



Flying pollen transporters: oilseed rape is an important source of food for honey bees.

GREATER COOPERATION BETWEEN FARMERS AND BEEKEEPERS

Partners for bee safety

Cooking oil, animal feed, energy source and supplier of nectar and pollen for bees – oilseed rape has multiple applications. However, pests are also more than happy to feed on the oily plant, leading to smaller yields. Farmers therefore need effective active substances to protect their fields – without endangering beneficial organisms such as honey bees. A study commissioned by Bayer tested a crop protection agent whose bee compatibility has repeatedly been the focus of heated public debate.

Oilseed rape farmers today face a major challenge: they have to protect their yellow fields against hungry pests but have fewer and fewer pesticides at their disposal to do so because in 2013, the European Union restricted the use of the previously standard seed dressings in crops that are attractive to bees. The reason for this ban was the, according to the authorities, not yet fully resolved suspicion that these products could represent an unacceptable risk to beneficial organisms, in particular important pollinators such as honey bees, wild bees and bumblebees. Farmers in the EU are therefore now only allowed to use these extremely effective seed dressings, which replace extensive spray applications, to a limited extent.

A few years ago, the situation was different. Farmers had plenty of tools at their disposal for pest control and were able to reliably harvest good yields. Insecticidal seed dressings like the neonicotinoids form a particularly efficient protective shield around the young seedlings that are especially vulnerable to pests. Applied as a seed dressing, they create a thin protective layer around the seed. The active substance is then taken up continuously by the roots of the seedlings as they develop, protecting oilseed rape, corn and many other crops against ravenous insects during the sensitive emergence phase. This targeted use of active substances provides optimum protection directly at the seed.

Without effective crop protection oilseed rape fields are defenseless against pests

The only alternatives now available are the pyrethroids, which farmers have to spray extensively onto their fields after sowing. "Without the support of neonicotinoid seed dressings, however, we have to use these other insecticides much more frequently than before," says Jörg Thiess, unit manager at the Gross Niendorf



“Neonicotinoids are safe when used correctly.”

Dr. Richard Schmuck,
Environmental Safety,
Bayer CropScience

e.g. agricultural cooperative in Germany. That is not only time-consuming and means higher costs for the farmer, it also increases the risk of resistances forming.

In fact, the situation is even more complicated. "At the moment, there is a lot of contradictory information about whether neonicotinoids actually are harmful to bee colonies," says Dr. Holger Kersten, a freelance agricultural pesticides consultant. The agricultural engineer himself farms oilseed rape fields among other crops and also has his own bee hives.

Bayer therefore commissioned one of the world's largest ever bee monitoring studies into the potential impact on bees in predominantly arable areas of land, with the objective of investigating under scientifically sound and real-life agricultural conditions whether pollinators and pesticides can coexist and, if so, how. Mecklenburg-Vorpommern was selected as the location for the field study. Approximately one quarter of the entire arable land of this state in northern Germany is planted with winter oilseed rape, which each year produces a harvest of 4 tons of oilseed rape per hectare. But in the fall of



Honey bees
have to visit around 2 million flowers to produce half a kilogram of honey.



The view from outside: in the evening, Martina Flörchinger (photo left) from tier3 solutions counts the female red mason bees spending the night in the tubes of the special nesting boxes. Meanwhile, her colleague Dr. Fred Heimbach (photo right) checks the bumblebee boxes in the oilseed rape fields.



Bumblebees

are also part of the bee family. Some of them shake half-opened flowers, for example on tomato, eggplant or blueberry plants, to release the pollen from their anthers.

2014, when the farmers were left without the previously available insecticides to protect the emerging oilseed rape seedlings, pests like the rape flea beetle and the cabbage root fly had to be combated with spray applications. This method is not always sufficiently effective and, as a consequence, some oilseed rape plots had to be replanted with wheat. "If the study shows that the seed dressings are in fact harmless to bee colonies, we definitely need them back," says Kersten.

Beekeepers and farmers can work together to ensure bee and plant health

"But we also want to further promote the dialog between beekeepers and farmers at the same time," says Dr. Richard Schmuck, who is responsible for evaluating the environmental safety of crop protection agents at

Bayer CropScience. After all, only if there is mutual understanding of both farmers' and beekeepers' needs can the wellbeing of bees be protected in the long term and crop yields safeguarded. The goal of mutual consideration naturally also means that any measures required to protect crops must be sufficiently compatible with bees. The findings of the study in Mecklenburg-Vorpommern went some way towards sounding the all-clear. "The scientists reported no harmful effects on the investigated insect species." On the basis of these results, Schmuck as the Bayer expert responsible for evaluating the bees' safety comes to the conclusion that "effective crop and bee protection can and must co-exist in harmony."

