Host plant specificity studies of the western corn rootworm - experiments in isolation cages

Untersuchungen zur Wirtspflanzenspezifität des Westlichen Maiswurzelbohrers – Versuche 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. The western corn rootworm has invaded large parts of the maize growing areas of Central Europe (Edwards and Kiss, 2011). In 2002 the beetle arrived in the eastern parts of Austria and extended in 2012 as well into the southern and western parts. Only a few cases with observed economic damages have been recorded since in invaded areas. Official control measures according to EU Decision 2003/766/EG is in place to prevent the further spread of the western corn rootworm. Crop rotation is known to be the most efficient strategy to suppress the western corn rootworm. The required crop rotation may however lead to economic impacts for growers. In the experiments presented here different plant species to be rotated with maize were studied with respect to their effects on the reproduction of *Diabrotica* in the field. The population dynamics of *Diabrotica* was studied in isolation cages in the field (Figure 1).

Fig. 1 Isolation cages for recording *Diabrotica* populations (photo: K. Foltin).

Abb. 1 *Isolationskäfige zur Untersuchung von Diabrotica-Populationen (Foto: K. Foltin).*

2. Material and methods

Since crop rotation is the most efficient measure to suppress *Diabrotica* reproduction and spread, several experiments have been set up to identify those plant species that could either interfere the development of western corn rootworm or are potential host plants. Experiments were carried out on a maize site in Austria near Graz in cages especially designed for an isolated development of *Diabrotica* beetles in the field. Cages were of about 2 m^2 ground size and 2.5 m height (1.4 m x 1.4 m x 2.5 m, see Fig. 1). Maize was planted with 20 plants per cage. Maize plants were infested artificially by defined numbers of female and male beetles released into the cages (Foltin and Robier, 2014). Descendant generations i.e. hatching beetles were recorded regularly.

The most common arable crops and plant species cultivated in Austria were planted after maize into these isolation cages in 2010 and subsequent years:

1. Maize
2. Green rye – hibernal green cover between maize followed by maize
3. Field peas undersown in maize
4. Winter and spring cereals
5. Oil Pumpkin („Styrian oil pumpkin" *Cucurbita pepo var. styriaca*)
6. *Miscanthus*
7. Warm season grasses: barnyard grass - *Echinochloa crus-galli*, yellow foxtail - *Setaria glauca*

3. Results and conclusions

The experiments resulted in beetles hatching only when maize after maize was grown (plant species/variant numbers 1 to 3). Larval damage as well was only observed in continuous maize fields. All other variants led to the hatching of no or only small and negligible numbers of beetles (Figure 2).

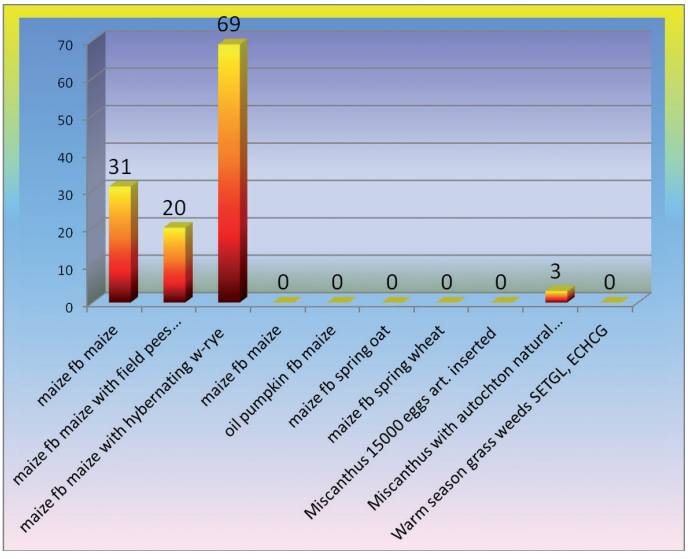

Fig. 2 CROP rotational experiments in isolation cages in Graz (Austria). No. of specimen of *Diabrotica virgifera virgifera* hatched and caught in yellow sticky traps within isolation cages from July to October 2012 within 10 different variants of crop rotation in four replications.

Abb. 2 *Versuche zur Fruchtfolge in Isolationskäfigen in Graz (Österreich). Anzahl* Diabrotica-*Käfer, die in der Zeit von Juli bis Oktober 2012 geschlüpft waren und mit Gelbtafeln gefangen wurden, in 10 unterschiedlichen Fruchtfolgevarianten mit jeweils vier Wiederholungen.*

Table 1 shows a summary of results derived from the isolation cage experiments from 2010 to 2012. Spring cereals and oil pumpkin plants were not suitable as host plants for larval development, because reproduction of western corn rootworm was not possible. Autumn planted hibernating winter rye had no suppressive effect on western corn rootworm as maize follows maize in this variant. Undersown fodder peas as well did not have any suppressive effect on *Diabrotica* due to the continuous maize in this rotation. Although elephant grass (*Miscanthus*) was described as a host plant of *Diabrotica* only very few beetles hatched in these experiments (Gloyna *et al*., 2011).

Despite artificial infestation of 15,000 eggs per cage in spring only very small numbers of beetles could be detected. In warm season grass weeds (*Echinochloa crus-galli*, *Setaria glauca* and *Setaria viridis*) *Diabrotica* could only reproduce at high population densities the year before in maize and only very few hatched beetles were found. In 2012 no hatched adults could be observed at all until August.

Table 1 reflects scenarios of 100% and 50% maize in crop rotation. When maize is even less than 50% in crop rotation the risk of reproduction and spread of *Diabrotica* is almost zero. But the risk also depends very much on the current infestation level and the population densities of western corn rootworm.

Tab. 1 Summary of host suitability and estimated risk for the reproduction of *Diabrotica* in crop rotations of maize with various plant species.

Tab. 1 *Zusammenfassung der Wirtspflanzeneignung und geschätztes Reproduktionsrisiko von* Diabrotica *in Mais-fruchtfolgen mit unterschiedlichen Pflanzenarten.*

Common arable crops tested in isolation cages after maize	**Suitability as host plant**	**Estimated risk (%) in alternating crop rotation with maize (mono maize=100%)**
Spring cereals – spring oat, spring wheat	-no-	**< 1**
Maize	+ + +	**100**
Oil pumpkin*	-no-	**15–30***
Fodder peas undersown in maize	+ + + (no for peas) (no suppression by undersown fodder peas in maize)	**100**
Winter rye/maize	+ + + (no for rye) (no suppression when maize drilled into hibernating rye)	**100**
Miscanthus – Elephant grass	(+)	**<10**
Warm season grass weeds *Echinochloa crus-galli*, *Setaria glauca, Setaria viridis*	(+)	**<10**

*Oil pumpkin is due to its long period of flowering a strong attractant for *Diabrotica* which might lead to oviposition there. Pumpkin however is not a host plant for larvae.

Acknowledgements

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References

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