Exposure of pollinating insects to neonicotinoids by guttation on straw cereals after seed-treated sugar beet

(November 2017)

SUMMARY

At the early stage of their growth, sugar beets are protected from pest insects and notably from aphid vectors of virus yellows by neonicotinoid treatments in the beet seed pellets.

Sugar beets are not attractive to pollinating insects and we have considered the exposure of this typology of insects to neonicotinoids by flowering or guttation of straw cereals, which in more than 95% of cases constitute the succeeding crop to seed-treated sugar beets.

The inflorescences of straw cereals are not attractive to pollinating insects, there is therefore no exposure by this route.

Due to the plants' growth and of the DT50s of the products studied, the plants' metabolism has low or even unmeasurable levels of neonicotinoids in the spring; either by capturing residues from the previous crop or by direct coating of the winter cereals.

In addition, the guttation exudates of the observed cereals are very poorly visited by pollinating insects in the autumn, and even if a slightly higher visitation rate is recorded in the spring, this rate still remains low. Indeed, the guttation taking place in humid conditions, the bees easily find water in their environment, sources that they privilege compared to the exudates.

These low levels, when they are actually measurable, and the low visitation rate of cereals by pollinators, have no impact on bee colonies.

Following the direct treatment of winter cereals or by capture of residues from a sugar beet culture of the previous year, the exposure of bees to neonicotinoids via cereal guttation is a negligible route and has no remarkable effect on their populations.

(references/bibliography p. 5)

A/ The cultivation of sugar beets / neonicotinoids / crop sequences

In France 98.4% of sugar beet seeds are in pellets containing neonicotinoids, Thiamethoxame - Imidacloprid, at 60 and 90 grams per hectare. These treatments only prevent the proliferation of pest insects, which feed on beet, including aphids (notably Myzus Persicae), vectors of virus yellows which massively impacts the productivity of the plant.

Sugar beet, an anemophilous plant, harvested before any flowering and characterized by a very low guttation, is unattractive to all pollinating insects and pollinators - its pellet containing neonicotinoids has therefore no impact on the pollinating fauna.

In real cultivation conditions, the effectiveness of these systemic products rarely exceeds 90 days, after which colonization by insects of very diverse species, including a return of piercing/sucking insects, is observed in sugar beet. After these first three months of growth under protection of neonicotinoids, no other insecticide treatment against aphids is recommended for sugar beet cultivation. All certification of a phytosanitary product includes the establishment of the DT50 (*) (Degradation Time 50) which reflects the time required, in number of days and under different conditions, for the degradation of half the quantity of active substance.

(*) DT50 imidacloprid: minimum 40 days - average 92 days – maximum 288 days - source Bayer.
DT50 thiamethoxam: minimum 7 days - average 52 days – maximum 172 days - source Syngenta.

This observation of rapid colonization of beets, and the permanent presence of non-pests by populations of various insects, coupled with the duration of half-lives (DT50) of neonicotinoids should not prevent questions on the persistence of these products in soil and their potential capture by the following crops; crops that may be attractive to pollinating insects.

B/ Attractiveness of the year N+1 cultivation after sugar beets in year N for pollinating insects including bees

In France, sugar beet is widely followed, in more than 95% of cases, by a straw cereal. We must therefore examine the attractiveness and potential impacts on the populations of insects which pollinate cereal crops that have succeeded a sugar beet culture, and that could have therefore potentially assimilated neonicotinoids from this previous crop.

It should be noted that the implementing regulation N° 485/2013 of 24th May 2013 of the European Commission prohibiting the use of neonicotinoids on spring cereals (barley, millet, oats, rice, rye, sorghum, triticale, wheat) is based on the risk of dust dispersal at a time of year favourable to the presence of bees and not the attractiveness of the crop to them; and for corn on its potential exudates.

The question of the attractiveness of straw cereals for pollinators arises.

1/ Attractiveness by nectar and pollen for straw cereals

At the time of the first restrictions of 2013 on the ban of neonicotinoid use on plants attractive to bees, the EFSA, in its report "EFSA Journal 2013;11(1):3068 ; ***Conclusion on the peer review of the pesticide risk assessment for bees for the active substance imidacloprid"***, the EFSA listed which crops were concerned. This document clearly established the non-attractiveness of bees to cereals, and this is summed up in Table 8 below.

Table 8 Attractiveness of agricultural crops (for which imidacloprid seed treatment authorisation is granted) to honey bees for the collection of nectar and/or pollen

Attractive and nectar or pollen may be collected by bees	Non-attractive to bees (for nectar or pollen)			
asparagus	headed brassicas	Chinese cabbage	onion	cereals
cotton	leafy brassicas	Brussels sprouts	leek	wheat
maize (corn)	head cabbage	lettuce	potato	barley
oilseed rape	kohlrabi	endive	beets	oat
sunflower	kale	radicchio rosso	sugar beet	
pumpkin	broccoli	sugar loaf	fodder beet	
linseed (flax)	cauliflower	bulb crops	mangolds	

The pollen and nectar of straw cereals are thus only very weakly attractive (classified "Non-Attractive" by the EFSA) for bees. In addition, straw cereals' pollen is not found in honey.
Bees are naturally attracted to flowers but little to straw cereals.

The presence of neonicotinoids, absorbed as residue of a previous sugar beet culture, or of a direct coating of winter cereal seeds, does not have a remarkable impact on the population of pollinators because of a very low attractiveness of cereal inflorescences.

