Such drift reduction setup change is compulsory for sowing insecticidal seed treated maize in Germany in 2009.

Furthermore, within a risk assessment the possible amount and drift of dust, and the potential hazard of dust for honeybees should be taken into account. Hazard quotient (HQ) values are in use to describe the risk for honeybees caused by spray applications. The HQ approach or TER- calculations may possibly be used for risk assessment but must be adapted from spray applications to the risk of dust emission, as the allocation, dispersion and deposition of dusts may be different from sprays. Only a fraction of the total active substance is blown out during sowing with dust, but the higher portion of this dust is presumably depositing within a short distance, within few meters of the sowing machine. For the risk assessment, trials on dust emission were formerly conducted but these did not indicate a considerable risk for bees. Only clean seed batches seem to have been used for these trials. To estimate possible adverse effects to honey bees, the development of appropriate new approaches of study designs are required to cover sowing scenarios and generate basic data necessary for improving the effectiveness of the established risk assessment schemes.

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Bee poisoning caused by insecticidal seed treatment of maize in Germany in 2008

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Abstract

Background: In late April and early May 2008 a bee mortality occurred in parts of South-West Germany, which affected approximately 12,000 colonies of bees, some of them substantially. Immediately after this became known, an intensive search for the causes of these incidences was started.

Results: Very soon, maize seeds which had been treated with the insecticidal substance clothianidin were suspected as a possible cause. Only two weeks later a clothianidin poisoning was confirmed by the JKI. On May 15, 2008 the BVL-authority ordered suspension of the authorisation of a number of insecticidal seed

treatment products, especially those containing neonicotinoid substances such as clothianidin, imidacloprid and thiamethoxam and in addition methiocarb.

Conclusions: For all future authorizations of pesticides used as seed treatments additional conditions for use will be applied for precautionary reasons. These will cover: the use of additional stickers, maximum permissible values for abrasion, where applicable, the prohibition of sowing of treated seeds at wind speed higher than 5 m/s, the obligation to incorporate treated seeds including dusts into or directly onto the soil, the ban of vacuum systems, unless the exhaust air pipe allows for an incorporation of dusts into the soil or directly onto the soil, where applicable.

Keywords: bee poisoning, seed treatment, maize, neonicotinoids

Introduction

In 2007 the western corn rootworm (*Diabrotica virgifera virgifera*), which was classified as quarantine pest by the European Union (EU) in 2003, was found at different locations in Southern Germany, namely Bavaria and Baden-Württemberg. It was therefore essential, in order to eradicate this pest, to control the larvae of the western corn rootworm by using maize seeds treated with appropriate pesticides in 2008. In late April and early May 2008 severe poisonings of honey bees (*Apis mellifera*) were reported in parts of South-West Germany, which affected approximately 12,000 colonies of bees, some of them substantially.

Immediately after this became known, an intensive search for the causes of these incidences was started. For this purpose the Ministerium für Ernährung und Ländlichen Raum (Ministry for Food and Rural Areas) of the federal state of Baden-Württemberg and the local authorities collaborated with the bee-keepers, the laboratory for the investigation of bee incidents at the Julius Kühn-Institute (JKI), the Federal Office of Consumer Protection and Food Safety (BVL) and the plant protection products industry.

Findings

In early May, maize seeds which had been treated with the insecticidal substance clothianidin were suspected as a possible cause and only two weeks later a clothianidin poisoning was confirmed by the JKI.

The regional distribution of the bee damages and the investigation of the seeds also suggested that quality deficiencies occurred in certain lots of maize seeds, which had been treated specifically against the western corn rootworm (*Diabrotica v. v.*).

For this purpose a higher application rate (i.e. 125 g a.s./ha) had been authorised than for the protection against frit-flies and wire-worms.

On a number of expert symposia, organized by the BVL, the details of the honey bee poisonings were presented and it was broadly agreed that the detected clothianidin originated from treated maize seeds where the active substance did not adhere well to the grains.