The study commissioned by Bayer was designed and carried out by the Institute for Apiculture in Oberursel, Germany, IPM Impact, a Belgian company specializing in integrated pest control and pollination issues, and a

Different species of bees

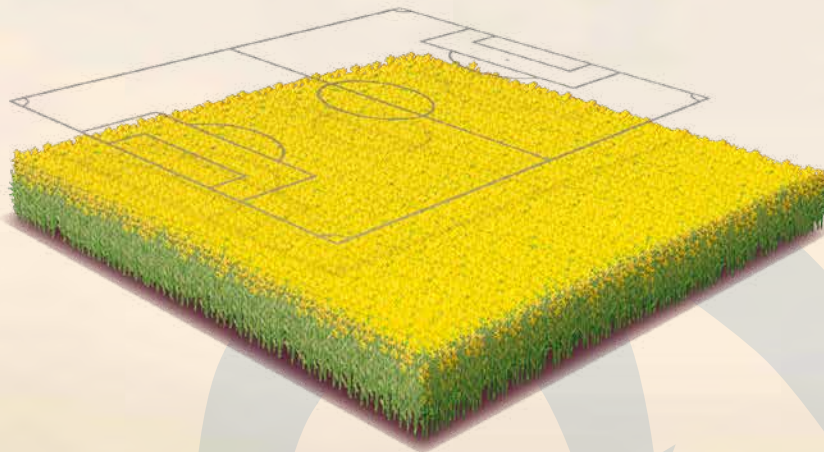
The honey bee may well be the most popular bee species, but there are another 20,000 – 30,000 species buzzing around the globe. Some of these wild bees vary greatly from one another: they have preferences for different flowers, for example, and forage at different times. That allows them to pollinate certain plants even more efficiently than their domesticated cousins. A couple of hundred female mason bees would be enough to pollinate a one-hectare apple plantation, for example, but it would take some 10,000 honey bee workers to do the same work. Wild bees and bumblebees also play a huge role in the pollination of tomato and melon plants. And the nectar from flowers of the bean plant is particularly accessible for insects with long tongues – such as bumblebees.



Helpful wild bees: leafcutter bees are found almost all over the planet and pollinate plants such as alfalfa and lavender.

Yellow source

Oilseed rape is the second most important oil plant after soy and demand for it, as a source of valuable vegetable oil, animal feed or in Europe in particular for the production of biodiesel, is continuing to grow worldwide. Its production has increased almost ten-fold over the past 40 years.



1 hectare

of oilseed rape is slightly bigger than a soccer pitch – and produces resources for humans, bees and livestock.



100 kg of honey ...

The bees are rewarded with sugar-rich nectar, which they use to produce honey.



... would represent a lifetime's supply for two people.



1,600 kg of oil ...

The black seeds consist to 40 per cent of the coveted rapeseed oil. The two largest consumers are the United States and China, who use it primarily as a cooking oil.



... is equivalent to the amount of vegetable oil consumed in a year by 100 people.



2,100 kg of rapeseed meal ...

Rapeseed meal is produced as a byproduct of rapeseed oil production. It is used as a high-protein animal feed for pigs and cattle.



... will feed three dairy cows for a year.



Bee expert Sebastian Wiegand, a beekeeper from the Institute for Apiculture in Oberursel, checks the health status in the beehives set up in the oilseed rape fields for the study.



Butterflies

are primarily interested in the nectar and less in the pollen. Their in some cases extremely long tongues allow them to reach even into deep flowers, for example in some species of orchid.

team of experienced field ecologists from the subcontracted institute tier3 solutions GmbH. The team worked together closely with farmers and beekeepers in Mecklenburg-Vorpommern. There were no other agricultural crops in the area surrounding the study site that were visited by bees during the oilseed rape blossom period. The farmers who were actively involved in the study, including Thieß and Kersten, planted winter oilseed rape on their arable land. The scientists were able to conduct their tests directly on farmland and did not have to set up an artificial trial environment. "So the conditions were very realistic," explains Dr. Fred Heimbach, Senior Expert Ecotoxicology at tier3 solutions. Heimbach coordinated the study and got all of the collaboration partners to one table. The farmers taking part in the project prepared the ground for the tests: in the summer of 2013, they sowed oilseed rape seed dressed with clothianidin on a total area of 800 hectares in a 65 km² trial area, and then sowed untreated seed on roughly 600 hectares in a reference area that was likewise 65 km² in size. In the flowering period of the following spring, it was the turn of the bee experts. They set up a total of 95 honey bee hives at the edges of the oilseed rape fields and also released two species of wild bee: the large earth bumblebee and the solitary red mason bee. "All three bee

species are important pollinators but have different life cycles. This allows us to compare how any seed dressing residues on the flowers affect the different bee species," says Schmuck.

