THE INFLUENCE OF ORGANIC MANURE APPLICATION ON DYNAMISMS OF OCCURRENCE OF EPIGEIC GROUPS WITH FOCUS TO CARABIDAE

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Abstract: *The aim of this work was to investigate the effects of different rates of organic fertilizers (farmyard manure and bio sludge) on occurrence of soil organisms with focus to species of family Carabidae. Experiment was realized in agricultural field experiment in the research farm Kolíňany of the Slovak Agricultural University in Nitra. Biological material was collected using the earth trap method, during the years from 2007 to 2009. Total area of trial was 9000 m^2 diving into five treatments. Samples were taken from five treatments: A, unfertilized; B, 25t.ha^{-1}farmyard manure; C, 50 t.ha^{-1}bio sludge; D, 50 t.ha^{-1} farmyard; E, 100 t.ha^{-1}biosludge. Collections of epigeic material were realised during vegetation period from April to October. Totally 60 472 individuals of soil organisms were collected from which 35 species totally. The higher abundance and higher level of dominance were determined by Coleoptera, Acarina, Araneidea, Collembola and Opilionidea. Other investigation epigeic groups were for example Formicoidea, Heteroptera, Diplopoda, Chilopoda, Lumbricidea and otheras, they were represented abundance increased 5 %. Family Carabidae has dominant share in all treatments with 35 720 individuals. Other important families increased the biodiversity of this monitored site occurred as follows Silphidae, Cryptophagydae, Curculionidae, Liodidae, Scydmanidae, Coccinelidae and others. Focus of our experiment was followed by determination to particular family with special interest to Carabidae species. As the dominant species were determined Pseudoophonus rufipes and Brachinus crepitans. From other determined species increased 5 % of occurrence were determined Pterostichus melanarius, Pterostichus angustatus, Pterostichus cylindricus, Pterostichus niger, Pterostichus vernalis, Carabus coriaceus, Carabus ullrichi, Carabus violaceus, Badister bipustatulus, Harpalus distinquendus, Harpalus tardus and Calathus fuscipes. The attributes of specific identity according by Jaccard ranged from 58.33 to 80.95 %, and those of dominant identity from 86.58 to 96.02 %. The total attributes of diversity was 0.9559. Particular variability of abundance of evaluated communities was influenced by agro technology, year conditions with relation to type and amount of organic manure. Maximal abundance was also noted at unfertilized treatments.*

Key words**:** *biosludge, biodiversity, Carabidae, organic matter, soil organisms*

INTRODUCTION

Renewable energy from biogas power station produced also as organic waste material - biosludge as a new ecologically acceptable organic manure (PETRVALSKY et al., 2005). The application of organic matter in form of FYM and biosludge plays an important role in developing of specified zooedaphon community including family *Carabidae*. Apart from decomposition processes the main role of zooedaphon is stressed in development of soil characteristics and stabilization of soil fertility (PORHAJAŠOVÁ et al., 2005; VICIAN et al., 2007; POSPIŠIL and ONDREJIČKOVÁ, 2008). According to LŐWEI et al. (1996), the occurrence of *Carabidae* is inversely related to organic manure application. In the contrary of this statement are finding that *Carabidae* prefer an application of organic manure mainly *Pterostichus*

melanarius (KROMP, 1990). Excessive input of slurry manure increased the dominance of high tolerant and expansive species *Pseodoophonus rufipes* while other species disappeared (KABACYK and WASYLIK, 1986).

Occurrence of *Carabidae* is significantly influenced by vegetation structure connected with various anthropogenic actions that influenced also the potential of predators in ecosystems (CARDAMO and SPENCE, 1994; IRMLER, 2003). Occurrence of *Carabidae* can not be limited only to natural habitat; they definitely belong into family with dominant occurrence in agroecosystems. *Carabidea* sensitively react to toxic materials (insecticides, herbicides etc.), on the soil pH changes, the change of soil humidity. From this reason they may be used as bioindicators of environmental changes in natural or agricultural ecosystems.

Any intervention into to environment is reflected by a change in living populations of the environment (SZOMBATHOVÁ et al. 2007; PORHAJAŠOVÁ et al., 2008a, b).

The aim of the work is to find out the influence of evaluated doses of organic manure (farm yard manure and biosludge) on occurrence of edaphone with respect of *Carabidae* family in agroecosystem.