This minor dressing quality led to a strong abrasion and build up of dust within the seed packages (maximum amounts of approx. 50 g/ha dust containing maximum amounts of approx. 4.5 g a.s./ha clothianidin, Figure 1).

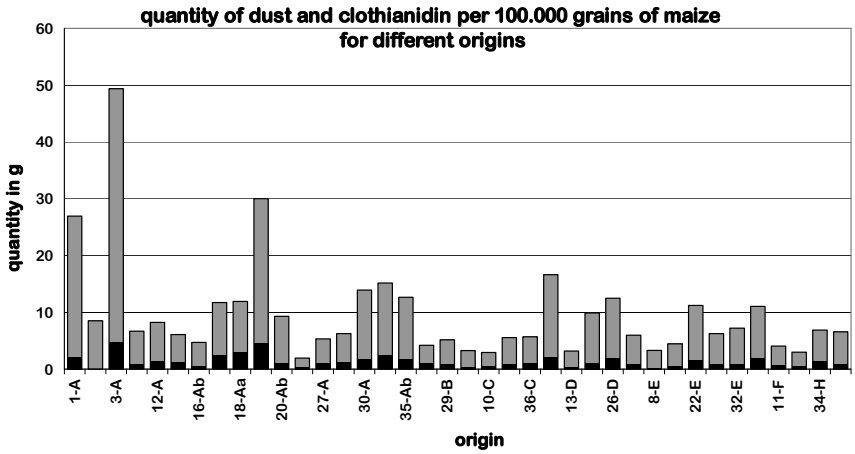

Figure 1 The amount of free dust and proportion of the active substance clothianidin (g per 100.000 grains) contained in 38 seed packages (analyzed by the Landwirtschaftliches Technologiezentrum Augustenberg (LTZ)

In the Upper Rhine Valley pneumatic seeding machines with vacuum systems for single grain application were employed, which, due to their construction, release abrasion dust into the air and onto neighbouring blooming plants, such as oil seed rape an apples (Figure 2).

Figure 2 Emission of contaminated dusts during sowing of maize on adjacent crops (picture by the Landwirtschaftliches Technologiezentrum Augustenberg (LTZ))

The Landwirtschaftliches Technologiezentrum Augustenberg (LTZ) demonstrated that drift of free dusts emitted by pneumatic seeding machines (vacuum systems) onto oil seed rape at 1 m distance amounted up to about 100 µg per kg of oil seed rape (OSR), indicating a severe risk for honey bees. Furthermore the LTZ studied the emission of different types of exhaust air pipes (directed upwards, directed downwards, directed into the soil) and so demonstrated that the emission of dusts into neighbouring fields might be significantly reduced, if the exhaust air pipes were modified so that dusts are incorporated into the soil, e.g. via the fertilizer share (Figure 3).

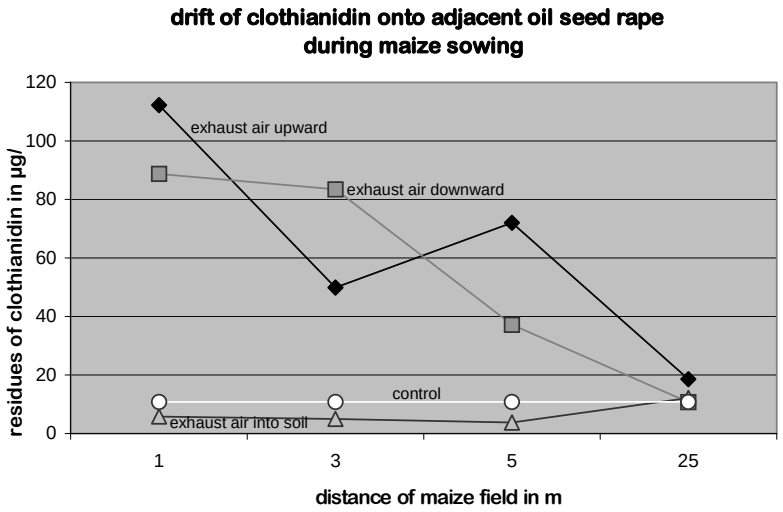

Figure 3 Drift of free dusts (µg per kg) emitted by pneumatic sowing machines (vacuum systems) onto oil seed rape at 1 up to 25 m from the maize field using different types of exhaust air pipes (directed upwards, directed downwards, directed into the soil, control) (analyzed by the Landwirtschaftliches Technologiezentrum Augustenberg (LTZ))

