



ALTERNATIVE BIOLOGICAL METHODS FOR THE CONTROL OF THE WESTERN CORN ROOT WORM (*DIABROTICA V. VIRGIFERA*) IN MAIZE

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1 ABSTRACT (PARTNER UIBK)

Based on the results of the efficacy and long-term study carried out in planting season 2018 and since 2012 in Styria, Austria, the knowledge gained to date on the control of the western corn rootworm *Diabrotica v. virgifera* can not only be confirmed, but also practical recommendations can be derived for consultants and practitioners. It has been shown that

1. the beetle catches of *Diabrotica v. virgifera* continue to be increasing in the Bad Radkersburg area. In the 2018 planting season, up to 130 beetles per square metre were caught on the untreated maize fields with the established emergence trap system. This catch rate corresponds to a threefold increase in the number of adults compared to 2017 and an increase of almost 500 percent compared to 2016. The alarm threshold of the larvae or beetles can thus be set much higher than has previously been derived from literature data. A threshold value at the height of 50-70 beetles per m² (i.e. approx. 10 beetles per plant; depending on the sowing strength of the maize seed per hectare) can be confirmed as a realistic alarm number.
2. the grain yield in 2018 was high, regardless of the treatments (on average 11.2 t ha⁻¹ maize grains - dry). The weather conditions and the type of maize used thus made an important contribution to healthy plant development (i.e. formation of secondary roots and compensation for root loss due to larval feeding), if this loss occurred at all in the season 2018. Despite the high *Diabrotica* larval density, no damage to the maize roots could be detected ("Node-Injury Scale" evaluation: 0.00; lowest value; n = 10 per investigated active substance). Also, no direct damage to the maize plant and its maize ear could be assessed (i.e. less than 1.5 percent of all assessed plants showed symptoms of plant growth damage).
3. the active substances alone or in combination with other active substances led to a significantly lower number of beetles compared to the number of adults in the untreated control areas. Each control measure led to a significant reduction in beetle abundance and thus improved yield.
4. the desired abundance of 5.000 *Metarhizium brunneum* CFU g⁻¹ TG soil and more could already be achieved after the first application of the fungal barley product GranMet™ in the soil, alone and in combination with the other biological agents. The high indigenous *Metarhizium* abundance at all three experimental sites was striking, although it decreased slightly over the summer months. The genotyping, which is currently being carried out for the third time, is intended to finally confirm that the BIPESCO 5 production strain has established itself in the treatment areas. The multivariate CANOCO analysis method confirmed that the *Metarhizium* density in the soil could be significantly increased by a single GranMet™ applications. The *Metarhizium* density in the soil should be evaluated in the future as an indirect measure for the evaluation of the effectiveness of the biological active substance. The higher the *Metarhizium* abundance, the better the crop yield and the control of the pest *Diabrotica*. As expected, the combination of GranMet™ with other biological agents did not lead to a negative effect on the *Metarhizium* abundance. The results of this combination study are in line with the results of the EU INBIOSOIL study. Mayerhofer and co-authors were able to show that the microbial soil communities (i.e. bacteria and fungi) were not negatively affected in the presence of *Metarhizium* (Mayerhofer, Strasser et al., full paper submitted to Biocont Sci. Technol.).
5. as an immediate measure, crop rotation should be continued to be used and continued to regulate the western corn rootworm population. The high efficiency of the measure enables a reduction of the beetles in the entire infested area (reduction of more than 2/3 of the beetles per

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year and crop rotation; Foltin et al., 2014). The more hectares of infected arable land in the region are planted with alternative crops (i.e. no maize as subsequent crop), the greater the effect on the overall population. The larvae hatching from the laid corn rootworm eggs do not find a host plant suitable for development into beetles. After a corresponding reduction of the beetle population in the area, the prerequisite for a sufficient effect also arises for the other control measures.

6. according to the recommendation of the EPPO experts (EPPO guideline 2017), as well as the experts of the Austrian Chamber of Agriculture (warndienst.lko.at/maiswurzelbohrer...), the use of the insecticidal fungus *Metarhizium brunneum* BIPESCO 5 can be recommended in addition to all listed countermeasures. However, the use of the fungus would currently only be possible if the GranMet™ product was approved in an emergency situation.
7. due to the lack of effective, environmentally friendly, approved chemical insecticides, holistic, direct control of the beetles with biological agents will also be unavoidable. Alternative products based on biological agents are desirable and could be found, for example, in the above-ground use of the insecticidal fungus *Metarhizium* for beetle treatment. First positive results indicate a promising potential - a follow-up application is currently being planned.