The researchers made sure that the two trial areas, at 65 km², were large enough to ensure that the trial bees could not leave the area and therefore could on the whole only forage for food on the trial sites. On the other hand, the two study areas were adjacent to one another so that they were both subject to the same climatic and geographic conditions. Apart from the winter oilseed rape, only very few alternative sources of food such as wild flowers or flowering bushes were available to the study bees. Says Schmuck, "That meant that in particular the honey bees collected almost exclusively nectar and pollen from plants that had been treated with clothianidin. In this way, the study ensured that the bees were exposed to the full amount of active ingredient." After the oilseed rape had blossomed, the researchers investigated whether the bees' uptake of nectar and pollen from the oilseed rape plants treated with clothianidin had an unfavorable impact on the development of the colonies. The experts also measured how much oilseed rape pollen was collected by the insects during the study period. "The honey bees and bumblebees visited the oilseed rape very frequently. We knew that oilseed rape would not be so attractive to the red mason bees as it is to the two other species of bee, and this was confirmed in the trial," sums up Heimbach.

Varroa mite: the honey bee's biggest foe made the study more difficult to assess

The experts also determined the levels of seed dressing residues in the pollen that the bees had collected. The measured concentrations for all three bee species were within the analytical trace range typical for dressed winter oilseed rape. "These residue levels – typical for this crop – do not negatively affect any of the three species of insects," says Schmuck. Throughout the duration of the study, the experts closely monitored the development and behavior of the bees. "The honey bee colonies developed completely normally. Honey production was also on a par with the average," says Heimbach. The bumblebees likewise displayed no abnormalities. The number of workers and, above all, queens was the same in both trial areas, regardless of whether the insects had collected their food from treated or untreated oilseed rape fields. And the red mason bee built its nests without any disruptions and filled its nesting chambers with fertilized eggs.

But as well as the successes in the field trial, the researchers also had to accept some setbacks. Their work was made more difficult by the Varroa mite. This parasite has been regarded as the biggest threat to the western honey bee for many years and spread to the colonies

1/3

of all plants consumed by humans rely to some degree on pollination by insects.

Source: BBCC

Security check in the field

In some cases, it is not known which bee species are found in particular agricultural fields. Depending on climate and geography, insect populations can vary from country to country. Bayer is therefore providing funding for many projects in other parts of the world.

In the heart of Colombia, researchers from the Universidad Nacional de Colombia are combing through bean fields. Their mission: to find out which bee species are attracted to the plants' blossoms. The researchers are hoping that this study, funded by Bayer CropScience, will help identify pollinators associated with bean crops and also the pollen collected by these insects.

Something similar is happening in Chile: the country is one of the largest wine producers in the world – Chile's agricultural sector relies heavily on the fruit of the vine. The local Chilean Bee Team and their partners investigated whether bees in Chile fly around in vineyards. The study was done to see if the use of crop protection products could impact bees. The results: the bees are almost not affected at all by pesticides because they are apparently not significantly attracted to the vineyards in Chile.



Popular flower: honey bees gather pollen and nectar particularly frequently from sunflowers compared to other crops such as corn.

In Spain, bee protection plays an important role: in cooperation with industry and research partners, Bayer is carrying out tests in the sunflower fields of Spain to determine if the crop protection products clothianidin and thiamethoxam have any impact on honey bee colony health. The large-scale field study in Spain will run until spring 2018.

in the trial fields as well. When the Varroa mite sucks the "blood" of adult bees or larvae, a body fluid called hemolymph, it transmits fatal diseases and can thus eliminate entire colonies. "Unfortunately, the honey bees were so severely infested that we could not complete the overwintering analysis and were unable to continue our tests through to the following spring," explains Professor Bernd Grünewald, Head of the Institute for Apiculture in Oberursel.

To supplement the oilseed rape study in Mecklenburg-Vorpommern, Bayer is supporting further large-scale field trials in Germany, Hungary and the United Kingdom, which are being carried out by an international research group.

The study participants have already registered one positive side effect of the studies carried out so far. "The trial dramatically raised awareness of the topic of bee health among many farmers," says Thiess. And that is an important basis for future cooperations between beekeepers and farmers. For example, even simple arrangements can pay big dividends right now. Farmers can pay attention to the timing of their crop protection

measures and wait until the evening before they start spraying, in order to further minimize the exposure to pollinators. "We have to work together. We as farmers have to understand bees better. At the same time, beekeepers have to appreciate that we cannot avoid crop protection agents altogether when we grow crop plants," explains Kersten. At any rate, the results of the study give grounds for optimism, and oilseed rape growers can look forward to better harvest times. And if they can protect their oilseed rape fields more effectively against plant pests, an important source of food for valuable pollinators like the honey bee will be saved. That ultimately benefits them all: the farmers who grow oilseed rape to make a living, and the beekeepers for whose bees oilseed rape is a significant source of food. And ultimately also for quality-conscious and critical consumers who are interested not only in conserving nature as far as possible but above all also want to improve the living conditions for bees and other flower-pollinating insects.



www.research.bayer.com/bee-study

More information on this subject



Mosquitoes

Some species are vital for chocolate production: if they did not pollinate the small white flowers of the cocoa tree, it would not flower.