Both of these two main factors coincided with a number of special circumstances which finally generated an acute worst-case-exposure in the South-West of Germany:

- delayed sowings of maize on approximately 15 to 20.000 ha at the same time in the Upper-Rhine valley because of adverse weather conditions,
- followed by dry weather and constant winds which caused a high and directed discharge of dusts into adjacent areas,
- coincidental flowering of oil seed rape, fruits and weeds (e.g. *Taraxacum sp*.), which is considered the most important precondition for exposure of bees to contaminants.

Suspension of the authorisations of insecticidal seed treatment products for maize and oil seed rape

On May 15, 2008, still before the complete clarification of the incidents, the BVL ordered suspension of the authorisation of eight insecticidal seed treatment products:

1. Cruiser 350 FS, BVL-ZA 4914-00 (thiamethoxam)
2. Faibel, BVL-ZA 4704-00 (methiocarb; imidacloprid)
3. Mesurol flüssig, BVL-ZA 3599-00 (methiocarb).
4. Poncho, BVL-ZA 5272-00 (clothianidin);
5. Antarc, BVL-ZA 4674-00 (beta-cyfluthrin; imidacloprid)
6. Elado, BVL-ZA 5849-00 (beta-cyfluthrin; clothianidin)
7. Chinook, BVL-ZA 4672-00 (beta-cyfluthrin; imidacloprid)
8. Cruiser OSR, BVL-ZA 4922-00 (fludioxonil; metalaxyl-m; thiamethoxam)

For precautionary reasons, these measures did not only apply to products for the treatment of maize seeds, but also to products for the protection of rape seed. On May 24, 2008, the Federal Ministry of Food, Agriculture and Consumer Protection banned for a period of 6 months the planting of treated maize by means of certain pneumatic machines for single grain delivery; this ban applied to maize seeds treated with clothianidin or with one of three further insecticides.

In parallel to these immediate measures, the BVL and the JKI intensively dealt with the problem of the abrasion of active substances in seed treatment products. The aim was to clarify which factors play a role in the treatment of seeds and in the sowing process, and how to minimise the damage to the environment. For this purpose the BVL asked authorisation holders for documents and held several expert meetings, during which seed producers, the industry for agricultural machinery, associations and independent experts could express their opinions. The review clearly showed that problems which occurred with maize seeds are not transferable to rape seed in Germany. An experimental study (JKI) on the quantity of dusts in batches of maize and oil seed rape sold on the market demonstrated, that 90 % of the batches for oil seed rape contained less than 1 g/ha of dust whereas for maize 100 % contained more than 1 g/ha dust. More than 99 % of the sowing machines for oil seed rape are either mechanical or pneumatic systems (pressure) where dusts are incorporated into or onto the soil rather than emitted into the air and onto plants.

The risk evaluation by the JKI and the results of the German bee monitoring programme did not produce any evidence for a possible damage to bee colonies due to sowing of oil seed rape. Therefore, on June 25 2008, the BVL reinstated the authorisation for rapeseed (Antarc, BVL-ZA 4674-00, Elado, BVL-ZA 5849-00, Chinook, BVL-ZA 4672-00, Cruiser OSR, BVL-ZA 4922-00). For precautionary reasons additional conditions for use were ordered, such as the use of an additional sticker, in order to minimise free dusts and dusts from abrasion, as well as further labels, such as the prohibition of sowing treated seeds at wind speed higher than 5 m/s, the obligation to incorporate treated seeds including containing dusts or dusts generated during the sowing process into or directly onto the soil, the ban of pneumatic systems (vacuum systems), unless the exhaust air pipe allows for an incorporation of dusts into the soil or directly onto the soil.

