OCCURRENCE AND FAUNA COMPOSITION OF GRUOND BEETLES IN WHEAT FIELDS

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ABSTRACT

According to this research, among the collected Coleoptera the most numerous were the epigeobiotic species of the families Carabidae, Silphidae, Staphilinidae, Curculionidae, Scarabaeidae and Chrysomelidae. Based on the number of individuals and the percentage of encounters in the studied areas, the Carabidae stand out in comparison to the other Coleoptera which is proved by the qualitative and quantitative composition of the collected fauna (36 species and 7,768 individuals). The representatives of the family Carabidae are of certain economic significance as well. Within this family the dominant and subdominant species in 2006 year were Agonum (Anchomenus) dorsalis (Ponto ppidan,1763) and Pterostichus (Poecilus) cupreus (Linnaeus, 1758) and in 2007, besides those, the same quantitative category also comprised the species Stomis pumicatus (Panzer,1795) , Trechus quadristriatus (4-stiatus) (Schrank, 1781), Harpalus (Pseudoophonus) rufipes (De Geer, 1774) and Harpalus distinguendus (Duftschmid, 1812).

Key words: Coleoptera, Carabidae, active dominance, density, succession, wheat, soil

INTRODUCTION

In the macroentomofauna of the agricultural crops, according to the research work of the authors from other countries, (Belorussia, Germany, Russia, Poland and others), the Carabidae are, among the Coleoptera, the most numerous in the percentage of 20-30% and in some biocenoses even in 50-60% in the total of the collected entomofauna [1, 4, 5, 8, 9, 20, 25].

The representatives of the family Carabidae are of certain economic significance and there are over 25,000 known species. Some representatives of this family can appear as pests, whereas, on the other hand, they are far more known as very beneficial i.e. as zoophags. It is also known that some species and genera of the Carabidae positively affect, through their life activity, the physical properties and air-water conditions of the soil. According to Brauns [7], in his well-known "Praktische Bodenbiologie" imagoes and larvae of the Carabidae are exceptionally significant members of zoocenoses of farm land, both as predators and pantophags or as saprophags. That is why this family of insects, due to their features can be used in a great number of studies, and as a reliable indicator of biocenoses since it promptly reacts to the changes of the soil conditions such as salinity, hydro-thermal conditions, mechanical composition, configuration or as an indicator of vegetative cover.

The diversity and abundance of the Carabidae family representatives as well as their multifold economic significance on agricultural crops drew the attention of a great many researchers. That is why the species of this family are a relatively common subject of studies concerning various problems related to biology, science of fauna, taxonomy, ecology and particularly those related to their place and role in the communities of different habitats. In our country, the studies of this family of Coleoptera refer mostly to forests and other natural biotopes.

The research of the Carabidae in the region of Vojvodina has been reported in the papers by Gradojević [18] and Stančić [30]. They deal with the studies of biotopes in the locality of Deliblatska Peščara and concerning the objective of the studies they are characterized by a relatively small number of species. A more thorough presentation of the research of the Carabidae family fauna in agrobiocenoses of Vojvodina, in the region of Srbobran on calcareous chernozem and in Horgoš on sandy chernozem was reported by Sekulić [29].

Bearing in mind the economic significance of this family, as well as to what extent it was studied, the aim of this paper was researching the qualitative and quantitative composition of the Coleoptera species, particularly the Carabidae family, in relation to various threatened chernozem and wheat varieties and to determine the total density of the Coleoptera population in the studied soil and plant varieties and the dynamics of their occurrence as well.

MATERIAL AND METHOD

Starting from the domination of geobiotic insects which spend most of their life in soil and manifest their imaginal activity on the surface of the soil (epigeobiotic species) the method of "Barber traps" has been applied, which also has the advantage in the interpretation of the results in comparison with other methods of catching dishes, was applied. Adapted to the given conditions, double plastic containers for the collection of fauna were used as Barber traps, while a basic one still remains in the soil.

