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Epigeic beetle (Coleoptera) communities in summer barley agrocenoses

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The species composition, structure of dominance, abundance and activity density dynamics of epigeic beetles in different managed (Conventional: without insecticides, Conventional: with insecticide treatment, Ecological: without biopreparation treatment and Ecological: with preparation made on the basis of plant extraction treatment) summer barley fields has been discussed. Some species were detected in Lithuanian agrobiocenoses for the first time, namely *Calosoma maderae auropunctatum, Cilyndera germanica, Pterostichus macer*. The index of species diversity (H˙) in the studied fields differed insignificantly and was from 2.4 in conventionally managed summer barley to 2.61 in ecologically managed fields, with a dominance index (d) – from 0.27 to 0.19 respectively. A few eudominants have been detected throughout the study in all research sites: *Poecilus cupreus* (24 -16%), *Pterostichus melanarius* (21 - 28%) and *Harpalus rufipes* (13 - 18%). A negative influence of the insecticide aktara (*tiametoksam 250g/kg*) was observable on almost all species of epigeic beetles, however, the differences were not equally tendentious. No tendentious differences in the beetle communities were ascertained between ecological fields, differing in the application of preparation made on the basis of plant extraction.

Key words: Coleoptera, species composition, abundance, summer barley, farming systems.

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INTRODUCTION

Beetles are the predominant group of epigeic arthropod fauna in agricultural lands (Tischler 1971). Ńarabid and staphylinid beetles are two of the most common taxa of above-ground, or epigeal polyphagous predators in agroecosystems (Chiverton 1986, Suderland et al. 1987, Luff 1989, Kromp 1989, Andersen, 1992, Pileckis & Šaluchaitė 1993; Tamutis 1999; Andersen & Eltun 2000, Tamutis, 2000, Tamutis 2002a, b, Tamutis et al. 2004). As well as these, beetles from other families, such as: *Silphidae, Histeridae , Elateridae, Cryptophagidae, Lathridiidae, Byrhidae, Cantharidae, Corylophidae, Phalacridae, Mycetophagidae, Cocccinelidae, Anthicidae, Apionidae, Chrysomelidae, Curculionidae,* also inhabit the soil surface of cultivable lands (Pileckis & Monsevičius 1995, 1997, Leitschert 1986; Tamutis 1999, Tamutis & Černiauskaitė-Kedienė 2005). A lot of phytophagous insects, usually the pests of agricultural plants, such as: caterpillars, flies, click beetles, leaf beetles and weevils, spend one or more stages of their development in the soil surface (Kazlauskas 1984, Pileckis & Monsevičius 1995, 1997, Alford 1999). Investigations of beetles in ecosystems continually affected by human activity are important for several reasons. Firstly, they help to detect the peculiarities of their biology and ecology, also abundances of significant species, secondly, they enable to estimate the influence of different ecological factors on both harmful and beneficial fauna; thirdly, they help to determine the character of succession in communities and the ecological state of habitats (Thiele 1997, Dritschilo & Wanner 1980, Good & Giller 1991, Luff et al 1992). A lot of investigations in this area have been done, but these investigations have to be consistent, whereas the human activity intensifies agriculture, as well as introducing new preparations and technologies. Only the results of these investigations enable us to forecast alterations of nature to create the systems of agrobiocenosis management and protection. As a rule, pitfall traps are used for the investigation of carabids and staphylinids (Baars, 1979; Kromp, 1989, Andersen, 1992, Tamutis, 2002a, 2002b, 2004), because we have insufficient information about the possibilities to use this method for the other beetle families. Investigations of the complex of epigeic beetles in agrobiocenoses of Lithuania are only few. Only in rape fields have these complexes been studied in more detail (Tamutis, 1999). Elsewhere, investigations are limited to only two families of beetles: carabids and staphylinids (Tamutis 2000, 2002a, 2002b, Tamutis et al 2004).

The objective of this study is thus to answer the question - how is the structure of the epigeic beetle community in spring barley influenced by the following factors: ecological and conventional farming systems; treatment with the insec-

Table 1. Cultivation specifics of the investigated summer barley fields[1]

Research field	Previous crop	Using period	Fertilization	Weed control	Fungicides (F) Insecticides (I) Biopreparations (B)
Ecological (1)	Winter wheat	August 2003	5000 kg litter dung	None	none
Ecological (2)	Winter wheat	August 2003	5000 kg litter dung	None	
		June, 2005			B: 10 l Biokal[2]
Conventional (1)	Summer rape		Compex (NPK) (	none	
Conventional (2)	Summer rape	May, 2005	Compex (NPK)	none	
		June 2005		none	I: 0.06 kg Aktara[3]

[1] *All amounts are given* ha^{-1}

[2] *preparation of plants extracts 57%, biohumus 38%, essential oils 5%*

[3] *tiametoksam 250g/kg*

ticide aktara and biological preparation biokal treatment

MATERIALS AND METHODS

The research area was located in the Kaunas district – Kazliskiai ecological farm and the Experimental farm of the Lithuania University of Agriculture. The ecological farm was established in 1997. The investigations were conducted on two adjacent field sites, which were of about 5 ha size each. Two of them were surrounded by a dirt road on one side and grassy border on another side (Training farm). The other two fields were surrounded by grassy borders on all sides (Ecological farm). The soil type was loam, PLG-g^4 (Endohypogleyi-Eutric Planasols) (Buivydaite et al, 2001). In 2005, four fields of summer barley (farmed ecologically and conventionally) were sampled in parallel. Ecological and conventional cultivation differed with respect to weed, disease and pest controls (see Table 1 for other field parameters).

Beetles were sampled from summer barley fields using pitfall traps during the period from 15th June to 29th July. Three traps (8.6 cm diameter) were used in each plot. The traps were set in the fields at a distance of at least 20 meters from the other field site and 10 m from each other. Traps were half-filled with ethylene glycol solution and emptied approximately every 10 days. The trapped beetles were sorted and identified to species level according to Hůrka (1996), Szujecki (1961, 1965, 1976, 1980), Smreczyński (1966, 1974), Mroczkowski (1955), Warchałowski (1978) and Opredelitel nasekomyh (1965).

Data analysis

Dominance data are presented as the proportions of the individuals of a species in each community. The following classes of dominance (D) – dominants are used: D5 - eudominants (>10%), D4 – dominants (5.1-10%), D3 – subdominants (2.1-5%), D2 – recedents (1.1 – 2.1%), D1 – subrecedents (1%).

Beetle catches were used from all three pitfall traps placed in a field, and each trap within a field was considered as a replicate. Standard statistical procedures were applied to the data, significance of difference has been estimated using Students-t statistic (Campbell 1989). The software BioDiversity Pro (McAleece 1997) has been used for calculating the Shannon-Wiener species diversity (H') and Berger-Parker dominance (d) indices.

RESULTS

During the sampling period, a total of 7147 beetle individuals representing 80 species were collected. The beetles belonged to 11 families: *Carabidae*, *Staphylinidae*, *Silphidae*, *Elateridae*, *Histeridae*, *Cantharidae*, *Coccinellidae*, *Lathridiidae*, *Phalacriidae*, *Chrysomelidae* and *Curculionidae*.

