A monitoring study confirming the safe use of DuPont Steward insecticide (a.s. indoxacarb) for natural bumblebee populations in flowering apple orchards and recommendations for the use of commercial bumble bee hives in flowering apple and pear orchards treated with Steward

Jozef J.M. van der Steen[1], Axel Dinter[2]

[1]PRI Biointeracties, Postbus 16, 6700 AA Wageningen, The Netherlands
[2]DuPont de Nemours (Deutschland) GmbH, DuPont Str. 1, 61352 Bad Homburg v.d.H., Germany

Abstract

In spring 2006 a monitoring field study was conducted to assess naturally occurring bumble bees in flowering apple orchards. Spread over the Netherlands, Belgium and Germany, 19 orchard sites were selected. The occurring pollinators (i.e. honey bees and bumble bee species) were determined during visual observations of 30 flowering trees per orchard, once before and after commercial treatment with Steward and in insecticide untreated orchards. Generally bumble bees were much less abundant than honey bees (about 1:10). No indications for decrease or disappearance of natural bumble bee populations due to Steward application in flowering orchards were found.

Commercial bumble bee hives (Biobest multi-hives) were set up in 20 apple and pear orchards in the Netherlands, Belgium and Germany in spring 2006. During the flowering period the bumble bee were exposed to commercial Steward applications in 18 orchards, while two were insecticide untreated. Three bumble bee hives per orchard were kept continuously open over the whole observation period or only for 4-day exposure/foraging period with exposure during the Steward application or with exposure starting 1, 2 or 3 days after the Steward application. Steward application caused on average 25% and 22% mortality of worker bumble bees in the colonies that were actively foraging during spraying and in the colonies that started foraging one day after Steward application, respectively. Mortality of worker bumble bees in the colonies opened two and three days after Steward application was statistically significantly lower. Colonies of all treatments developed from 50 to over 150-300 bumble bee workers during the study period and no effects on brood or the survival of queens were observed in any of the treatments.

Based on good agricultural practices, it is recommended to close commercial bumble bee hives during the day of Steward application and to keep the hives also closed the day after application to minimize acute worker bumble bee mortality.

Evaluation of side effects of commercial biological pesticides on the beneficial insect, *Bombus terrestris*

Veerle Mommaerts[1], Guido Sterk[2], Guy Smagghe[1,3]

[1] Laboratory of Cellular Genetics, Department of Biology, Faculty of Sciences, Free University of Brussels, Brussels, Belgium
[2] Biobest NV, Westerlo, Belgium
[3] Laboratory of Agrozoology, Department of Crop Protection, Faculty of Bioscience Engineering, Ghent University, Ghent, Belgium

Abstract

Nowadays cultivators are facing the problem that a percentage of their harvest is lost due to damage of pest insects or infections of plant pathogens. Meanwhile the use of pesticides is being limited because of environmental and residual risks and the development of resistance. Microbiological control agents (MCAs) are now widely used in integrated pest management (IPM) programs as an alternative for the conventional pesticides. MCAs include bacteria, yeast-like fungi, yeasts and viruses. In the field MCAs are dispersed in the crops by spraying applications. It is not unlikely that pollinators like bumblebees are exposed to these

biological pesticides while they are foraging. Biological pesticides may contain biological active materials that could grow on or in the insect. Therefore possible adverse effects on beneficial pollinators must be evaluated as pollination must be guaranteed.

This study has examined the potential adverse effects of commercial biological pesticides that contain bacteria, fungi, yeasts and viruses on the bumblebee *Bombus terrestris*. Worker bees were exposed under laboratory conditions to the maximum field recommended concentration (MFRC) of each compound via three different routes of exposure: dermal contact and oral feeding via the consumption of treated sugar water and pollen. In general all tested MCAs were found safe for workers of *B. terrestris*, with the exception of Botanigard *(Beauveria bassiana GHA*) via dermal contact treatment that caused 90% worker mortality at its MFRC after 12 weeks. Even at half of the MFRC, 50% mortality was observed, but there was no mortality with a lower dose of 1/10 of the MFRC.

Apart of to acute toxicity also sublethal effects on nest reproduction were examined. Here none of the tested compounds did exert detrimental effects as the production of drones after 12 weeks appeared to be not significantly different from the control nests (39.5±6.7) ($P>0.05$).

Overall, the results demonstrated that most of the biological pesticides tested can be considered as safe for *B. terrestris*, but some can be harmful. Therefore it is recommended that before any use in combination with pollinators all should be tested. In this context it is also advised that these compounds should be evaluated for potential effects on the foraging behavior in more field related tests.

Side effects of commercial *Bacillus thuringiensis* insecticides on micro-colonies of *Bombus terrestris*

Veerle Mommaerts[1], Guido Sterk[2], Guy Smagghe[1,3]

[1] Laboratory of Cellular Genetics, Department of Biology, Faculty of Sciences, Free University of Brussels, Brussels, Belgium
[2] Biobest NV, Westerlo, Belgium
[3] Laboratory of Agrozoology, Department of Crop Protection, Faculty of Bioscience Engineering, Ghent University, Ghent, Belgium

Abstract

Bacillus thuringiensis (*Bt*) is a natural soil bacterium that is used worldwide for the control of pest insects as its protein crystals possess insecticidal activity. Due to the intensive use of Bt in different crops like vegetables, ornamentals, flowers and fruiting plants, the question has raised whether Bt is safe for non-target organisms. Nowadays cultivators are using beside honeybees also bumblebees for the pollination of their crops such as tomatoes.

In this study the risk of two different strains of commercial Bt insecticides, *B. thuringiensis kurstaki* (Dipel® WG) and *B. thuringiensis aizawai* (Xentari® WG) on the biology of the bumblebee *Bombus terrestris* was assessed. In order to evaluate potential lethal and sublethal effects on the reproduction, micro-colonies of worker bumblebees were exposed to 0.1% of each compound, representing the maximum field recommended concentration (MFRC), and this via three different routes of exposure: dermal contact and oral feeding via treated sugar water and treated pollen.

For both Bt compounds no loss of survival was scored after dermal contact treatment. Via treated sugar water, Xentari® at 0.1% killed all worker bumblebees, but with a lower dose of 0.01% (1/10 of the MFRC) mortality was zero. With Dipel® at 0.1% in the sugar water and in the pollen, no mortality was scored.

Next to lethal effects, also sublethal effects were evaluated. In the nests exposed to Xentari® at 0.1% via the pollen a significantly lower number of drones was produced ($P<0.05$). However, no detrimental effects were seen with a lower dose of 0.01% ($P>0.05$). For the treatments with Dipel®, the reproduction in the micro-colonies was normal (37.6 ± 5.5 drones per nest) as in the controls (39.5 ± 6.7 drones per nest).