By means of this method in the localities spatially apart, it is possible to study the fauna continuously so that the valuable results necessary for the study of the kinship and differences between habitats are obtained. In the science of fauna this procedure is used for the determination of artropode structure in different biotopes so that, based on the comparative researches, conclusions regarding the distribution and dispersion of species in relation to the biotic and abiotic factors can be drawn. This procedure can also be used to monitor the fauna during winter months in certain localities. Taking this into account, the new findings regarding the succession of particular species as well as the periods of multiplication have been obtained. In recent times, by means of "automatic Barber traps" it has been possible to monitor the daily routine activity of epigeal fauna.

The research, the successions of epigeobiotic Coleoptera was carried out in the crop area of three different wheat varieties (NS-RANA 5, RENESANSA, PESMA) in the experimental field of the Institute of Wheat at Rimski Šančevi (Institute of Field and Vegetable Crops, Novi Sad), soil type: chernozem.

In the first year of the research, the experimental plots with different varieties of wheat were next to each other whereas in the second year the plots with PESMA and RENESANSA were together while the variety NS-RANA 5 was 1 km away but on the plot of the same pedological and other features. In both years of the research, the size of the plot was 10 ha (± 1 ha) for each variety.

The total of 30 dishes were placed in the crop area of three different wheat varieties: NS-RANA 5, RENESANSA and PESMA i.e. 10 in each variety at the distance of 20 m in the same row of each field. As the preservative 4% formalin was used. In order to prevent the contamination of the dishes with the plant particles and to achieve the protection from rain and birds, the plastic roof-like covers on the aluminum props were placed above the catching dishes.

In the first year of the research the "Barber traps" were placed on 28/03/2006 and the collecting of insects was carried out in decades until 05/07/2006 whereas in the second year the dishes were placed in the fields on 02/04/2007 and the collecting of insects was also carried out in decades until 11/06/2007.

The determination of the collected insects was carried out in accordance with the accepted criteria [16, 19, 27], as well as by the experts from the Department of Phytomedicine of the Faculty of Agriculture in Novi Sad and by the comparison with the existing collection of previously determined species in Hungary, Holland and England. The microscopic investigation of insects was carried out by means of stereomicroscope (binocular), with the magnification up to 100 times.

All the numerical data obtained after the sample treatment were presented in the corresponding quantitative and qualitative indices. In order to determine the level of abundance of particular species i.e. the relative density, in accordance with the applied method, the term "active abundance" was introduced and used for the first time as long ago as 1953 by B. Heydemann. The active abundance gives the data on individual density or species density shown in the degree of their activity [6] and is a relative method in the quantitative study of living communities. The values of active abundance in our results are shown in decimal intervals, when the dynamics of strenght of total Carabidae habitats is analyzed in terms of the number of probes, i.e. hunting traps.

$$Na = \frac{Bi}{Bp}$$

Na - active abundance

Bi - number of individuals of given habitat

Bp - number of probes

In order to describe the structure of Carabidae family some other indices were applied. For the determination of the quantitative structure the "active dominance" which is calculated by Heydemann`s formula [cit. 6, 36] as used:

$$\mathrm{D}(\%) = \frac{\text{number of individuals of given species}}{\text{number of individuals of given habitat}} \times 100$$

D - stands for the active dominance of individuals of the given species.

For the determination of the type of dominance as well as the relation between the species the common categories were applied [26, 36]. The eudominant species were those whose relative value in relation to the total number of registered individuals was over 10%. The dominant species were those whose relative value in relation to the total number of registered individuals, during the study period, in a particular habitat (wheat variety) was over 5%. As subdominant species were designated those which amount to 1.0-4.99% in relation to the total number of individuals, whereas those whose relative number was 0.5-0.99% were labeled as recedent. The subrecedent, i.e. the last category, comprise those which were present in the percentage of 0.01-0.49%. The other species whose value was below the last category were not analyzed in depth and were labeled "the others".

