulation of population of individual staphylinid species in cereals and their impact on aphid populations. ECOLOG. ENTOMOL. 16: 17-24.

Freude H., Harde W.K., Lohse G.A. 1964. Die Käfer Mitteleuropas. Band 4 Staphylinidae I. Goecke & Evers, Krefeld, 265 p.

Freude H., Harde W.K., Lohse G.A. 1974. Die Käfer Mitteleuropas. Band 5 Staphylinidae II, Goecke & Evers, Krefeld, 328 p.

Galli P. 1985. Integrated plant protection in Baden-Wurttemberg apple growing. Training, advisory services and experiments within the framework of a model plan for introducing an integrated procedure into commercial fruit growing. SCHRIFTENREIHE DES BUNDESMINISTERS FUR ERNAHRUNG, LANDWIRTSCHAFT UND FORSTEN. 319: 54-65.

Good J.A., Giller P.S. 1991a. The diet of predatory Staphylinid beetles – a review of records. ENTOMOLOGIST´s MONTHLY MAGAZINE 127: 77-89.

Good J.A., Giller P.S. 1991b. The effect of cereal and grass management on Staphylinid (Coleoptera) assamblages in south-west Ireland, J APPLIED ENTOMOL. 28(3): 210-226.

Heyer W. 1994. Occurrence of epigeal predatory arthropods in apple orchards – a basic approach to a risk assessment. N. des D. PLANZENSCHUTS 2: 15-18.

Knopp M. 1997. Research on integrated pest management of apple and peaches in the highlands of Yemen. Institut für Pflanzenproduction in den Tropen und Subteran 3: 25-29.

Krooss S., Schaefer M. 1998. The effect of different farming systems on epigeic arthropods: a five-year study on the rove beetles fauna (Coleoptera: Staphylinidae) of winter wheat. AGRIC. ECOSYSTEMS ENVIRON 69: 121-133.

Kutasi Cs., Balog A., Markó V. 2001. Ground dwelling Coleoptera fauna of commercial apple orchards. Integrated Fruit Production IOBC/wprs BULL 24 (5): 215-219.

Kutasi Cs., Markó V., and Balog A. 2004. Species composition of carabid (Coleoptera: Carabidae) communities in apple and pear orchards in Hungary. ACTA PHYTOPATH. ENTOMOL. HUNG. 39: 71-89.

Majzlan O., Holecová M. 1993. Arthropodocoenoses of an orchards ecosystem in urban agglomeration. ECOLOGIA (Bratislava) 12 (2): 121-129.

Markó V., Merkl O., Podlussány A., Víg K., Kutasi Cs., Bogya S. 1995. Species composition of Coleoptera assemblages in the canopies of Hungarian apple and pear orchards. ACTA PHYTOPATH. ENTOMOL. HUNG. 30 (3-4): 221-245.

Mészáros Z., Ádám L., Balázs K., Benedek M., Csikai Cs., Draskovits D.Á., Kozár F., Lővei G., Mahunka S., Meszleny A., Mihályi F., Mihályi K., Nagy L., Oláh B., Papp J., Polgár L., Radwan Z., Rácz V., Ronkay L., Solymai P., Soós Á., Szabó S., Szabóky Cs., Szalay-Marzsó L., Sarukán I., Szelényi G., Szentkirályi F., Sziráki Gy., Szeőke L., Török L., 1984. Results of faunistical and floristical studies in Hungarian apple orchards (Apple Ecosystem Research No. 26.). ACTA PHYTOPATH. ENTOMOL. HUNG. 19 (1-2): 91-176.

Perner J., Malt S. 2002. Zur epigäischen Arthropodenfauna von landwirtschaflichen Nutzflachen im Thüringen Becken Teil 2: Käfer (Insecta: Coleoptera). AUSGEGEBEN 16(22): 267-271.

Reede R.H. 1985. Integrated pest management in apple orchards in the Netherlands: a solution for selective control of tortricids. MED LAB ENTOMOL 493: 105.

Reich M., Funke W., Heinle R., Kuptz S. 1986. Die zeitliche Struktur der Insektenzonönoze im Ökosystem „Obst Garten". VERH. GES. ÖKOL. 14: 142-150.

Sunderland K.D., Crook N.E., Staccy D.L., Fuller B.J. 1987. Study of feeding by polyphagous predators on cereal aphids using ELISA and gut dissection. J APPL. ECOL. 24: 907-933.

Tóth L. 1982. Magyarország Állatvilága – Fauna Hungariae, Holyvák II. – Staphylinidae II. VII (6). Akadémiai Kiadó, Budapest, 119 p.

Tóth L. 1984. Magyarország Állatvilága – Fauna Hungariae, Holyvák III.– Staphylinidae III. VII (11). Akadémiai Kiadó, Budapest, 223 p.

Wardle D.A., Nicholson K.S., Yeates G.W. 1993. Effect of weed management strategies on some soil-associated arthropods in maize and asparagus ecosystems. PEDOBIOLOGIA 37(5): 257-269.

Wickerman G.P., Coombes D.S., Turner G., Mead-Briggs M.A., Edwards J. 1987. The effect of pirimicarb, dimethoat and deltametrin on Carabidae and Staphylinidae in winter wheat. In XXXIX INT. SYMP. CROP. PROT. 52(20): 213-223.

BADANIA NAD CHRZĄSZCZAMI Z RODZINY KUSAKOWATYCH (Coleoptera: Staphylinidae) W EKOSYSTEMACH SADÓW NA WĘGRZECH

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S T R E S Z C Z E N I E

Badania dotyczyły częstotliwości występowania i dominacji wśród chrząszczy z rodziny kusakowatych (Staphylinidae) zasiedlających sady jabłoniowe i gruszowe na Węgrzech.

W obrębie tej rodziny, gatunkami znajdowanymi zazwyczaj w sadach w relatywnie większej liczebności były *Omalium caesum*, *Sphenoma abdominale*, *Drusilla canaliculata*, *Palporus nitidulus*, *Dexiogyia corticina*, *Mocyta orbata*, *Oligota pumilio* i *urrolinus laeticeps*.

Chociaż gatunki te wystąpiły w większości sadów, liczebność tych chrząszczy była zmienna i udział ich w całym zebranym materiale był poniżej dziewięciu procent.

Rozważając różne typy gleby, gatunki z rodziny Staphylinidae częściej znajdowano w piaszczystych lub piaszczysto-gliniastych glebach niż w glebach gliniastych, ale różnica ta nie była istotna. Staphylinidae występowały często zarówno na konwencjonalnie chronionych, jak i na zaniedbanych plantacjach. Typ gleby, pokrycie roślinnością i zabiegi ochronne miały wpływ na kształtowanie się zespołów tej grupy chrząszczy zasiedlających sady.

Słowa kluczowe: Staphylinidae, częstotliwość występowania, dominacja, jabłoń, grusza, sady, Węgry