For pesticides containing neonicotinoids used for seed treatment of maize, the requirements for an authorization in accordance with Directive 91/414/EEC are currently not fulfilled. Therefore the authorizations are suspended as long as the relevant conditions do not allow for a safe use. Further requirements are:

The chemical companies need to submit new data and risk assessments covering:

- the dispersal of contaminated dusts, including wind erosion,
- new exposure scenarios for contaminated dusts, including toxicity data for dusts,
- abrasion of upgraded formulations, e.g. using stickers, and improved sowing machinery,
- prescriptive limits for free dusts and abrasion, e.g. according to the Heubach-test.

The plant breeding companies need to establish:

- new procedures for seed treatment, especially aspiration of free dusts and use of optimal stickers,
- quality assurance with respect to free dusts and abrasion, e.g. according to the Heubach-test.

The producers of sowing machines need to reconstruct their machines in order to avoid the emission of contaminated dusts.

Future perspectives for the authorisations of insecticidal seed treatment products

The aim of BVL is to close the source of emission by reducing the dusts in the seed bags by 90 % and reducing the emission of remaining dusts by sowing machines by 90 %, in total accounting to a 99 % reduction of emission as far as maize seeds are concerned. The BVL is about to impose a limit for the quality of maize seeds with respect to the abrasion of dusts. For 2009 the maximum permissible value will be down to 0.75 g per 100.000 grains. In addition to that approach of the BVL the JKI is about to establish a list of

'acceptable' sowing machines, reducing dusts in adjacent fields by 90 %, which will be addressed by the respective authorizations.

However, for the authorization of pesticides for seed treatments new data requirements will be defined on a crop by crop basis to take this path of exposure into due consideration:

- data on free dusts and dusts from abrasion for each crop,
- data on sowing machines used and potential emissions.

For all future authorizations of pesticides used as seed treatments additional conditions for use will be applied for precautionary reasons. These will cover:

- the use of additional stickers, in order to minimise free dusts and dusts from abrasion,
- maximum permissible values for abrasion, where applicable,
- the prohibition of sowing treated seeds at wind speed higher than 5 m/s,
- the obligation to incorporate treated seeds including containing dusts or dusts generated during the sowing process into or directly onto the soil,
- the ban of pneumatic systems (vacuum systems), unless the exhaust air pipe allows for an incorporation of dusts into the soil or directly onto the soil, where applicable.

Acknowledgements

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Risks to bees from dusts emitted at sowing of coated seeds: concerns, risk assessment and risk management

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Abstract

The use of Plant Protection Products (PPP) through seed coating may lead to honey bee exposure mainly in the case of systemic properties, through residues that thus may reach green and flowering parts of growing plants. Incidents occurred in France, Germany and Slovenia. These revealed mortality events in honey bee colonies occurring immediately after sowing of coated seeds which could not be explained by systemic properties. These incidents were related to a loss of active substance from the outflow air fan of pneumatic sowing machines and possible pollution of vegetation in nearby fields.

Investigations were undertaken in France in order to identify the factors responsible of these incidents[1]. A low coating quality was demonstrated, which lead to the emission of higher level of dusts compared to usual coating. Higher levels of residues could also be observed in the dusts generated by the low quality coating compared to a normal one. Further research was performed in Italy, on outflow air from pneumatic seed drills[2], which demonstrated a pollution of plants in the vicinity of sowed areas, at levels directly dependant on the length of sowing duration. This observation leads to recommend a quality control of the dust level at the seed treatment plant.

Specific equipments exists, which may reduce the risks by limiting dust emission during sowing operations. Outflow fans may for example be oriented towards the soil so that dust drift is limited. In addition, deflecting devices may redirect dust to the soil and avoid turbulence and further drift. An efficacy assessment of these devices compared to 'conventional' equipment may be a preliminary requirement to their generalized implementation on seed drills.