MATERIAL AND METHODS

During 2007 till 2009 collections of soil edaphon were realized by the method of soil traps in agricultural field experiment in the research farm Kolíňany of Slovak Agricultural University in Nitra. The experimental site belongs to warm and moderate arid climatic region, with normal average precipitation 631 mm and 9.7 °C temperatures and 160-180 m altitude. The main soil type is Orthic Luvisol. Collections of epigeic material were realised during vegetation period from April to October by soil trap. Total area of trial was 9 000 m^2 dividing into five treatments. The size of one treatment was 100 m long and 18 m wide. The fertilization treatments as follows: A – non fertilized control; B – 25 t ha^{-1} farmyard manure; C – 50 t ha^{-1} biosludge; D – 50 t ha^{-1} farmyard manure; E – 100 t ha^{-1} biosludge. Focus of our experiment was order beetles *Coleoptera* followed by determination to particular family with special interest to *Carabidae* species. Family *Carabidae* was evaluated by indexes as follows: abundance, species dominance, species identity according Jaccard index (I_A), dominant identity according Rennkonen (I_D), level of diverzity according Shannon-Weaver index (d) and biodiversity.

Research was carrying out at the Experimental Station of the SAU in Nitra, location Kolíňany 10 km north east from Nitra. The experimental site belongs to warm and moderate arid climatic region with the LTA precipitation of 631 mm and 9.7 and 160-180 altitude. Soil type was Haplic Luvisol, clearly affected by antropogenic activity. Humus layer was sand-loamy with the middle content of humus (2.15), l pH in KCL was strong acid or acid (pH 4.59-5.39). (CHLPÍK and POSPIŠIL, 2004; ŠÁLY et al., 2004). Collections of epigeic material were realized during vegetation period at field trial of sugar beet (2007, *Beta vulgaris*) spring barley (2008, *Hordeum vulgare*) and sunflower (2009, *Helianthus annus*) from April to October. Soil traps (2% soilution of formaldehyde) were control and renew in month interval.

RESULTS AND DISCUSSIONS

During three years of collections of epigeic material in frame of five treatments was obtained totally 60472 individuals of soil edaphon belongs to 23 epigeic groups with dominant occurrence (more than 5%) of *Coleoptera, Acarina, Araneidea, Collembola* a *Opilionidea.* Maximal occurrence of individuals (Table 1) was noted in unfertilized treatment –A which is in agreement to statement of L.-BARTOŠOVA (2005), CANDRÁKOVÁ and LÍŠKA (2006), that intensive tillage may reduce abundance of beneficial organisms including family *Carabidae*. However from our results documented in table 1 is evident the almost equal

representation of individuals due proximity of treatments and migration is regular. Similarly MAJZLAN (2002) found out identical dominant groups *Acarina, Araneidea* and *Collembola.* Their high dominance is probably related with their trophic preference. The trophic preferences of soil invertebrates such as *Collembola* are often determined by the analysis of gut contents, or through visual observations of the location of individuals (CHAMBERLAIN et al., 2006). According PETŘVALSKÝ et al. (2005) dominant group play important role with relation to soil and there are evidence of homeostatic environment.

According above mentioned, the evaluation of another epigeic groups as *Formicoidea, Heteroptera, Diplopoda, Chilopoda Lumbricidea* and the other species belongs to the subdominant, the recendent and the subrecendent groups with occurrence under 5% is only complement. Occurrence of these species is important from biodiversity of agroecosystems.

Species of order *Coleoptera* were classified into 15 families with dominant position of target family *Carabidae* (table 2).

Table 1

Abundance of epigeic grops on the locality Kolíňany in the years 2007 – 2009

Epigeic group with occurrence above > 5% /treatment		*Coleoptera*	*Acarina*	*Aranei dea*	*Collembola*	*Opilionidea*	Other epigeic groups under < 5 %	Total
A	ind.	8786	2180	634	602	274	1206	13682
	%	64.21	15.93	4.63	4.39	2.01	8.83	100.00
B	ind.	7078	1892	912	474	226	1142	11724
	%	60.37	16.14	7.78	4.04	1.93	9.74	100.00
C	ind.	8058	1058	598	552	352	1322	11940
	%	64.67	12.19	4.79	4.43	2.82	11.18	100.00
D	ind.	7218	1614	632	1024	376	796	11660
	%	61.91	13.84	5.42	8.78	3.22	6.83	100.00
E	ind.	7788	1788	634	282	100	874	11466
	%	67.92	15.59	5.53	2.42	0.87	7.67	100.00
Total	ind	38928	8532	3410	2934	1328	5340	60472
	%	64.37	14.12	5.64	4.85	2.19	8.83	100.00

The family belongs to polyphagous predators and play important role in agrocenoses and natural ecosystems (ANDERSEN and ELTUN, 2000).

Family *Carabidae* has dominant share in all treatments with 35 720 individuals and represent 91.76 %. Maximal abundance of *Carabidae* - 8 118 individuals was noted at unfertilized treatment with suitable topic and trophic conditions of specific site for reproduction and shelter. On fertilize treatment the regular dissemination of individuals was noted. In spite of high antropogenic pressure family *Carabidae*, bat also *Staphylinidae* maintain their species spectrum. There are not so sensitive to pollution and to intervention into environment and are rather reversible. Other important families increased the biodiversity of this monitored site occurred as follows: *Silphidae, Cryptophagidae, Curculionidae, Liodidae, Scydmanenidae, Pselaphilidae, Chrysomelidae, and Coccinelidae* and etc.