With the aim of establishing the faunal similarities or the kinship within the family in the studied localities and cultures, the coefficient or "Sörens index" (1948), which is frequently used in the zoo-cenological researches [6, 36], was applied. Sörens index (Quotient of similarity) shows the similarity degree of species, two or more observed habitats, that is to say it takes into consideration the qualitative distinctive features of the observed group but not their quantitative proportion and is calculated according to the following formula:

$$I(\%) = \frac{2j}{a+b} \times 100$$

I - stands for the degree of faunal similarity or the identicalness of two observed habitats i.e. two biotopes or two cultures

J - common species for both habitats

a - species in habitat A

b - species in habitat B

The values of this index range from 0.0 – 100.0 % and the closer they are to the upper limit, the more similar the two observed habitats are in the structure of the fauna of the studied group.

RESULTS AND DISCUSSION

Based on the past research of the Carabidae fauna in agrobiocenosis it can be seen that the structure of the colony of this family in certain regions is affected by the ecological (abiotic and biotic) factors. By certain combinations of these factors the specific microclimatic conditions, which are a precondition for the characteristic fauna, are created.

In Moscow region, Šarova [31] identified 117 Carabidae

Table 1. Proportion of Carabidae species in wheat, during two years of research (Rimski Šančevi, 2006-2007 year)

No.	Carabidae species	2006		2007		Total	
		Number	%	Number	%	Number	%
1.	*Anchomenus dorsalis* (Pontoppidan, 1763)	6427	96,90	580	51,14	7007	90,23
2.	*Agonum viridicupreum* (Goeze, 1777)	-	-	1	0,09	1	0,01
3.	*Pterostichus (Poecilus) cupreus* (Linnaeus, 1758)	79	1,19	187	16,50	266	3,43
4.	*Pterostichus (Poecilus) sericeus* (Fischer, 1824)	34	0,51	4	0,35	38	0,49
5.	*Pterostichus melanarius (vulgaris)* (Illiger, 1798)	2	0,03	5	0,44	7	0,09
6.	*Pterostichus (Poecilus) punctulatus*(Schaller,1783)	2	0,03	-	-	2	0,03
7.	*Poecilus versicolor* (Sturm, 1824)	1	0,02	-	-	1	0,01
8.	*Pterostichus (Poecilus) koyi* (Germar,1824)	1	0,02	1	0,09	2	0,03
9.	*Pterostichus (Cophosus) cylindricus*(Herbst,1785)	27	0,41	-	-	27	0,35
10.	*Stomis pumicatus* (Panzer,1795)	14	0,21	61	5,38	75	0,97
11.	*Calosoma auropunctatum* (Herbst, 1784)	8	0,12	17	1,50	25	0,32
12.	*Carabus (Autocarabus) cancellatus* (Illiger,1798)	1	0,02	9	0,79	10	0,13
13.	*Carabus (Procrustes) coriaceus* (Linnaeus,1758)	-	-	1	0,09	1	0,01
14.	*Calathus fuscipes* (Goeze, 1777)	1	0,02	1	0,09	2	0,03
15.	*Anisodactylus signatus* (Panzer, 1797)	1	0,02	-	-	1	0,01
16.	*Harpalus albanicus* (Reitter, 1900)	-	-	1	0,09	1	0,01
17.	*Harpalus distinguendus* (Duftschmid, 1812)	-	-	109	9,61	109	1,40
18.	*Harpalus zabroides* (Dejean, 1829)	2	0,03	-	-	2	0,03
19.	*Harpalus tardus* (Panzer, 1796*)*	1	0,02	8	0,71	9	0,12
20.	*Harpalus (Pseudoophonus) rufipes* (De Geer, 1774)	15	0,23	37	3,26	52	0,67
21.	*Harpalus serripes*(Quensel in Schönherr, 1806)	1	0,02	-	-	1	0,01
22.	*Harpalus smaragdinus (Duftschmid, 1812)*	-	-	1	0,09	1	0,01
23.	*Harpalus rubripes* (Duftschmid, 1812)	-	-	1	0,09	1	0,01
24.	*Brachinus explodens* (Duftschmid, 1812)	4	0,06	4	0,35	8	0,10
25.	*Brachinus crepitans* (Linnaeus,1758)	1	0,02	7	0,62	8	0,10
26.	*Amara (Amara)saphyrea* (Dejean, 1828)	-	-	1	0,09	1	0,01
27.	*Amara (Amara) aenea* (De Geer, 1774)	1	0,02	-	-	3	0,04
28.	*Amara (Amara) similata (Gyllenhal, 1810)*	1	0,02	3	0,26	4	0,05
29.	*Amara (Amara) anthobia* (Villa et Villa, 1833)	-	-	2	0,18	2	0,03
30.	*Bembidion (Metallina) properans* (Stephens,1828*)*	-	-	3	0,26	3	0,04
31.	*Trechus quadristriatus (4-striatus*) (Schrank,1781)	7	0,11	74	6,53	81	1,04
32.	*Trechus pilisens* (Csiki,1918)	1	0,02	-	-	1	0,01
33.	*Laemostenus (Pristonychu) terricola* (Herbst, 1784)	-	-	8	0,71	8	0,10
34.	*Microlestes maurus* (Sturm, 1827)	-	-	1	0,09	1	0,01
35.	*Microlestes minutulus* (Goeze,1777)	-	-	1	0,09	1	0,01
36.	*Chlaenius nigricornis f.melanocornis (*Dejean, 1826)	-	-	6	0,53	6	0,08
	Number of specimens	6632	100,00	1134	100,00	7768	100,00
	Number of species	23		28		36	

