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EFFECTS OF PLANT PROTECTION PRODUCTS ON GRASSHOPPERS IN THE AGRICULTURAL LANDSCAPE

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Introduction

In the risk assessment of plant protection products (PPP) towards non-target arthropods no herbivorous insect species (e.g. grasshoppers) are considered. However there is a high possibility of herbivorous insects to be exposed against PPPs. Beside the direct exposure due to contact with the PPP, they are also at risk due to the consumption of contaminated food. Therefore the main objective of this study was to determine potential effects of PPPs on grasshoppers in field margins. A detailed literature research has been conducted followed by a practical research project investigating grasshopper density in field margins of different crop cultures (wine, fruit and cereals). The crop cultures differ in their management and also in the application of PPPs: for the cultivation of fruits and cereals large amounts of insecticides are used, while in the viniculture herbicides are applied predominantly.

Materials and Methods

a) Search Strategy:

At first a literature research to detect the typical species of grasshoppers which live in and around an arable field has been conducted. In the second step a systematic review of studies to the effects of PPPs on grasshoppers was carried out. Therefore we investigated the published literature using e.g. libraries, online databases and internet searches. We also followed the literature in the field and searched the reference lists of relevant articles.

Figure 1: field margin

b) Practical Work:

Grasshopper populations were quantified in field margins (Fig. 1) located next to crops used to grow wine, fruits and cereals. Grasslands exhibiting a very limited PPP exposure located within the cultivated area under investigation were used as reference sites. In order to determine quantitatively and qualitatively grasshopper populations a catch square (Fig. 2) was applied. For each field margin up to 30 sub-samples were taken and grasshopper species and density were determined immediately.

Figure 2: catch square (0.5 m²)

Results

Primarily field margins with a high variability in vegetation structure show a high species diversity. Therefore especially wide field margins are suitable habitats for many species. We could also identify two species of grasshoppers (*Chorthippus apricarius, Gryllus campestris*) which are red listed in Germany and have their main habitat exclusively in field margins. Thus they are potentially exposed to PPPs. The disappearance of grasshoppers is in many textbooks related to an increased use of PPPs. However this claim is hard to substantiate since only eight studies could be identified that are treating direct or indirect effects of PPPs on grasshoppers.

The results of the field investigation are showing that the density of grasshoppers in field margins is significantly reduced compared to the reference sites. Furthermore, significant lower densities are apparent in field margins bordered on fruit and cereal crops compared to those of wine crops (Fig. 3). The width of a field margin seems to be also important for the population density of grasshoppers (Fig. 4). Field margins with a width below 6 m are exhibiting a significant reduced density compared to the other width under investigation.

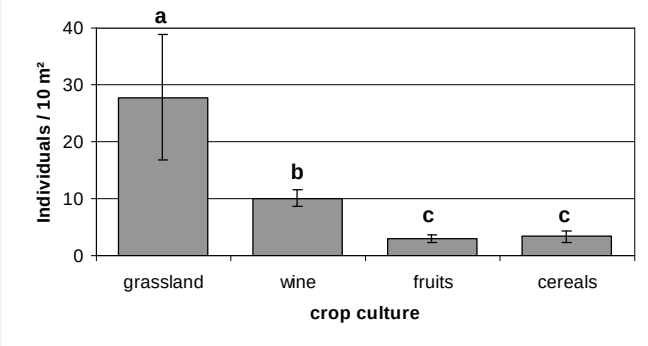

Fig. 3: Density of grasshoppers in field margins and grasslands. Densities are significantly different between treatments (ANOVA, $p < 0.0001$). A Tukey test for multiple comparisons identified significant differences between the treatments displayed by different letters.

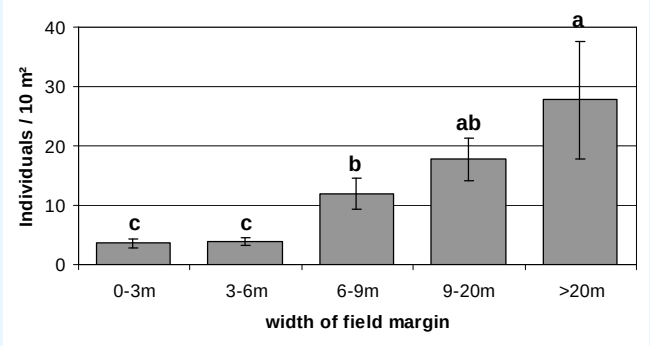

Fig. 4: Density of grasshoppers in field margins of different width. Densities are significantly different between treatments (ANOVA, $p < 0.0001$). A Tukey test for multiple comparisons identified significant differences between the treatments displayed by different letters.

Summary

A literature research revealed that grasshoppers are potentially sensitive to PPPs. However, the effects of PPPs on grasshoppers are sparsely investigated until now. The results of the field work presented here support these findings. Further laboratory toxicity tests are planned in order to provide a direct link between pesticide application and grasshoppers density.