In frame of the five evaluated treatments 35 species of family *Carabidae* were specified (Table 3). Relatively stable occurrence of individuals of family *Carabidae* was noted during vegetation. Migration of *Carabidae* is mainly in spring and autumn period if humidity gradient between canopy of crops and vicinity decreas. Maximal abundance was also noted at unfertilized treatments. The higher abundance and higher level of dominance was determined by *Pseodoophonus rufipes* which preferred dry and semi humid unshaded fields and meadows. These results are with concordance with previous study of PORHAJAŠOVÁ et al. (2007). From

other determined species under 5% of occurrence we can mentioned *Pterostichus melanarius, P. angustatus P. cylindricus, P. niger, P. vernalis, Carabus coriaceus,, C. ullrichi, C. violaceus, Badister bipustatulus, Harpalus distinquendus, H. tardus* and *Calathus fuscipes.*

Table 2

Abundance of families of order *Coleoptera* on the locality Kolíňany in the years 2007-2009

Family with occurrence above > 5%/ treatment		*Carabidae*	Other families with occurrence < 5 %	Total
A	ind.	8118	668	8786
	%	92.39	7.61	100.00
B	ind.	6616	462	7078
	%	93.47	6.53	100.00
C	ind.	7372	686	8058
	%	91.49	8.51	100.00
D	ind.	6660	558	7218
	%	92.27	7.73	100.00
E	ind.	6954	834	7788
	%	89.29	10.71	100.00
Total	ind.	35720	3208	38928
	%	91.76	8.24	100.00

Table 3

Occurrence of species of family *Coleoptera* on lokality Kolíňany in the years 2007-2009

Species with occurrence > 5% /treatment		*Pseodoophonus rufipes (De Geer,1774)*	*Brachinus Crepitans (Linn., 1758)*	Other species with occurrence < 5%	Total
A	ind.	5908	1410	800	8118
	%	72.78	17.37	9.85	100.00
B	ind.	4720	964	932	6616
	%	71.34	14.54	14.09	100.00
C	ind.	5686	1126	560	7372
	%	77.14	15,27	7.59	100.00
D	ind.	5212	640	808	6660
	%	78.26	9,61	12.13	100.00
E	ind.	4870	1450	634	6954
	%	70.03	20.85	9.12	100.00
Total	ind.	26396	5590	3734	35720
	%	73.89	15.66	10.45	100.00

The attributes of specific identity according Jaccard (I_A) ranged from 58.33% to 80.95% and those of dominant identity (I_D) from 86.58% to 96.02% that proves similarity of population of evaluated treatments. The attributes of diversity (d) achieved a level 0.9559.

CONCLUSIONS

On the base of three year field study we can conclude that there are no significant differences between evaluated treatments. The input of organic matter positively influence occurrence of epigeic communities including *Carabidae*. Species of order *Coleoptera* were classified into 15 families with dominant position of target family *Carabidae* According analysis of the five evaluated treatments 35 species of family *Carabidae* were specified. Particular variability of abundance of evaluated communities was influenced by agro technology, year conditions with relation to type and amount of organic manure. Maximal abundance was also noted at unfertilized treatments.