species and established that each biotope has a characteristic species composition which enabled the differentiation of particular ecological complexes of species, forest, meadow, marsh and field. On the arable land the representatives of the cultural biotopes or field complex such as Bembidion (Metallina) properans (Stephens, 1828) , Harpalus (Harpalus) affinis (Schrank, 1781), Harpalus (Pseudoophonus) rufipes (De Geer, 1774), Amara (Celia) bifrons (Gyllenhal, 1810), Pterostichus melanarius (vulgaris) (Illiger, 1798) and Pterostichus (Poecilus) cupreus (Linnaeus, 1758) are prevalent.

There were numerous papers (nearly 500) dating from 1905-2008 devoted to the above-mentioned fields of research of this family of insects. The researchers from Russia, the countries of Central (Slovakia, Poland, Germany) and South-East Europe (Romania, Bulgaria, Albania) paid particular attention to the science of fauna and some ecological issues concerning the Carabidae of cultural biotopes. In other countries, particularly neighbouring countries, there has been less work regarding the questions dealing with the ecology of this family in agrobiocenoses [9, 10, 15, 21, 22, 24] and in our country the Carabidae fauna has been researched by Čamprag, [13], Sekulić, [29], Šrbac et al., [35], Štrbac, [32, 33, 34], Vukasović et al., [38], Ćurčić, [11], Ćurčić et al., [12].

During the two-year research work, the family Carabidae stood out in number. In the experimental fields of Rimski Šančevi, in three wheat varieties the total of 7,768 individuals of the Carabidae family were collected and sorted into 15 genera and 36 species. The greater number was noticed in the first year when 6,632 individuals were

Table 2. Active dominance of Carabidae in different wheat varieties during 2006 and 2007 year