Species composition

The farming systems had no significant effect on species richness and composition of epigeic beetles in the researched fields. 51-52 species have been caught in ecologically farmed summer barley fields and 46 – 49 in conventionally farmed ones. Most of the beetle species have been sampled in both field sites. Small differences in the distribution of recedent and subrecedent species have been detected. The Shanon-Wiener diversity index (H') was higher in ecologically farmed fields: 2. 611 – 2.615, in conventionally farmed fields this value was 2.381 – 2.472. Species composition was almost similar in all investigated fields. Ground beetles were the most abundant family. In total, 36 carabid species were caught, the number of individuals of which comprised more than 75% of all caught beetles. *Poecilus cupreus, Pterostichus melanarius* and *Harpalus rufipes* were numerous in all investigated fields. Many species of carabids, such as: *Loricera pilicornis, Carabus cancellatus, Carabus granulatus, Clivina fossor, Trechus* *quadristriatus, Asaphidion flavipes, Bembidion properans, Pterostichus niger, Calathus fuscipes, Dolichus halensis, Anchomenus dorsalis, Agonum muelleri* and *Harpalus aeneus* were caught in all plots. The detection of some species of carabids, such as: *Leistus ferrugineus, Notiophilus palustris, Calosoma maderae auropunctatum, Cylindera germanica, Bembidion guttula, Pterostichus macer, Synuchus vivalis, Harpalus luteicornis, Anisodactylus binotatus* and *Acupalpus meridianus* exhibited their tolerance of arable

Table 2. Beetles captured in conventionally and ecologically managed summer barley fields in 2005: list of species, number of individuals (dominance classes: D1 – subrecedents; D2 – recedents, D3 – subdominants, D4 – dominants, D5 - eudominants) and Shannon-Wiener species biodiversity index

№	Species	Number of individuals				
		Conventional (1)	Conventional (2)	Ecological (1)	Ecological (2)	Total
	Carabidae					
1.	*Leistus ferrugineus* L.	0	0	2 (D1)	2 (D1)	4
2.	*Notiophilus palustris* Duft.	0	1 (D1)	0	0	1
3.	*Loricera pilicornis* F.	13 (D1)	19 (D2)	15 (D1)	23 (D2)	70
4.	*Calosoma maderae auropunctatum* Hbst.	21 (D2)	5(D1)	0	1 (D1)	27
5.	*Carabus cancellatus* Ill.	8 (D1)	13 (D1)	34 (D3)	38 (D3)	87
6.	*Carabus granulatus* L.	2 (D1)	4 (D1)	9 (D1)	3 (D1)	18
7.	*Cylindera germanica* L.	5(D1)	0	0	4 (D1)	9
8.	*Clivina fossor* L.	6 (D1)	6 (D1)	25 (D2)	10 (D1)	47
9.	*Trechus quadristriatus* Schrnk.	13 (D1)	12 (D2)	11 (D1)	12 (D1)	48
10.	*Asaphidion flavipes* L.	3 (D1)	1 (D1)	1 (D1)	3(D1)	8
11.	*Asaphidion pallipes* Duft.	1 (D1)	0	2 (D1)	0	3
12.	*Bembidion guttula* F.	0	3 (D1)	0	0	3
13.	*Bembidion properans* Step.	37 (D2)	26(D2)	12 (D1)	12 (D1)	87
14.	*Bembidion quadrimaculatum* L.	14 (D1)	15 (D1)	3 (D1)	9 (D1)	41
15.	*Bembidion tetracolum* Say.	0	0	1 (D1)	0	1
16.	*Poecilius cupreus* L.	457 (D5)	316 (D5)	280 (D5)	271 (D5)	1324
17.	*Poecilius versicolor* Sturm.	3 (D1)	8 (D1)	0	0	11
18.	*Pterostichus melanarius* Ill.	664 (D5)	364 (D5)	337 (D5)	304 (D5)	1669
19.	*Pterostichus niger*	12 (D1)	11 (D1)	23 (D2)	9 (D1)	55
20.	*Pterostichus macer* Marsh.	3 (D1)	1 (D1)	0	0	4
21.	*Calathus fuscipes* Goeze.	40 (D2)	28 (D2)	11 (D1)	53 (D3)	132
22.	*Calathus melanocephalus* L.	0	0	1 (D1)	1 (D1)	2
23.	*Dolichus halensis* Schall.	1 (D1)	3 (D1)	4 (D1)	3 (D1)	11
24.	*Synuchus vivalis* Ill.	0	0	0	2 (D1)	2
25.	*Anchomenus dorsalis* Pont.	57 (D2)	25 (D3)	116 (D4)	46 (D3)	244
26.	*Agonum muelleri* Hbst.	72 (D3)	57 (D3)	12 (D1)	19 (D2)	160
27.	*Amara aulica* Panz.	1 (D1)	0	3 (D1)	0	4
28.	*Amara familiaris* Duft.	0	1 (D1)	0	4 (D1)	5
29.	*Amara bifrons* Gyll.	0	0	3 (D1)	0	3
30.	*Amara plebeja* Gyll.	0	0	1 (D1)	0	1
31.	*Amara similata* Gyll.	1 (D1)	0	7 (D1)	5 (D1)	13
32.	*Harpalus rufipes* Deg.	317 (D5)	241 (D5)	225 (D5)	293 (D5)	1076
33.	*Harpalus aeneus* F.	77 (D3)	49 (D3)	68 (D3)	77 (D3)	272
34.	*Harpalus luteicornis* Duft.	0	0	2 (D1)	0	2
35.	*Anisodactylus binotatus* F.	1 (D1)	1 (D1)	0	0	2
36.	*Acupalpus meridianus* L.	7 (D1)	1 (D1)	0	0	8
	Total: species/individuals	**26/1836**	**24/1211**	**23/1203**	**24/1207**	**36/5457**
	Silphidae					
37.	*Nicrophorus vesspillo* L.	82 (D3)	64 (D3)	80 (D3)	78 (D4)	304
38.	*Nicrophorus sepultor* Charp.	63 (D3)	24 (D1)	19 (D2)	26 (D2)	132
39.	*Silpha tristis* Ill.	2 (D1)	2 (D1)	10 (D1)	3 (D1)	17
40.	*Silpha carinata* Hbst.	0	4 (D1)	0	0	4
41.	*Thanatophilus sinuatus* F.	290 (D5)	117 (D3)	13 (D1)	88 (D3)	508
42.	*Thanatophilus rugosus* L.	12 (D1)	0	3 (D1)	6 (D1)	21
	Total: species/individuals	**5/449**	**5/211**	**5/125**	**5/201**	**6/986**