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BIBLIOGRAFY

1. ANDERSEN, A., ELTUN, R. 2000. Long-term developments in the carabid and staphylinid (*Coleoptera, Carabidae and Staphylinidae*) fauna during conversion from conventional to biological farming. In: J. Appl. Ent., No. 124. 2000. p 51- 56.
2. CANDRÁKOVÁ, E., LÍŠKA, E. 2006. Influence of temperature and water conditions on field pea zield formation. In: Acta fyt. et zoot., Vol. 9. No. 3. 2006. p. 57-61. ISSN 1335-258X.
3. CARDAMO, H. A., SPENCE, J. R. 1994. Crop type effects on the activity and distibution of ground beetles (*Coleoptera, Carabidae*). In: Environmental entomology. Vol. 23, No. 3. 1994. pp. 123-140. ISSN 0046-225X.
4. CHLPÍK, J., POSPÍŠIL, R. 2004. Area characterization of the mechanical and chemical characteristics of the soil at the research – experimental station of the Slovak University of Agriculture in Nitra, location Kolíňany. In: Acta fyt. et zoot. 7, 2004. p. 6-10.
5. CHAMBERLAIN, I.D., BULL, H.I.J., BLACK, P., INESON and R.P. EVERSHED. 2006. Collembolan trophic preferences determined using fatty acid distributions and compound-specific stable carbon isotope values. Soil Biology and Biochemistry.Volume 38, 2006, (6), p. 1275-1281.
6. IRMLER, U. 2003. The spatial and temporal pattern of carabidbeetles on arable fields in northern Germany (Schloleswig-Holstein) and their value as ecological indicators. In: Agr. Ecosyst. Environ. Vol. 98. 2003. p. 231-256.
7. KABACIK WASYLIK, D. 1986. Drapiezne biegaczowate. In. Biologiczne metody walki ze szkodnikami roslin. Warszava, 1986, p. 225 . 239.
8. KROMP, B. 1990. Grassy Field Margin and Antropod Diversity – A Case Study ground Beetle and Spiders in Eastern Austria (*Coleoptera, Carabidae, Arachnidae, Aranei, Opiliones*). In: Agriculture, ecosystems and environment. Vol. 40. No. 1–4, 1990. pp. 116. ISSN 0167-8809.
9. L. BARTOŠOVÁ, M. et. al. 2005. Udržateľné a ekologické poľnohospodárstvo. Vyd. SPU Nitra. 2005. 571 s. ISBN 80-8069-556-3.
10. LÖWEI, G.L., SUNDRELAND, K.D. 1996. Ecology and behaviour of ground beetles (*Coleoptera: Carabidae*). In: Annual Review of entomology. Vol. 41. 1996. pp.231-256.
11. MAJZLAN, O. 2002. Migrácia chrobákov (*Coleoptera*) na kmeňoch pagaštana konského (*Aesculus hippocastanum*). In: Folia faunistica Slovaca. č. 7. 2002. s. 49-53. ISSN 1335-7522.
12. PETŘVALSKÝ, V. et al. 2005. Evaluation of occurrence soil organisms with accent on order Coleoptera in dependence on organic substances matter. In: Agriculture. Vol. 51. No. 9. pp. 497 – 501. ISSN 0551-3677.
13. PORHAJAŠOVÁ, J. et al. 2005. Vplyv množstva organickej hmoty v pôde na výskyt epigeónu a populácií bystruškovitých (*Carabidae, Coleoptera*). In: Acta horticulturae et regiotecturae. Roč. 8, č. 2. 2005 . s. 42 – 46. ISSN 1335-2563.
14. PORHAJAŠOVÁ, J. et al. 2007. Monitoring epigeic groups of edaphon in spring barley (*Hordeum sativum, var. Annua*) and winter barley (*Hordeum sativum, var. Biennis*) in thw locality of Nitra – Dolná Malanta over 2002-2004. In: Acta fyt. et zoot. Vol. 10. No. 1. 2007. pp. 1-6. ISSN1335-258X.
15. PORHAJAŠOVÁ, J., PETŘVALSKÝ, V., MACÁK, M., URMINSKÁ, J., ONDRIŠÍK, P. 2008 a. Zastúpenie druhov čeľade *Carabidae* (*Coleoptera*) v závislosti od vstupov organickej hmoty do pôdy. In: Journal Central European Agriculture. Vol. 9. No. 3. 2008 a. pp. 557-565. ISSN 1332-9049.
16. PORHAJAŠOVÁ, J., PETŘVALSKÝ, V., ŠUSTEK, Z., URMINSKÁ, J., ONDRIŠÍK, P., NOSKOVIČ, J. 2008 b. Long-termed changes in ground beetle (*Coleoptera*: *Carabidae*) assemblages in a field treated by organic fertilizers. In: Biologia. Vol. 63. No. 6. 2008. pp. 1184-1195. ISSN 1336-9563.
17. POSPIŠIL, R., ONDREJČÍKOVÁ, Z. 2008. Vplyv biokalu na produkciu a kvalitu slnečnice ročnej (*Helianthus annus* L.). In: Naše pole. č. 3. 2008. s. 18 – 19. ISSN 1335-2466.
18. SZOMBATHOVÁ, N., MACÁK, M., CANDRÁKOVÁ, E. 2007. Soil organic mater characteristics in nature reserve žitavský wetland – Natura 2000 site. In : Agri-environment and Animal

Welfare. Book of proceedings from 2nd International Conference on agricultural and Rural Development. MC MF SPU Nitra. 2007. p. 198-205. ISBN 978-80-8069-962-8.

19. ŠÁLY, R., BEDRNA, Z., BUBLINEC, E. 2004. Morfogenetický klasifikačný systém pôd Slovenska. Bratislava VUPOP. 2004. 76 p. ISBN 80-85361-70-1.

20. VICIAN, V. et al., 2007. The structure of Coleoptera, Carabidae on differrent management agricultural areas. In: Zb. z konf. „Vplyvy foriem obhospodarovania poľnohospodárskej krajiny na základné zložky agroekosystémov vo vzťahu k optimalizácii využívania krajiny“. Vyd. Čižmárová-Partner. 2007. s. 67 – 77. ISBN 978-80-89183-35-7