Fam. Carabidae	Active dominance					
	2006			2007		
	NS-RANA 5	PESMA	RENESANSA	NS-RANA 5	PESMA	RENESANSA
Anchomenus dorsalis	d♣	d♣	d♣	d♣	d♣	d♣
Agonum viridicupreum	subr•					
Pterostichus(Poecilus) cupreus	subd♦	subr•	subd♦	d♣	d♣	d♣
Pterostichus(Poecilus) sericeus	reced®	reced®	reced®	subr•	subr•	subr•
Pterostichus melanarius (vulgaris)	oth⊗			subr•	subr•	subr•
Pterostichus (Cophosus) cylindricus	reced®	subr•	subr•			
Stomis pumicatus	subr•	subr•	subr•	d♣	subd♦	subd♦
Calosoma auropunctatum	subr•	oth⊗	subr•	reced®	subd♦	subd♦
Carabus (Autocarabus) cancellatus		oth⊗		subd♦	reced®	subr•
Harpalus albanicus				subr•		
Harpalus distinguendus				subd♦	d♣	d♣
Harpalus tardus		oth⊗		subr•		subd♦
Harpalus (Pseudoophonus) rufipes	subr•	subr•	subr•	subd♦	d♣	subd♦
Brachinus explodens	oth⊗		subr•	reced®		
Brachinus crepitans		oth⊗		subr•	reced®	reced®
Amara similata		oth⊗		subr•	subr•	
Bembidion properans	oth⊗	oth⊗	oth⊗			
Trechus quadristriatus (4- striarus)	subr•	subr•		subd♦	d♣	subd♦
Laemostenus (Pristonychu) terricola				subd♦	subr•	subr•

LEGEND: d♣ = dominant species; subd♦ = subdominant species; reced® = receding species; subr• = sub-receding species; oth⊗ = others

collected and sorted into 23 species, whereas in 2007 the number was significantly lower when only 1,134 individuals were recorded but they were more diverse so that 28 species were identified (Table 1).

The results of the faunal composition of the Carabidae show that the most numerous species in both years of study was Agonum (Anchomenus) dorsalis (Pontoppidan, 1763) with 6,427 (96.90%) individuals in 2006 i.e. 580 (51.14%) in 2007.

Besides this species, in the first year, the following were also found as more numerous: P. cupreus with 79 (1.19%) individuals, Pterostichus (Poecilus) sericeus (Fischer, 1824) with 34 (0.51%) individuals, Pterostichus (Cophosus) cylindricus (Herbst, 1785) with 27 (0.41%) and H. rufipes with 15 (0.23%) individuals. The other species in that year of the research work were at the level of single specimens.

In the second year P. cupreus with 187 (16.50%) individuals, Harpalus distinguendus (Duftschmid, 1812) with 109 (9.61%), Trechus quadristriatus (4-striatus) (Schrank, 1781) with 74(6.53%), Stomis pumicatus (Panzer, 1795) with 61 (5.38%), H. rufipes with 37 (3.26%) were also more numerous whereas the other species were scarce.

Out of all the identified individuals, in both years of study, the most numerous was A. dorsalis with 7,007 specimens or 90.23% while the significantly less numerour were P. cupreus with 3.43%, H. distinguendus (1.40%) and T. quadristriatus (1.04%). The other species were below 1% in number.

Besides the different proportion in 2006 and 2007, as shown in the table 1, the species composition as well as the number of the Carabidae family varried depending on the wheat variety and the plant habit during vegetation, which will be discussed further on.

Active dominance and abundance of Carabidae during two-year research

The term active dominance explains the quantitative structure of the Carabidae colony. According to our information from the years of research, there were not any eudominant species identified, while the others have been devided into five groups according to their strenght: dominant species, subdominant species, receding species, sub-receding species and others (Table 2).

In the table 2 it can be seen that in 2006 the dominant species was A. dorsalis (Figure 1) in all three wheat varieties, then as subdominant P. cupreus in the vatiety NS- RANA 5 and RENESANSA whereas in the variety PESMA the dominant species was from the group of sub-receding species. Only P. sericeus was recorded as receding species, based on the collected data.

Figure 1. *Agonum* (*Anchomenus*) *dorsalis* (http://www.koleopterologie.de/gallery/)

A great number of indentified individuals belonged to the sub-receding and other species. The species S. pumicatus and H. rufipes were recorded as sub-receding in all three varieties. Besides these two species the same group comprised also the following: P. cylidricus, Calosoma auropunctatum (Herbst, 1784), Harpalus zabroides (Dejean, 1829), Brachinus explodens (Duftschmid, 1812) and Trechus quadristriatus. Some of these species also occur in a smaller number depending on the variety, so that they can be classified as others as well.

