

Ground Beetles as Bioregulators of Harmful Insect Populations on Arable Land

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ABSTRACT

Ground beetles are the typical polyphagous predators, very important for the maintenance of agroecosystems and other ecosystems, therefore often the subject of research. The aim of this study is to determine the adults of the family of ground beetles. Moreover, the dominance and degree of faunal similarity of ground beetles were observed. During research in the fields of wheat, maize and sugar beet on the territory of Vojvodina on the fields of Bečej and Rimski Šančevi, using the method of "Barber traps" a total of 1,519 individuals of the ground beetles family were collected. The dominant species in the three above-mentioned crops and at all three sites were predators in the genera of *Pterostichus* spp., *Harpalus* spp. and *Anchomenus* spp. Furthermore, based on the obtained results it can be concluded that the composition of ground beetles is dependent on the ruling biotic and abiotic factors, and the combination of these factors creates a specific micro climate conditions, thus the characteristic fauna.

AIMS AND BACKGROUND

Ground beetles belong to the cosmopolitan group of insects, with over 40,000 species worldwide, out of which 2,700 species are registered in Europe. On the territory of Serbia, a total of 520 species of ground beetles were recorded^{2,3}. Ground beetles are important biological control agents in agroecosystems. Members of ground beetles family as predators can significantly reduce the population of harmful species^{6,7}. Considering that the agricultural land is covered with vegetation in some parts only a few months during the year, the seasonal activity of ground beetles involves their removal from agricultural areas to adjacent habitats for food and shelter. One very important reservoir of ground beetles is the vegetation on the edge areas of arable land. The edges of the fields affect the increase in population of ground beetles by providing shelter and places to overwinter. The edges of the fields with a well-developed plant cover and stable micro habitats such as hedges indicate an increased rate of overwintering in relation to the open-air habitats within an agricultural land⁷. Given the economic importance of this family, as well as its degree of exploration, the main objective of this study was to investigate the qualitative and quantitative composition of species in the family of ground beetles in the crops of wheat, sugar beet and maize.

EXPERIMENTAL

The experiment was set up in chernozem soil in the crops of wheat, maize and sugar beet during in the experimental field of the Institute for wheat, maize and sugar beet in Rimski Šančevi (GPS coordinate: N45 40 6.015 E19 5 3.376) and in the experimental fields of Bečej (GPS: N45 37 0 E20 1 59.999). Through the year of research, experimental plots with different plant species observed were located at the distance of 1-2 km within an experimental field. A total of 60 pitfall traps, i.e. Barber traps, were set in maize, wheat and sugar beet, ten in each plant species, at the

distance of 20 m in the same row of each field. The "Barber traps" were placed during the period of vegetation.

All numerical data obtained after processing the samples are expressed by appropriate quantitative and qualitative indicators. In order to describe quantitative structure, the term active dominance was used, which is calculated according to the procedure applied by Heydemann:

$$D (\%) = \frac{\text{No. of individuals of a given species}}{\text{The total no. of individuals of a given habitat}} \times 100$$

D - Active dominance of individuals of a given species

RESULTS AND DISCUSSION

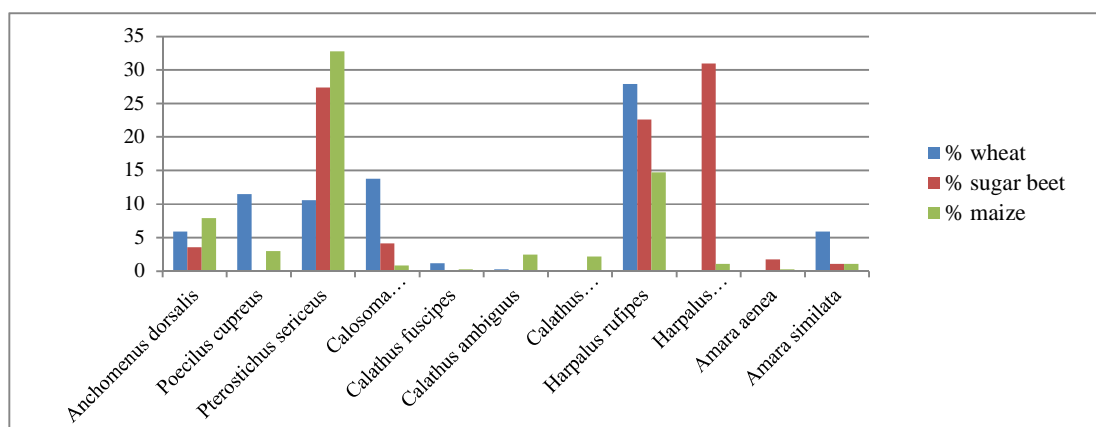
According to the research of numerous authors in entomofaunal fields of wheat, sugar beet, maize, sunflower and alfalfa, beetles representatives are very numerous, even dominant in the total registered macroentomofauna⁶.

During research, ground beetles were distinguished as a very important group of predators. In the crops of wheat, maize and sugar beet in the experimental fields of Becej and Rimski Sancevi, using the method of "Barber traps", a total number of 1,159 individuals of ground beetle family were collected and classified into 51 species. During the growing period of vegetation in the experimental fields of Becej in all three crops a total number of 869 individuals were collected, while the smaller number of individuals was recorded in the fields of Rimski Šančevi, that is 650 individuals, where also the number of insecticide treatments was greater.