	Staphylinidae					
43.	*Philonthus rotundicollis* Menn	3 (D1)	0	1 (D1)	3 (D1)	7
44.	*Philonthus addendus* Sharp.	3 (D1)	0	0	0	3
45.	*Philonthus varius* Gyll.	6 (D1)	3 (D1)	21 (D2)	6 (D1)	36
46.	*Philonthus fuscipennis* Mann.	88 (D3)	53 (D3)	179 (D5)	135 (D4)	455
47.	*Philonthus sp.*	0	2 (D1)	1 (D1)	1 (D1)	4
48.	*Staphylinus dimidiaticornis* Gemm.	11 (D1)	5 (D1)	1 (D1)	5 (D1)	22
49.	*Otholestes murinus* L.	1 (D1)	0	6 (D1)	0	7
50.	*Paederus riparius* L.	2 (D1)	3 (D1)	0	0	5
51.	*Lathrobium geminum* Kraatz.	4 (D1)	1 (D1)	1 (D1)	1 (D1)	7
52.	*Tachyporus hypnorum* F.	0	3 (D1)	3 (D1)	1 (D1)	7
53.	*Tachinus rufipes* L.	0	0	11 (D1)	3 (D1)	14
54.	*Aleocharinae* sp.	4(D1)	6 (D1)	2 (D1)	9 (D1)	21
	Total: species/individuals	**9/122**	**8/72**	**10/226**	**9/168**	**12/592**
	Histeridae					
55.	*Paralister carbonarius* Hoff.	0	1 (D1)	0	0	1
56.	*Margarinotus purpurescens* Hbst.	1 (D1)	0	1 (D1)	0	2
	Total: species/individuals	**1/1**	**1/1**	**1/1**	**0/0**	**2/3**
	Elateridae					
57.	*Agrypnus murinus* L.	0	0	1 (D1)	0	1
58.	*Agriotes lineatus* L.	6 (D1)	2 (D1)	5 (D1)	2 (D1)	15
59.	*Agriotes obscurus* L.	2 (D1)	1 (D1)	3 (D1)	4 (D1)	10
60.	*Hemicrepidius niger* L.	4 (D1)	0	0	0	4
61.	*Hemicrepidius hirtus* Hbst.	0	1 (D1)	4 (D1)	2 (D1)	7
62.	*Oedostethus quadripustulatus* F.	16 (D1)	9 (D1)	3 (D1)	0	28
	Total: species/individuals	**4/28**	**4/14**	**5/16**	**3/8**	**6/65**
	Cantharidae					
63.	*Cantharis fusca* L.	0	0	1 (D1)	0	1
64.	*Cantharis rufa* L.	0	0	0	1 (D1)	1
65.	*Cantharis lateralis* L.	1 (D1)	0	0	0	1
	Total: species/individuals	**1/1**	**0/0**	**1/1**	**1/1**	**3/3**
	Coccinellidae					
66.	*Propylea quatuordecimpunctata* L.	0	0	0	1 (D1)	1
67.	*Coccinella septempunctata* L.	1 (D1)	0	2 (D1)	1 (D1)	4
	Total: species/individuals	**1/1**	**0/0**	**1/2**	**2/2**	**2/5**
	Lathridiidae					
68.	*Enicmus sp.*	0	0	0	1 (D1)	1
	Total: species/individuals	**0/0**	**0/0**	**0/0**	**1/1**	**1/1**
	Phalacridae					
69.	*Stilbus testaceus* Panz.	0	0	0	1 (D1)	1
	Total: species/individuals	**0/0**	**0/0**	**0/0**	**1/1**	**1/1**
	Chrysomelidae					
70.	*Phyllotreta vittata* F.	0	1 (D1)	0	0	1
71.	*Phyllotreta nemorum* L.	0	0	1 (D1)	0	1
72.	*Apthona euphorbiae* Schrank	1 (D1)	0	0	0	1
73.	*Longitarsus suturellus* Duft.	0	1 (D1)	0	0	1
	Total: species/individuals	**1/1**	**2/2**	**1/1**	**0**	**4/4**
	Curculionidae					
74.	*Otiorhynchus ovatus* L.	1 (D1)	0	1 (D1)	0	2
75.	*Trachyphloeus aristatus* Gyll.	0	0	3 (D1)	3 (D1)	6
76.	*Sitona lepidus* Gyll.	4 (D1)	2 (D1)	7 (D1)	4 (D1)	17
77.	*Chlorophanus viridis* L.	0	0	0	1 (D1)	1
78.	*Gronops inaequalis* Boh.	0	0	0	1 (D1)	1
79.	*Ceutorhyncus floralis* Payk.	0	0	1 (D1)	0	1
80.	*Ceutorhynchus assimilis* Payk.	0	0	1 (D1)	1 (D1)	2
	Total: species/individuals	**2/5**	**1/2**	**5/13**	**5/10**	**7/30**
	Total number of beetles: species/individuals	**49/2647**	**46/1310**	**51/1594**	**52/1596**	**80/7147**
	Berger-Parker dominance index (d)	**0.27**	**0.24**	**0.21**	**0.19**	
	Shannon –Wiener index (H‘)	**2.414**	**2.467**	**2.609**	**2.572**	

fields. It is notable that a very rare carabid species in Lithuania, i.e. *Calosoma maderae auropunctatum*, caught in conventional summer barley, was quite abundant - 26 individuals.

Structure of dominance

A few eudominants were detected throughout the study in all research sites: *Poecilus cupreus* (24 -16%), *Pterostichus melanarius* (21 - 28%) and *Harpalus rufipes* (13 - 18%). A group of dominants species showed variation in dominance status with different treatments. For example, *Anchomenus dorsalis* was dominant only in Ecological (1) field, while in others it was a subdominant; *Philonthus fuscipennis* was eudominant and dominant in ecologically managed fields, but subdominant in conventionally managed fields. The same tendencies were observed for subdominant species, such as *Agonum muelleri* and *Carabus cancellatus*. A different result of the dominance of such species, as *Nicrophorus vesspillo* and *Thanatophilus sinutaus,* shows indifference of these species to the farming system. The dominance index was higher in Conventional (1) field (d = 0.73), while it was twice as low in the Ecological one (2) d = 0.36.

Abundance

The total catches of beetles were highest in the Conventional (1) field – 2637 individuals. Those from ecologically managed fields were lower – 1592 individuals in Ecological (1) and 1511 individuals in Ecological (2) fields. In the field of summer barley, where insecticides were applied, the amount of beetles was the lowest – 1313 individuals (Table 1). The abundance of ground beetles in the Conventional 1 field was significantly ($P<0.01$) the highest ($\bar{x}$ = 610 individuals/1 trap), as compared to all the other fields. However, among the other three fields, the numbers of trapped ground beetles showed no reliable differences (Fig. 1). The number of rove beetles caught by traps was reliably higher ($P<0.05$) in ecologically grown barley, as compared to the number caught in Conventional 2 field. The amount of trapped carrion beetles was the highest (= 150 individuals/1 trap) in Conventional (1), and was reliably higher as compared to the number of beetles caught in ecologically grown barley. The numbers of beetles from other families were reliably higher in Conventional 1 and Ecological 1 fields.

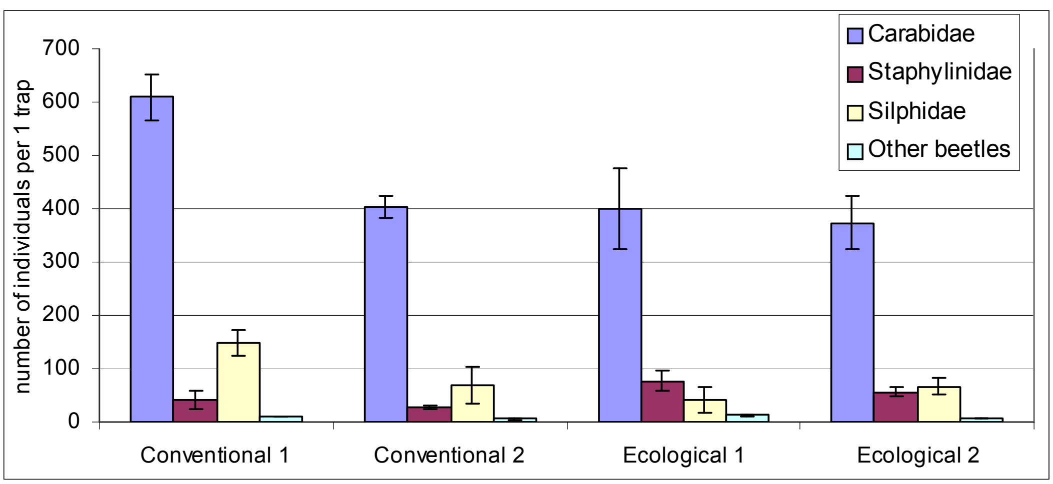

Fig. 1. Mean (± SD) number of the most abundant beetles families in spring barley

