Population dynamics studies of the western corn rootworm - experiments in isolation cages

Versuche zur Populationsdynamik des Westlichen Maiswurzelbohrers in Isolationskäfigen

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1. Introduction

Maize is a profitable crop for Central European growers. Many farmers prefer maize for feeding cows or pigs and for the maintenance of biogas plants. In case of official measures in place to prevent further spreading of the western corn rootworm *Diabrotica virgifera virgifera* the required crop rotation may lead to economic impacts for growers.

In the experiments presented here the population dynamics of *Diabrotica* was studied in isolation cages in the field. It is expected that the results may contribute to a review of the official measures and the further development of damage thresholds for the beetle.

2. Material and methods

Experiments were carried out in cages especially designed for an isolated development of *Diabrotica* beetles in the field. Cages were of 2 m^2 ground size and 2.5 m height. Maize was planted with 20 plants per cage (Figure 1). Maize plants were infested artificially by releasing beetles into the cages (in 2009 equal numbers of male and female beetles). Finally a population density of 0–1–3–5 beetles/plant was established as an artificial first generation. Hatching of beetles in the subsequent generation was recorded on a regular basis within the years following the release of beetles from 2010 to 2012. Plots within the cages usually were dug by spade in autumn 2009 and 2010 and no tillage was applied in 2011.

Fig. 1 Isolation cages sized 1.4 m x 1.4 m x 2.5 m (photo: Johann Robier).

Abb. 1 *Isolierkäfige in der Größe von 1,4 m x 1,4 m x 2,5 m (Foto: Johann Robier).*

3. Results

Table 1 summarizes the results for the number of hatched beetles recorded in the years 2010, 2011 and 2012. The number of beetles after artificial infestation in 2009 initially declined and then remained at low levels in 2011 until in 2012 the population seemed to recover slightly. Damage symptoms like goose neck symptoms with lodging were first visible in 2011. The assessment of root damage according to the traditional IOWA-scale (Hills and Peters) corresponded to the observed population density.

Tab. 1 Population dynamics of the western corn rootworm – recorded number of beetles in isolation cage experiments.

Tab.1 *Populationsdynamik des Westlichen Maiswurzelbohrers – beobachtete Anzahl Käfer in den Versuchen mit Isolationskäfigen .*

	Average number of hatched beetles per cage			Average number of hatched beetles per plant			Goose neck affected maize plants 2012 in%
Release 2009 – beetles/plant	2010	2011	2012	2010	2011	2012	2012
0	0	0	2	0	0	0.1	0
1	72	117	119	3.6	5.85	5.95	7.5
3	331	21	164	16.55	1.05	8.2	8.75
5	172	44	125	8.6	2.2	6.25	3.75

No correlation was found between yield and population density. The reasons for this were based on the growing conditions: damage by slugs and a delayed development of reseeded maize in 2011 were mainly responsible for the observed differences in yields.

It is assumed that a damage threshold under Styrian conditions with sufficient rain is higher compared to dry areas and it may be reached with a number of five or even more beetles per plant and season. Large scale observations in commercial maize have shown that damage with root pruning and plant lodging only occurs under dry conditions. Since test year 3 (2011) and in particular within test year 4 (2012), symptoms appeared expectedly at higher densities of hatched beetles/ plant.

Silk clipping symptoms were measurable in 2012 predominantly at higher beetle numbers. These results are not included in the statistics shown in table1.

A few visible and measurable symptoms caused by western corn rootworms were observed in the third and fourth year of the experiments – see figures 2 and 3.

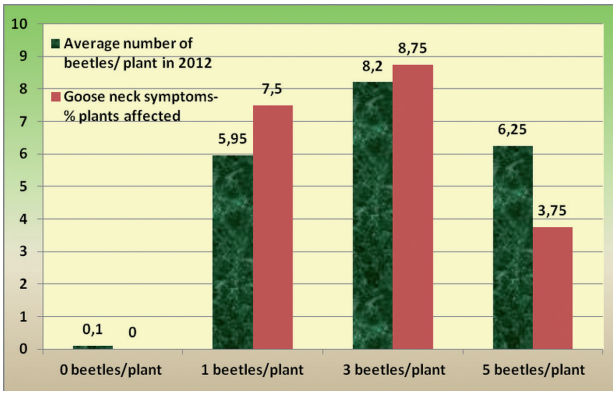

Fig. 2 Number of beetles inserted into cages in 2009 (0-5 per plant), number of beetles hatched and goose neck symptoms in 2012 after mono cropping of maize.

Abb. 2 *Anzahl freigelassener Käfer je Käfig im Jahr 2009 (0-5 je Pflanze), Anzahl geschlüpfter Käfer und Gänsehalssymptome im Jahr 2012 nach Maismonokultur.*

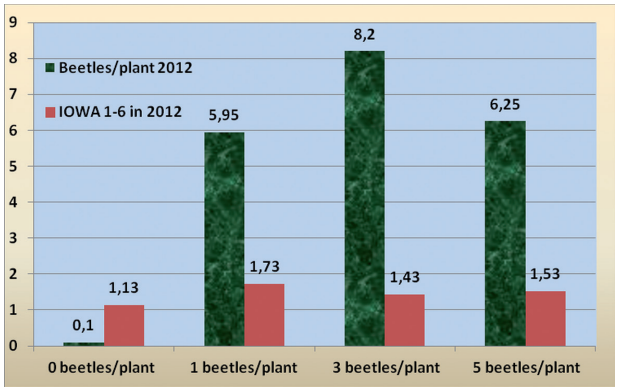

Fig. 3 Number of beetles inserted into cages in 2009 (0-5 per plant), number of beetles hatched and IOWA 1–6 scale rating of root damage in 2012 after mono cropping of maize.

Abb. 3 *Anzahl freigesetzter Käfer je Käfig im Jahr 2009 (0-5 pro Pflanze), Anzahl geschlüpfter Käfer und Wurzelschäden im Jahr 2012 nach Maismonokultur gemäß IOWA Scale (1-6).*

4. Conclusion

The results in 2011 and 2012 (representing the years 3 and 4 after release of beetles) show, that larval damage by root pruning according to the IOWA-Scale (1-6) corresponded well with affiliated population densities present, however did not correlate with populations inserted in 2009. Goose-neck symptoms differed measurably between population densities within the experimental years 2011 and in particular in 2012. Silk clipping damages differed only in 2012. In 2010 and 2011 no significant yield effects with respect to differences between population densities were observed.

From these data of plant damage of *Diabrotica* under the semi-moist conditions in Styria it is very likely that a threshold can be assumed to be five or more beetles per plant.

Acknowledgements

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References

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