They are: C. auropunctatum in the variety PESMA and B. explodens in the variety NS - RANA 5. Besides these two, which can belong to the group of others, there are 14 more species as shown in Table 2.

In the following year of the research work, 2007, the species A. dorsalis was also the dominant one but P. cupreus was dominant in all three varieties as well. The group of dominant species also comprised the following: H. distinguendus in the varieties PESMA and RENESANSA, S. pumicatus in the variety NS-RANA 5, H. rufipes and T. quadristriatus in PESMA. Some dominant species can also be subdominant in relation to the wheat variety and these are the species: S. pumicatus, H. distinguendus, H. rufipes and T. qadristriatus. The following were also found as subdominant: C. aoropunctatum, Carabus (Autocarabus) cancellatus (Illiger,1798), Laemostenus (Pristonychus) terricola (Herbst, 1784), Harpalus (Harpalus) tardus (Panzer, 1796), B. properans, Chlaenius nigricornis f. melanocornis (Dejean, 1826). The greatest number of species belonged to the group of sub-receding and receding: Agonum viridicupreum (Goeze, 1777), P. sericeus, Pterostichus melanarius (vulgaris), Pterostichus (Poecilus) koyi (Germar, 1824), Carabus (Procrustes) coriaceus (Linnaeus, 1758), Calathus (Calathus) fuscipes (Goeze, 1777), Harpalus (Harpalus) albanicus (Reitter, 1900), Brachinus (Brachinus) crepitans (Linnae us,1758), Amara (Amara) similata (Gyllenhal, 1810) and others, shown in Table 2.

As it has already been said the active abundance presents individual density or species density. If we analyze the two-year results, it is obvious that in 2006 a greater number of individuals was collected in the interval from 03/05 to 0/6/06 and from 27/06 to 05/07 (Table 3).

In 2007 there were no significant oscillations regarding the number, during the decade collecting of material, but the number of insects was rather equalized (Table 4), which is in the correlation with the weather conditions. Also, there were no extremely dry or rainy periods like in 2006. Instead, the weather conditions were rather constant during the vegetation.

As it has already been emphasized the number of the Carabidae, i.e. the dominance and density are directly dependent on both weather conditions, type of soil and plant varieties . Utrobina [37] established the relation between the population density of the Carabidae and the soil so that the populations were more numerous on ordinary and calcareous chernozem while on the others they were significantly less numerous. This phenomenon was explained by the same author through the fact that the number of Carabidae was in the positive correlation with the absolute density of the invertebrates in the soil,

Table 3. Active abundance of Carabidae in different wheat varieties, during 2006 year

Variety/Data	Active abundance								
	09.04.	18.04.	03.05.	15.05.	26.05.	06.06.	16.06.	27.06.	05.07.
NS-RANA 5	0	2,2	27,1	26,7	47,1	10,9	0,8	9,9	175,7
PESMA	0	1,9	23,9	21,6	28	7,1	24,5	1,9	57,5
RENESANSA	0,1	1,9	32,3	23,3	30,7	6,8	12,1	6,5	82,9

Table 4. Active abundance of Carabidae in different wheat varieties, during 2007 year

Variety/Data	Active abundance						
	13.04.	24.04.	04.05.	14.05.	24.05.	01.06.	11.06.
NS-RANA 5	2,7	8,3	11,8	3,2	5,9	6,7	6,0
PESMA	1,2	1,0	1,9	4,4	2,3	10,7	2,2
RENESANSA	3,0	4,5	5,4	12,7	5,9	1,8	11,8

whose number was dependent on the humus content to a great extent. Čamprag et al. [14] reported that the highest population density of the Carabidae was on sandy soil whereas on the chernozem as well as on marshy mould it was lower. According to the number indices a higher average number of insects were established on alluvial soil, then on the degraded chernozem and chernozem and the lowest on the marshy mould [32]. Some of the authors, point out that the density of one habitat is also dependent on the plant cover [3]. Also, Mišćenko [28], while studying the species composition and some ecological distinctive features of the Carabidae on the sandy soil in the region of Harkovsko, reported that the qualitative composition and abundance changed in response to the vegetation. In the habitats which had rather scarce vegetation some xerophilous species were recorded as dominant. When the differences in the composition and the number of fauna between the natural and cultural biotopes are observed, most authors are of the opinion that the natural biocenoses are more diverse, i.e. richer [23]. In the cultural biotopes with the regular tillage and crop rotation each year, it has been observed that only those forms characterized by a high ecological adaptability can survive [17].