Significant differences of abundance were found between Conventional 1 and Conventional 2, also between Conventional 1 and Ecological 2 for *Poecilius cupreus* and *Pterostichus melanarius* (= 134 individuals/1 trap, P<0.001; (= 105 individuals/1 trap, P<0.01, respectively) (Fig. 2). *Harpalus rufipes* were reliably more abundantly trapped in Conventional 1 field, as compared to Ecological 1. Differences in the the numbers of *Harpalus aeneus* and *Anchomenus dorsalis* between the studied fields were insignificant.

Calosoma maderae auropunctatum was detected only in conventionally managed barley. However, their catches were reliably more abundant in the first field, where insecticide was not applied. *Carabus cancellatus* was significantly more abundant in ecologically managed spring barley.

Meanwhile, *Bembidion properans* and *Agonum muelleri* were more abundant (P<0.01) in conventionally managed barley. Barley, where insec-

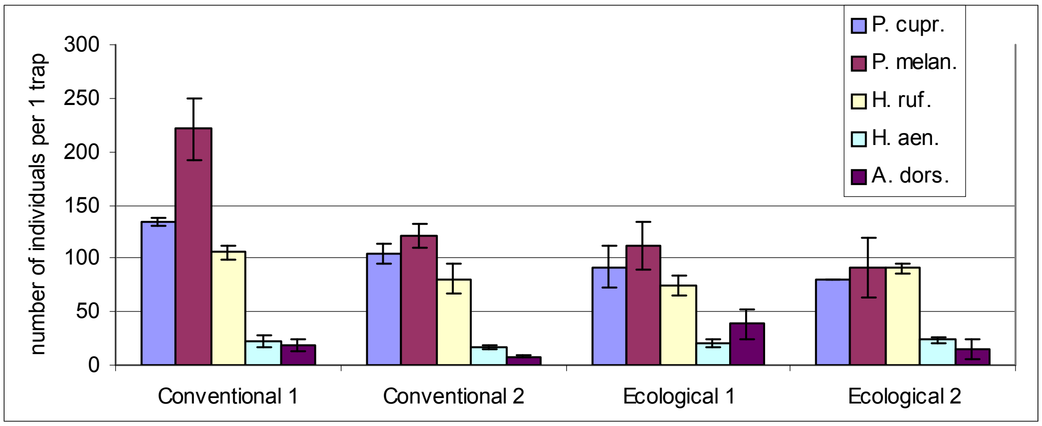

Fig. 2. Mean (± SD) number of eudominant, some dominant and subdominant carabid species in spring barley

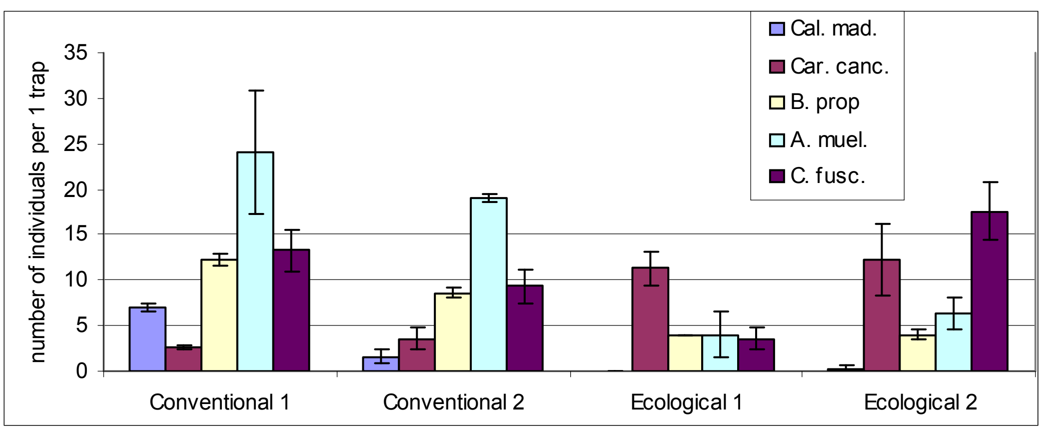

Fig. 3. Mean (± SD) number of some recedent, subrecedent and subdominant ground beetle species in spring barley

