Exposure of Coccinellidae to guttation droplets on maize seedlings with seed or granule treatment of neonicotinoids

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**ABSTRACT**

The exposure of non-target organisms to pesticides is expected to be reduced, if the pesticide application is performed via seed treatment instead of a spray application. But the phenomenon of guttation was not taken into account as a potential exposure pathway of systemic pesticides like the neonicotinoids, though guttation in maize occurred frequently under climate conditions of Central Europe. During guttation events leaflet droplets were observed on the upper side of leaves of maize seedlings (BBCH 13 - 14) between large guttation droplets on day 3, 5, and 11 after crop emergence. Both aphids and leafhoppers feed on leaf surface feeding were observed. The neonicotinoids and corresponding metabolites were analyzed in guttation water and in Coccinellidae with LC-ESI/MS/MS. Because the same a.i. and their corresponding metabolites were detected in guttation water and leafhoppers from the same variant, this indicates that the secretion of guttation droplets is an exposure pathway for leaf-feeding adult Coccinellidae.

**INTRODUCTION**

During 2010 and 2011 field studies were carried out at the inner-city experimental field station of JKI in Berlin with the objective to estimate the frequency of guttation in neonicotinoid treated maize (seed or granule treatment) and the content of neonicotinoids in guttation droplets under the climate conditions of Central Europe. Schenke et al. (2013) published their results in EFI-2013-10. In contrast a high skills was required for bees from exposure via guttation in need in regard to maize (EU 2013). But up to now nothing is published on the exposure of other non-target aphids to guttation droplets caused by systemic application of imidacloprid, clothianidin and thiamethoxam.

**RESULTS**

Concentrations of neonicotinoids in guttation water are presented in Tab. F together with the content of a.i. and their metabolites in the Coccinellidae found in the guttation water. Guttation water

- Neonicotinoids and their metabolites were detected in all guttation water samples and decreased over time.
- Based on the measured data also 20% of 6-hydroxylimidacloprid and 4% imidacloprid-deolin were measured in guttation water in average. One third of THM, CTN, and IMD were measured in guttation water in average. The origin of those neonicotinoids in guttation water which was not declared on the seed batch is likely caused by cross contamination during the seed treatment.

**Coccinellidae**

- The two species C. quinquemaculata (n = 8, 0.55 mg (ad = 32)) and C. septempunctata (n = 28, B1 23 mg (ad = 34)) were found on the upper side of leaves of maize seedlings between large guttation droplets.
- The beetles contained, with only one exception (IMD-deolin in a CTN-plot), the a.i. and their corresponding metabolites, which were applied in the variant in which the insects were collected. This is surprising because of small distance between the randomly arranged plots with different seed treatment.
- On day three after emergence of maize the highest contents of neonicotinoids in leafhoppers were detected.
- On day three, five and on day five, 3 beetles were found in treated variants. All of them were exposed to the neonicotinoid treatment.
- On day eleven no residues were detected in 6 beetles collected in untreated controls. This is also the case for 3 insects from IMD-treated. 1 from THM-treated and 5 from CTN-treated plots.
- Dead beetles were found eleven days after emergence of maize seedlings. Only 2 out of 3 dead insects in CTN-variants contained residues. 1 beetle was dead in an untreated control without hatchets.
- Residues were not measured in insects which were exposed to high amounts of THM from that in guttation water in average 80% of the measured IMD-equivalents were represented by IMD-
- The content of THM was in the most cases clearly higher than TZM in insects found in the THM- and CTN-plots.

**CONCLUSIONS**

- The measurement of the same a.i. and their corresponding metabolites in guttation water and also leafhoppers, originated from the same variant indicates that the secretion of guttation droplets is an exposure pathway for leaf-feeding adult Coccinellidae.
- Other exposure routes can be excluded in this study, as aphids and leaf damages resulting from the presence of seedlings were not observed in the guttation water.
- The data recorded here were obtained by chance and are not the result of a systematic exposure study.
- Research is needed on exposure of non-target organisms other than bees to drinking and transal contact of fresh or dried guttation droplets of plants grown from seed or granule treatments under climate conditions which induce guttation events. Such exposure may be in addition to consumption of plant tissue and leaf material.