The study of this family, on various soils and cultures, show a high degree of similarity or kinship on the observed areas [2]. This refers to the qualitative composition but concerning the abundance there can be greater differences between certain species. If the existing species and the degree of their dominance are analyzed, it is obvious that the widely spread species are prevalent [29]. Kovačević [24], when studying the harmful entomofauna on the soil in eastern Slavonia, identified 12 Carabidae species and as the most numerous among them, H. rufipes, which was found on all types of soil and different cultures.

Sekulić [29] based on the obtained data points out that the Carabidae fauna, in the quantitative sense, is comprised of relatively small number of species. The dominant and subdominant species, which are few, in most cases participate with over 75% in the total collected material. The species which are labeled as receding, sub-receding and others, according to Sekulić, are of lesser significance in the quantitative sense as they are represented with a few or only one specimen.

Based on the climatic, microclimatic and other factors existing in the wheat crop, which affect the composition, abundance and time distribution of the Carabidae, it can be concluded that the basis of the fauna are the xeromesophilous and mesophilous forms which prefer the open biotopes, such as: H. distinguendus, H. rufipes, P. cupreus, P. sericeus, C. auropunctatum, Anisodactylus signatus (Panzer, 1797), A. dorsalis, B. properans and others [29].

In the vicinity of Osjek, by the analysis of total dynamics of the occurrence of the Carabidae, expressed through the active abundance and by comparing the course of the curve of the active abundance of decade collecting and the total decade precipitation, a positive relation is evident. On the studied biotopes, significant differences in species composition and the dynamics of the occurrence of the Carabidae were established. The highest active abundance of the Carabidae per average dish was in alfalfa (19.7), then in wheat (11.6) and the lowest in sugar beet (3.9) [33]. The same author identified 19 species in total by soil sampling in the region of Apatin in 1979. A greater number of species belonged to the group of pantophags and zoophags whereas the portion of particularly harmful species was negligible [32], which corresponds with our results.

Degree of faunal similarity, Sörens index (Quotient of similarity)

The index of faunal similarity, which also shows the dynamics and the composition of the Carabidae family species, amounted to 74.07% on the varieties NS-RANA 5 and RENESANSA in the first year. This indicates a high degree of similarity between the observed wheat varieties. Lesser equality in the relation to the species composition was observed between the varieties NS-RANA 5 and PESMA as well as RENESANSA and PESMA (Table 5).

During 2007 the situation was reverse. A greater similarity was observed between NS-RANA 5 and PESMA and RENESANSA and PESMA i.e. the Sörens index ranged in the interval from 71 – 80% while in the varieties NS-RANA 5 and RENESANSA it was 66.67% (Table 5).

As stated above, the representatives of the Carabidae family are very important bioregulators of the population of insect pests. In other words, they affect the reduction of their number. This extremely important family is

Table 5. Degree of faunal similarity in studied wheat varieties

2006. Carabidae	NS-RANA 5	PESMA	RENESANSA
NS-RANA 5			
PESMA			
RENESANSA			

2007. Carabidae	NS-RANA 5	PESMA	RENESANSA
NS-RANA 5			
PESMA			
RENESANSA			

LEGEND:

	0-30%
	31-40%
	41-50%
	51-60%
	61-70%
	71-80%
	81-100%

present in faunal discussions in our open biotopes, and less in the environmental conditions. This is of particular importance, because anthropogenic factor i.e. the level of production of different crops, chemicals, fertilization and pesticides almost has a crucial influence on their abundance and species composition.

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