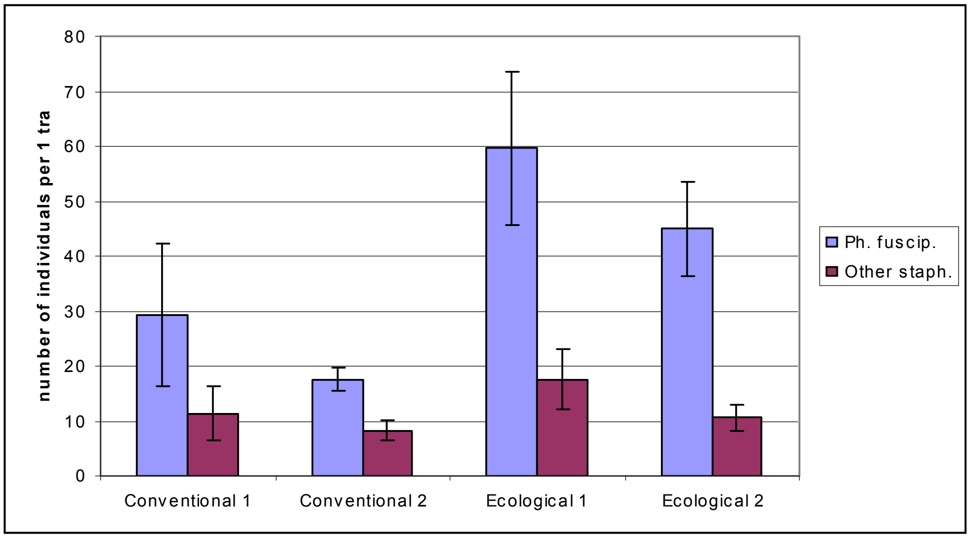

Fig. 4. Mean (± SD) number of rove beetles in spring barley

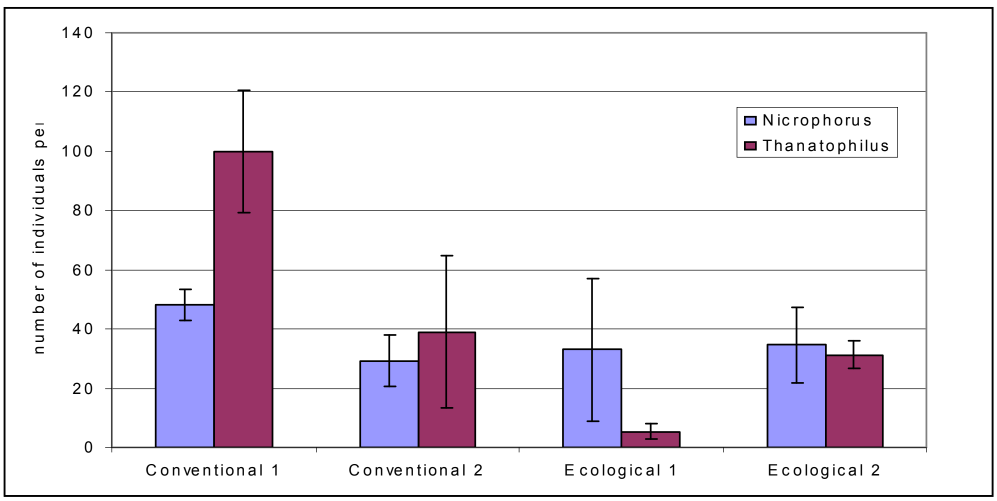

Fig. 5. Mean (± SD) number of some carrion beetles in spring barley

ticide was applied, contained a significantly lower number of *Bembidion properans* ($P<0.05$), as compared to the field where insecticide was not applied. The number of trapped *Calathus fuscipes* individuals in Conventional 2 field was considerably lower ($P<0.05$) than in Ecological 2 field. It remains unclear, why in Ecological 1 field, the number of trapped ground beetles of that species was the lowest.

Staphylinidae in the studied agrobiocenoses were inabundant. In conventionally managed barley their number comprised only 3-4%, while in ecologically managed –slightly more: 7-10%. *Philonthus fuscipennis* was distinguished as a dominant species. The number of individuals of this species, caught in conventionally managed barley where insecticide was applied, was considerably lower (P<0.05) than in ecologically managed barley.

Other *Philonthus* species, such as *Ph. varius, Ph. rotundicollis* and *Ph. addendus* were not so abundant. Most of them were detected in conventionally managed barley, where insecticide was applied. Here they comprised over 10% of all trapped staphylinidae. Meanwhile, in the field where insecticide was applied, their number was the lowest and comprised only 3.6% of all the staphylinidae in this agrobiocenosis.

Apart from ground beetles and staphylinids, beetles of other families were trapped as well, while the representatives of some families comprised a considerable portion of all trapped beetles. Namely, carrion beetles. In conventionally managed barley, where insecticide was not applied, the number of these beetles comprised 18.5% of all beetles in this agrobiocenosis. However, a reliably higher number (P<0.05) in this field, as compared to others, comprised carrion beetles of the *Thanatophilus* genus.

Apart from ground, staphylinidae and carrion beetles, beetles of 7 other families were also trapped, however, their relative abundance was comparatively low, thus this group was called "random beetles". Among these families, in almost all the studied fields, the most abundant were click beetles. In Conventional 1 field they comprised over 75 % of all random beetles and their amount was reliably higher (P<0.1), as compared to other studied fields.

Dynamics of beetle activity

Analysing the dynamics of beetle activity, some tendencies can be observed preconditioned by certain ecological factors and the biological peculiarities of individual species. The family of ground beetles were selected for a more detailed analysis, the individuals of which were the most active and most abundantly trapped.

In the Conventional 2 field, following insecticide application, a decrease in the activity of ground beetles was observed (the decrease in the activity of ground beetles in other fields might have been influenced by cooler and rainy weather at that time), however, after 4 days, their number in the traps significantly increased (Fig. 7). In order to explain this phenomenon, the activity of eudominant ground beetle species should be analysed separately. For instance, the activity of

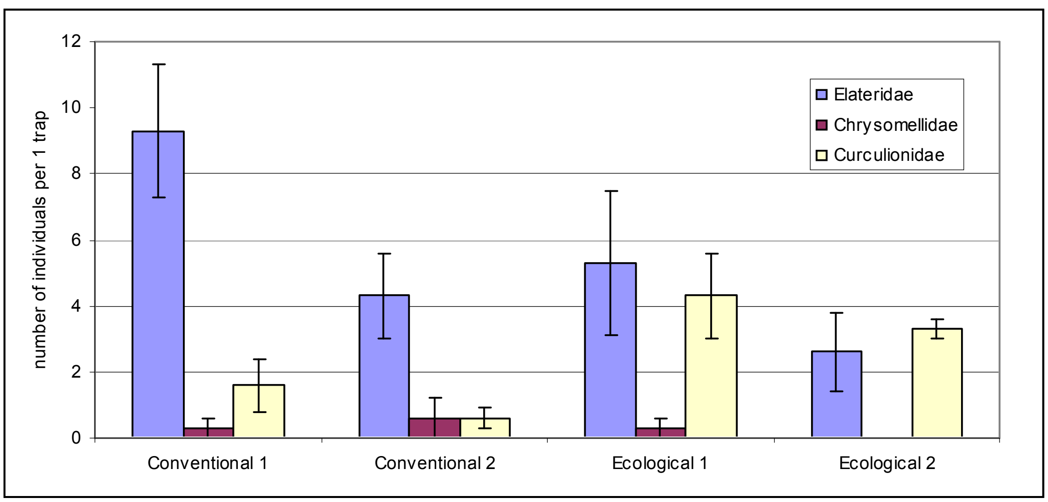

Fig. 6. Mean (± SD) number of some beetles in spring barley

Poecilus cupreus individuals after insecticide application decreases reliably and recovers after 4-7 days after application (Fig. 8). Meanwhile, the activity of *Pterostichus melanarius* individuals over the same period was consistantly higher than in the Conventional 1 field, where insecticide was not applied (Fig.9). This can be explained by the fact that after overwintering, *Poecilus cupreus* adults are most active in May-June, while the larvae of *Pterostichus melanarius* become imagos in the middle of summer, when their peak is observed. Here a conclusion can be drawn that insecticide aktara has the greatest effect on the adults of both the species. Such an increase in the activity of *Pterostichus melanarius* ground beetles at the end of June may be related to the appearance of a new generation of adults of the species.

However, in a week their activity in the Conventional 2 field decreases and is consistantly lower than the activity of the same ground beetle spe-