2/ Attractiveness through guttation of straw cereals by pollinator insects

If a remainder of neonicotinoids is present in the soil after a sugar beet culture, it could be absorbed by the succeeding cereal and end up in the droplets of guttation produced by these, and therefore have a potential impact on the pollinating fauna.
The guttation phenomenon is characterized by drops released from the hydathodes (aquifer stomata of the higher parts of the leaves). Guttation is a phenomenon different from dew (condensation of the water in the air) and different from transpiration (release of water through vapour at the level of aquifer stomata over the entire surface of the leaf). The composition of the drops is that of xylem, hence the possible presence of systemic insecticidal active substances in these drops. For straw cereals, guttation occurs mainly at young stages of the crop.

We must therefore give thought to the following points:

- the attractiveness of these guttations for pollinating insects,
- the impact of neonicotinoids, used in year N and which can be contained in the guttations of cereals directly following sugar beet or in N + 1.

Bayer: Hazards of pesticides to bees - 12th International Symposium of the ICP-PR Bee Protection Group, Ghent (Belgium), September 15-17, 2014 3.4 Neonicotinoid seed treatment products – Occurrence and relevance of guttation for honeybee colonies.

Table 1 Exposure of honey bees to guttation fluid

Crop	% of days where guttation was observed	Guttation coincides with bee flight	% of total bees observed that were seen collecting guttation fluid in crop
Cereals (winter wheat and barley)	90% (autumn) 86% (spring)	64% (autumn) 63% (spring)	1.2% (autumn) 14% (spring)

The observation of bees collecting guttation exudates in autumn, period during which the neonicotinoid content is technically the most important, is only 1.2%. In spring time, this figure increases to reach 14%.

However, the residues of neonicotinoid insecticides and of their metabolites, in spring guttations, are much lower than those observed in autumn. This can be explained by the growth and development of the plant during this period resulting in a biological dilution of the active ingredients of these products in plants coupled with the constantly decreasing availability of active ingredients (see DT50). Thus for imidacloprid, the concentrations measured in guttation fluids in Spring are 10 times lower than in Autumn (ref 5). **It should be noted that these concentrations would be even much lower, because of the rate of degradation of this product (DT50), if they had been measured in N + 1 on an untreated crop (spring or winter cereal).**

Guttation takes place when the climate is humid. There is therefore water in the environment. Bees thus have no interest in getting water off the cereals. This is confirmed by the following document: ***EFSA Guidance Document on the risk assessment of plant protection products on bees (Apis mellifera, Bombus spp. and solitary bees).****"Furthermore, the available data suggest that bees prefer permanent water sources to guttation droplets. Therefore, a vegetated buffer strip and permanent water bodies in the vicinity of the field could mitigate the risk from guttation water".*

No effects (mortality, behaviour, vigour, survival after winter) were observed on the colonies monitored with these studies (documents 4-5-6), compared to unexposed colonies.

As such, with these analyses, the EFSA concludes, in its report [1]*EFSA Journal 2016;14(11):4607*; ***Peer review of the pesticide risk assessment for the active substance imidacloprid in light of confirmatory data submitted****",* that exposure through guttation does not present any risk for bees, this exposure modus being of little relevance :

"However, as a general line of evidence the experts noted that guttation fluids might not be the primary route of exposure for bees. Generally, bees using guttation are only rarely observed. Therefore, although robustness of the available studies to assess the effects was questioned and there was uncertainty around the exposure assessment, the experts agreed that ***the risk from exposure to residues in guttation fluids, for uses under evaluation can be considered of lower relevance****."*

References / bibliography.

1/EFSA Journal 2013;11(1):3068 ; "***Conclusion on the peer review of the pesticide risk assessment for bees for the active substance imidacloprid"***

2/[1]*EFSA Journal 2016;14(11):4607*;***"Peer review of the pesticide risk assessment for the active substance imidacloprid in light of confirmatory data submitted"***

3/ IFZ: Ina Patrizia Wirtz, Melanie Hauer-Jákli, Detlef Schenke, Erwin Ladewig, Bernward Märländer, Udo Heimbach, Jens Pistorius. 2018,***"Investigations on neonicotinoids in guttation fluid of seed treated sugar beet: Frequency, residue levels and discussion of the potential risk to honey bees."*** Crop protection 105, 28-34***.***

BAYER :

4/ Hofmann, S.; Staffel, J.; Aumeier, P.; **2014** ***Field study to monitor potential effects on honey bees from exposure to guttation fluid of winter barley (W-BAR), seed-treated with the insecticidal seed-treatment product clothianidin + imidacloprid FS 100 + 175 G in Germany in 201***

5/Hofmann, S.; Lueckmann, J. 20141***/2012Field study to monitor potential effects on honey bees from exposure to guttation fluid of winter wheat (W-WHT), seed-treated either with an imidacloprid or a clothianidin combi-product***

6/Hofmann, S.; Garrido, C.; Lueckmann, J.; ***2012 Field study to monitor potential effects on honey bees from exposure to guttation fluid of winter barley (W-BAR), seed-treated either with an imidacloprid or a clothianidin combi-product***

SYNGENTA:

7/ Dittbrenner: **2016** – File A9765R_10119 - abstract " ***Limited levels of guttation occurred in the sugar beet treated and control fields and no honeybees were observed taking up guttation liquid during the entire observation period".***

8/ Gonsior: **2016** – File A9765R_10120 Abstract ***". Residues of thiamethoxam and CGA322704 were detected in plant (test item treatment group only) and guttation fluid samples taken on various sample dates during the study No residues of thiamethoxam or CGA322704 were detected in pollen, nectar or wax samples taken during the study. "***

9/ Gonsior: **2016** – File A9765R_10121 abstract ***"No test item related effects occurred on mortality, foraging behaviour, colony strength and brood development."***

10 / November 2017 Thiamethoxam sugar beet seed treatment " ***Evaluation of the risk from succeeding crops of thiamethoxam treated sugar beet seeds to honey bees".***