The composition of the ground beetle fauna in a habitat depends primarily on the agrotechnical measures, cultivated crops, and much of the agroprotective belts, which were very scarce and rare in the observed sites, yet play an important role in maintaining the population of ground beetles and other insects. As part of an agricultural land, the edge parts of plots are very important for biodiversity. Agroprotective belts enable biodiversity in agricultural areas in several ways: they are important for species that inhabit arable land, they are their shelter during and after the agricultural practices, and can also serve as places for overwintering or summer diapause⁵, or provide an alternative source of food.

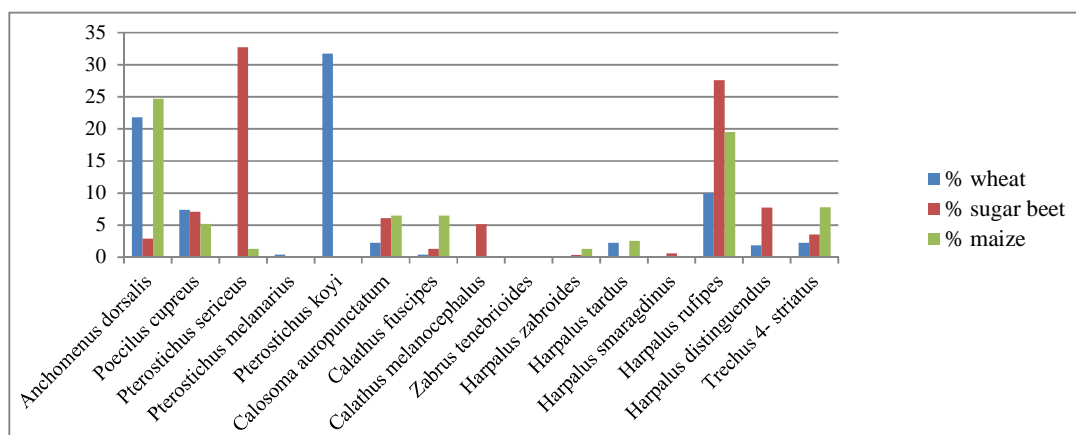
In order to determine the dominant species, in the total insect material collected, the concept of an active dominance has been introduced, as stated in the experimental section. On the researching fields of Becej, the dominant species in all three plant crops were *Pterostichus sericeus* and *Harpalus rufipes*; *Anchomenus dorsalis* species was dominant in wheat and maize, while in sugar beet it belonged to the subdominant species. Individuals belonging to *Poecilus cupreus* species were dominated in wheat, subdominant in corn whereas in sugar beet they were not recorded. The number of individuals belonging to *Calosoma auropunctatum* was largest i.e. dominant in wheat, subdominant in sugar beet and recedent in maize. Furthermore, the subdominant maize species were, in addition to the above-mentioned, *Calathus ambiguus*, *Calathus melanocephalus*, *Harpalus distinguendus* which dominated in sugar beet. All other species, belonged to the groups of recedent and subrecedent species (Figure 1).

Figure 1. Active dominance of ground beetles in three different plant crops in the experimental fields of Becej



In the experimental fields of Rimski Sancevi in 2010, dominant species were *Anchomenus dorsalis*, *Poecilus cupreus* in the crops of wheat and maize, and *Harpalus rufipes* in all three crops, then *Calosoma auropunctatum* in the crops of sugar beet and maize. In much larger number, in sugar beet crop were found individuals belonging to species *Pterostichus sericeus*, but also *Pterostichus koyi* in wheat, and *Trechus 4 - striatus* in maize (Figure 2).

Figure 2. Active dominance of ground beetles in three different plant crops in the experimental fields of Rimski Šančevi



Similar studies were also carried out in Eastern Lithuania and 41 species of ground beetles were collected in the fields of wheat¹. On the territory of Hungary the following species were present *Anisodactylus signatus*, *Harpalus pubescens*, *Anchomenus dorsalis*, *H. distinguendus*, *Poecilus cupreus*, *Pterostichus sericeus* and *Zabrus tenebrioides*, which also coincides with the species that were found at our sites. Then, species belonging to gender *Bembidion*, according to research of many authors, are very widespread and numerous both in wheat and sugar beet, alfalfa, cabbage, carrots and grassy areas, while in our samples only single individuals of *Bembidion properans* species were recorded in wheat and sugar beet⁴.

When it comes to a diet regime of ground beetles, we can analyse the diet of the dominant species in order to partially understand their vital role as bioregulators. Divided ground beetles between phytophagous, predators and omnivores. According to this division, among recorded dominant species during the study, only *Z. tenebrioides* species belongs to phytophagous species, while the group of predators, which is far more numerous, includes: *P. vulgaris*, *A. dorsalis*, *P. cupreus*, *P. sericeus*, *P. punctulatus*, *P. koyi*, *C. auropunctatum*, *Calathus ambiguus*, *Trechus quadristriatus*, *Brachynus crepitans* while *Harpalus rufipes*, *Harpalus distinguendus* belong to omnivores. When it comes to the last group of ground beetles, omnivores, some authors believe that this group of insects is very important because of its abundance and that they should be considered harmful, while increasing number of authors, however, argues that they do insignificant damage, and are more significant as predators⁵.

CONCLUSIONS

Based on the presented results it can be concluded that in the collected material almost all species belong to beneficial insects, i.e. predators or omnivores, with the exception of *Z. tenebrioides* species, which indicates the important role of this group of insects in the abundance regulation of pest species that inhabit a variety of plant crops on arable land. We can conclude that agroprotective belt, which consists of a thick hedge and crop residues instead of grassy edge parts of arable land, provides the shelter to insects during winter and vegetation period. Also, preservation of ground beetle habitat and application of appropriate cultural practices can improve natural regulation of harmful insects which also reduces their need for chemical control.

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