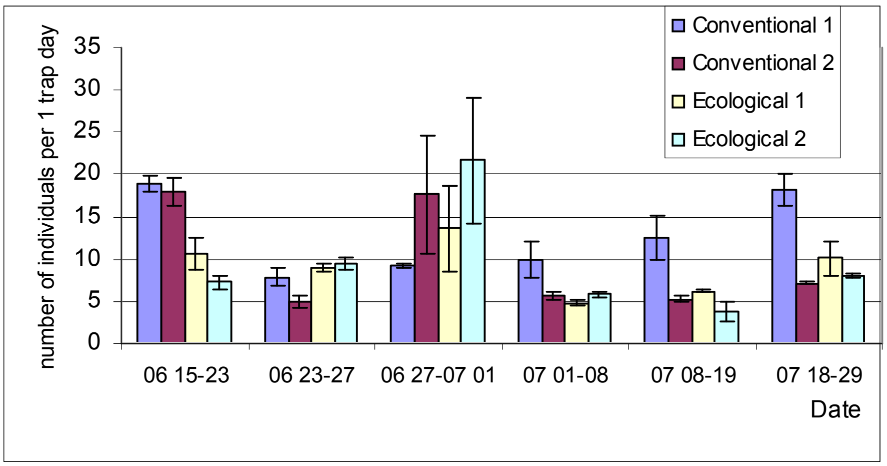

Fig. 7. Mean (± SD) activity density of carabid beetles in spring barley

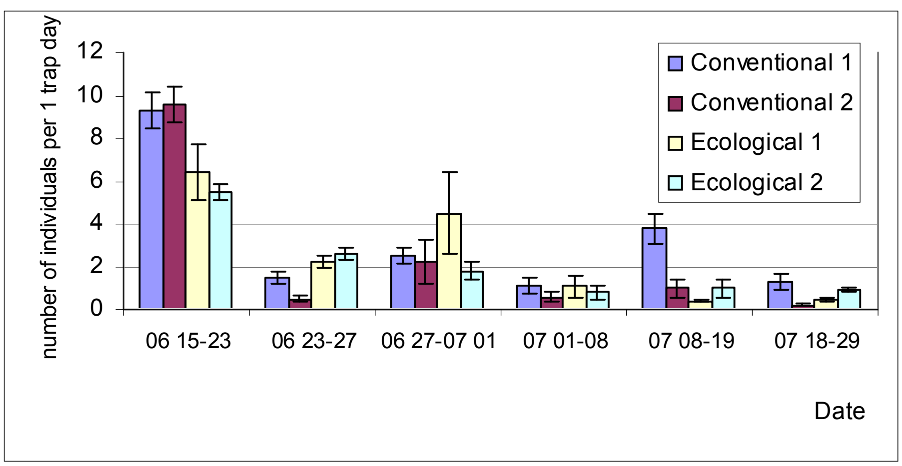

Fig. 8. Mean (± SD) activity density of *Poecilus cupreus* in spring barley

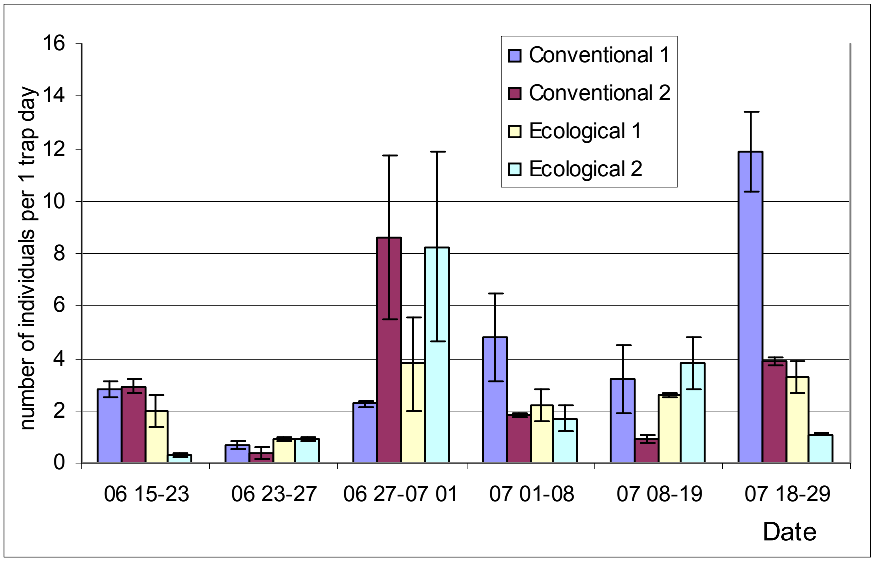

Fig. 9. Mean (± SD) activity density of *Pterostichus melanarius* in spring barley

cies in the Conventional 1 field, where insecticide was not used. This shows that the insecticide aktara affects adult *Pterostichus melanarius* individuals even 1 month after its application. Meanwhile, the activity of individuals of phytophagous ground beetles, such as *Harpalus rufipes* and *H. aeneus,* had no significant differences (Fig. 10, 11). In all the fields, their highest activity was recorded in July. The preparation of plant extract had no observable influence on the communities of epigeal beetles.

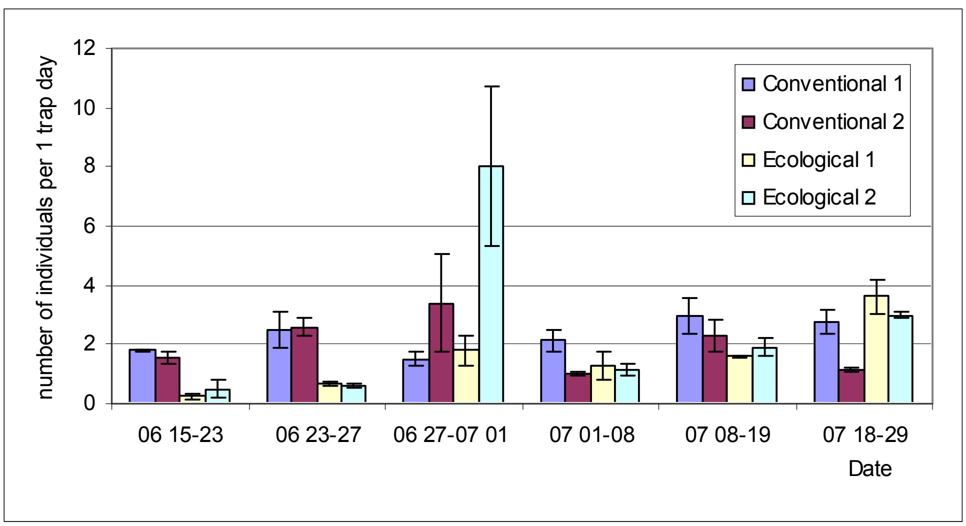

Fig. 10. Mean (± SD) activity density of *Harpalus rufipes* in spring barley

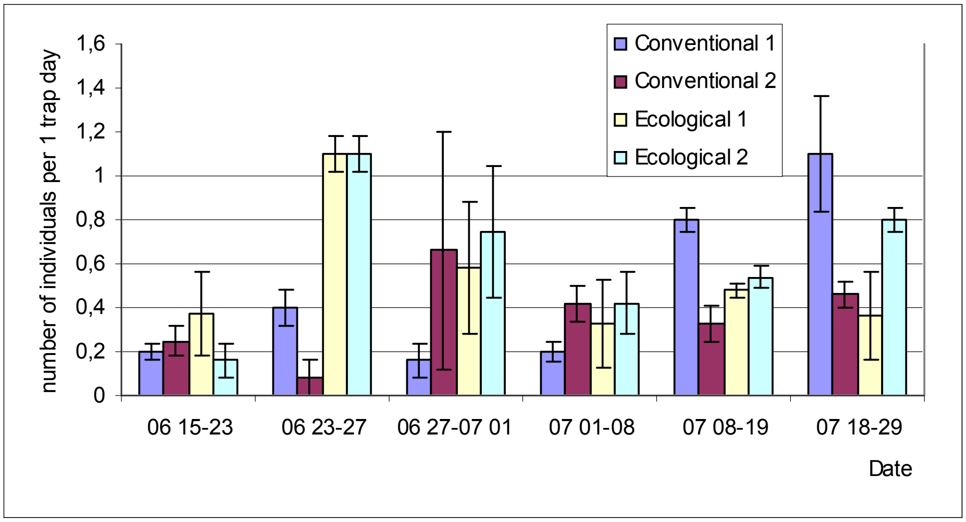

Fig. 11. Mean (± SD) activity density of *Harpalus aeneus* in spring barley

DISCUSSION

Analysing the study data, it can be said that even a relatively short period of study (45 days) allowed to ascertain the composition of the epigeal beetle community in barley agrobiocenosis. The results of similar studies, although carried out for a longer period of time, are similar (Andersen 1991, Hokkanen & Holopainen 1986, Tonhasca 1993, Luik et al.2000, Tamutis 2000, Tamutis 2002, Tamutis et al. 2004). Some species were detected in Lithuanian agrobiocenoses for the first time, namely *Calosoma maderae auropunctatum, Cilyndera germanica, Pterostichus macer*. The index of species diversity (H') in the studied fields differed a little and was relatively high, as compared to the results of similar studies in other countries. For example, in southern England the value of this index comprised only 2.1 and it was higher in conventionally managed fields (Shash et al. 2003), while in southeastern Norway, it failed to reach even 1.5 (Andersen & Eltun 2000). This shows that the studied agrocenoses are less degraded from the ecological viewpoint. Most ground beetles and staphylinidae are zoophagous and frequently compete for food. In conventionally managed barley fields, the number of caught individuals of such species as *Poecilus cupreus* and *Pterostichus melanarius* was significantly higher than in ecologically managed ones, although according to the data of some authors, the abundance of ground beetles in ecologically managed agrocenoses may be up to 20 times higher than in conventionally managed fields (Hokkanen & Holopainen 1986). On the one hand, this may demonstrate their higher tolerance of plant growing measures under conventional farming system. However, we cannot disprove the suggestion that this is determined also by competition for food with such species of beetles as *Carabus cancellatus, Clivina fossor, Anchomenus dorsalis* and *Philonthus sp*., which are far more abundant under ecological farming. The amount of staphylinidae was reliably higher in ecologically managed fields, although conducting studies 3 years previously in the same field of winter wheat, they were more frequent in conventionally managed fields. It was then found that the abundance of staphylinidae was positively influenced by fertilization with manure (Purvis & Curry 1984). Over the period of studies, carrion beetles were rather abundant in traps, however, their abundance should be analysed from another aspect. Firstly, the biology of the beetles should be taken into account. They feed on carrion, which they find by smell. Thus it would be wrong to ascribe these beetles to one or another habitat. Occurrence of the beetles in one or another trap might have been preconditioned by the smell of carrion coming out of the traps, attracting the beetles of this family. This suggestion becomes even more persuasive, having analysed relative abundance of individual species. The most abundant were the beetles of *Nicrophorus* and *Thanatophilus* genus, which are exceptionally strongly associated with carrion. Thus, in ecologically managed barley, the former comprised even 80% of all carrion beetles, while the latter were the most abundant in conventionally managed barley fields, where they comprised over 67 % of all carrion beetles in the fields. Meanwhile, carrion beetles of the *Silpha* genus were relatively inabundant, because they are mentioned more often as phytophagous and zoophagous than necrophagous. Obviously, the smell which attracted carrion beetles of the *Nicrophorus* and *Thanathophilus* genus, failed to attract them.

The negative influence of the insecticide aktara (*tiametoksam 250g/kg*) was observable on almost all species of epigeal beetles, however, the differences were not equally tendentious. For instance, *Calasoma maderae auropunctatum* were rare in the area treated with insecticides, while abundance differences of *Poecilus cupreus* and *Pterostichus melanarius* 5 days after spraying were unreliable between fields characterized by different application of insecticides. Later their activity reliably decreases in the field where insecticide was applied. This could be influenced by reduced food supply in the field, because aktara has a lethal influence on most insects and their larvae. This is partially confirmed by the number of phytophagous ground beetles, such as *Harpalus rufipes* and *H. aeneus*, which practically remained unchanged 5 days after spraying.

No tendentious differences in the beetle communities were ascertained between ecological fields, differing in the application of preparation made on the basis of plant extraction. This allows us to presume that the preparation fails to reduce the abundance of phytophagous and other invertebrates, which could have been the food of ground beetles and staphylinidae.

CONCLUSION

The epigeic beetle communities in summer barley have been represented by 11 families of the beetles, but the members of *Carabidae*, *Staphylinidae* and *Silphidae* have been more representative in the all study sites.. The positive effect of ecological management has been clear only for staphylinids and some of carabids beetles, such as *Carabus cancellatus*.

The species richness was higher (64 species), in ecologically managed spring barley while in conventionally managed barley only 58 species were captured. The index of species diversity (H') in the studied fields differed not so much and was from 2.4 in conventionally managed summer barley to 2.61 in ecologically managed fields, with a dominance index (d) – from 0.27 to 0.19 respectively.

Only few eudominants have been detected throughout the study in all research sites: *Poecilus cupreus* (24 -16%), *Pterostichus melanarius* (21 - 28%) and *Harpalus rufipes* (13 - 18%).

A negative influence of the insecticide aktara (*tiametoksam 250g/kg*) was observable on all species of epigeic beetles, however, the differences were not equally tendentious. In the area where insecticide aktara (*tiametoksam 250g/kg*) was applied, in the first week after spraying a distinct decrease in the activity of eudominant ground beetle adults of zoophagous species *Poecilus cupreus* was ascertained. A negative influence of the insecticide was observed on another eudominant species of zoophagous ground beetles *Pterostichus melanarius* as well, however, only after 2 weeks since spraying. Taking into account the biology of the mentioned species, it can be assumed that the influence of the insecticide on the first species might have been direct, while on the other species it was indirect, just as a factor which reduced the amount of food in the area.

No tendentious differences in the beetle communities were ascertained between ecological fields, differing in the application of preparation made on the basis of plant extraction.

Study results have shown that the influence of management systems and insecticide aktara for structure of epigeic beetle comunities is not critical. There are important other factors, such as: food resources, intraspecific and interspecific competition in this agosenoces. The main goals of further research will be to evaluate the role of these factors on structure of epigeic beetle community in agrocenoses.

REFERENCES

Alford D.V. 1999. A text book of Agricultural entomology. Blackwell Science. Cambridge. Pp. 314.

Andersen A., Eltun R. 2000. Long-term developments in the carabid and staphylinid (Col., *Carabidae* and *Staphylinidae*) fauna during conversion from conventional to biological farming. Journal of Applied Entomology. Blackwell Wissenschafts-Verlang, Berlin, P. 51-56.

Andersen A. 1992. Predation by selected carabid and staphylinid species on the aphid *Rhopalosiphum padi* in laboratory and semi-field experiments. Norwegian Journal of Agricultural Sciences. Vol. 6: 265-273.

Baars M.A. 1979. Catches in pitfall traps in relation to mean densites of carabid beetles. Oecologia Vol. 41:25-46.

Buivydaitė V., Vaičys M., Juodis J., Motuzas A. 2001. Classification of yhe soils of Lithuania. Vilnius. Pp. 137. (in Lithuania: abstract in English)

Campbell R.C. 1989. Statistics for biologists. Cambridge University Press. pp. 446.

Chiverton P. A. 1986. Predator density manipulation and its effects on populations of *Rhapalosiphum padi* (*Hom: Aphididae*) in spring barley. Annals of Applied Biology. 109: 49-60.

Dritschilo W., Wanner D. 1980. Ground Beetle Abundance in Organic and Conventional Corn Fields. Environmental Entomology. 9: 629-631.

Good J.A., Giller P.S. 1991. The effect of cereal and grass management on staphylinid (Coleoptera) assemblages in south-west Ireland. Journal of Applied Ecology Vol. 28: 810-826.

Hokkanen H., Holopainen J. K. 1986. Carabid species and activity densites in biologically and conventionally managed cabbage fields. Journal of Applied Entomology. 102: 353-363.

Hłrka K. 1996: *Carabidae* of the Czech and Slovak Republics. Illustrated key. Zlin. Pp. 565.

Kazlauskas R. 1984. Lietuvos drugiai (Butterflies of Lithuania)

Kromp. B. 1989. Carabid Beetle Communities (*Carabidae, Coleoptera*) in Biologically and Conventionally farmed Agroecosystems. Agriculture, Ecosystems and Environment. 27: 241-251.

Leitschert D 1986. Untersuchunben zur Arthropoden und Annelidenfauna von Weizen und Zuckerrübenfeldern in einem konventionellen und einem biologisch-dynamischen Anbau. Angew. Zool. 73: 93-113.

Luik A., Eenpuu R., Heidemaa M., Arus L., Tarang T., Vares A. 2000. Carabids in different agrocoenosis of Estonia. Proceedings of the International Conference "Development of environmentally friendly plant protection in the Baltic region". Tartu: 114-117.

Luff M.L. 1989. Biology of polyphagous ground beetles in agriculture. Biology and population dynamics of invertebrate crop pests. Ed. by Russell G. E. Andover. Intercept Ltd. 209-250.

Luff M.L., Eyre M.D., Rushton S.P. 1992. Classification and prediction of grassland habitats using ground beetles (Coleoptera, Carabidae). Journal of Environmental Management vol. 35: 301-315.

McAleece N., Lambshead P.J.D., G.L.J. Peterson. 1997. Software BioDiversity Pro. © The Natural History Museum & The Scottish Association for Marine Science. Oban. Scotland.

Mroczkowski M. 1955. Omarlicowate – *Silphidae*. Kłucze do oznaczania owadow Polski. Cz. XIX. Coleoptera. Zeszyt. 25. – Warszawa. pp. 29.

Opredelitel nasekomyh Evropeijskoj chasti SSSR. Zhestkokrylye i veerorrylye. (Key of insects of western part of USSR. Coleoptera and Strepsiptera) T2. Ed. Kryzhanjvskij O.L., Gureva E.L. 1965. Moskow-Leningrad. Nauka. pp. (in Russian)

Pileckis S., Šaluchaitė A. 1993. The investigation of beetles species composition and dynamic in different farmed summer barley. Acta Entomologica Lituanica, - Vilnius: Academia . -Vol.: 11. P. 99 - 105. (In Lithuanian: abstract in Engish).

Pileckis S., Monsevičius V., 1995. Lietuvos fauna. Vabalai (Fauna of Lithuania. Coleoptera). T.1. Vilnius. Pp. 1-303. (in Lithuanian ; abstracts in English and Russian).

Pileckis S., Monsevičius V., 1997. Lietuvos fauna. Vabalai (Fauna of Lithuania. Coleoptera). T.2. Vilnius. Pp. 1-216. (in Lithuanian ; abstracts in English and Russian).

Purvis G. and Curry J. P. 1984. The influence of weeds and farmyard manure on the activity of Carabidae and other ground-dwelling Arthropods in a sugar beet crop. Journal of Applied Ecology Vol. 21: 271-283.

Shah P.A., Brooks D.R., Ashby J.E., Perry J.N., Woiwod I.P.2003. Diversity and abundance of the coleopteran fauna from organic and conventional management systems in southern England. Agricultural and Forest Entomology. Vol. 5 (1): 51-60.

Smreczynski S. 1966. Ryjkowce – *Curculionidae* (*Otiorhynchinae, Brahyderinae*). Kłucze do oznaczania owadow Polski. Cz. XIX. Coleoptera. Zeszyt 98b. – Warszawa. pp. 130.

Smreczynski S. 1974. Ryjkowce – *Curculionidae* (*Curculioninae*). Kłucze do oznaczania owadow Polski. Cz. XIX. Coleoptera. Zeszyt 98e. – Warszawa. pp. 180.

Szujecki A. 1961. Kusakowate - *Staphylinidae*. Myśliczki (*Steninae*) Klucze do oznaczania owadow Polski. Cz. XIX (*Coleoptera*). Zeszyt 24 b. - Warszawa. pp.72.

Szujecki A. 1965. Kusakowate - *Staphylinidae*. Kiepurki (*Euaesthetinae*) i żarlinki (*Paederinae*) Klucze do oznaczania owadow Polski. Cz. XIX (*Coleoptera*). Zeszyt 24 c. - Warszawa. pp. 74.

Szujecki A. 1976. Kusakowate - *Staphylinidae*. Wydlużaki (*Xantholininae*) Klucze do oznaczania owadow Polski. Cz. XIX (*Coleoptera*). Zeszyt 24 d. - Warszawa. pp. 44.

Szujecki A. 1980. Kusakowate - *Staphylinidae*. Kusaki (*Staphylininae*) Klucze do oznaczania owadow Polski. Cz. XIX (*Coleoptera*). Zeszyt 24 e. - Warszawa. pp. 163.

Sunderland K. D., Crook N. E., Stacey D. L., and Fuller B.J. 1987. A study of feeding by polyphagous predators on cereal aphids using ELISA and gut dissection. Journal of Applied Ecology. Vol. 24: 907-933.

Tamutis V. 1999. The entomofauna of soil surface in rape agrobiocenoses. Ekologija., Vol.: 1: 18-24. (In Lithuanian: abstract in Engish).

Tamutis V. 2000. Carabid beetles species diversity and abundance in some agrobiocenoses. Proceedings of the International Conference. "Development of environmentally friendly plant protection in the Baltic region". Tartu: 200-204.

Tamutis V. 2002a. *Pterostichus* (*Col.: Carabidae*) abundance dynamics and distribution in different agrobiocenoses. *Ekologija*. Vol. 3: 44 - 49. (In Lithuanian: abstract in Engish).

Tamutis V. 2002b: Rove beetles (*Col.: Staphylinidae*) in cereals. LZUU mokslo darbai "Vagos" Vol. 55 (8): 62-66. (In Lithuanian: abstract in Engish).

Tamutis V., Monsevičius V., Pekarskas J. 2004. Ground and rove beetles (Coleoptera: Carabidae, Staphylinidae) in ecological and conventional winter wheat fields. Baltic J. Coleopterol., 4 (1): 31-40.

Tamutis V., Černiauskaitė-Kedienė V. 2005. The hibernated beetles (Coleoptera) in the soil surface of orchard. Book of abstracts 3rd International conference "Research and conservation of biological diversity in Baltic region" Daugavpils: 128-129.

Thiele H. U. 1977. Carabid Beetles in Their Environments. Zoophysiology and Ecology 10. Springer, Berlin. pp. 361.

Tishler B. 1971. Agricultural egology. Moscow. Kolos. pp. 456. (In Russian)

Tonhasca A. J., 1993. Carabid beetle assemblage under diversified agroecosystems. Entomologia experimentalis et applicata. Vol. 68: 279-285.

Wallin H.1985. Spatial and temporal distribution of some abundant carabid beetles (Coleoptera: Carabidae) in cereal fields and adjacent habitats. Pedobiologia Vol. 28:19-34.

Warchałowski A. 1978. Stonkowate – *Chrysomelidae* (*Halticinae, Hispinae* i *Cassidinae*). Kłucze do oznaczania owadow Polski. Cz. XIX. Coleoptera. Zeszyt 94c. – Warszawa. pp. 157.

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