Effects of pesticides on honey bees

Pesticides have potential, mostly neurotoxic, consequences on the behavioural patterns of honey bees. Complex behaviours govern foraging, the structure and construction of the hive, the maintenance of temperature and humidity for the brood by nurse bees and for the preservation of honey and pollen, the assessment of locations for a new swarm and the protection of the hive against predators. These innate behavioural patterns, which ensure a hive's survival, depend on the integrity of a nervous system where each synapse is important. Pesticides may affect these behavioural patterns (Rortais et al., 2004, Kievits, 2007). Because bees forage in a large circumference around the hive, they can easily fly into areas that are being or have recently been sprayed.

Moreover pesticides are often implicated in honeybee mortality because many of the chemicals used on the plants which are bee-pollinated are toxic to bees. A study by Cornell University in 1993 points out the highly variable LD50 doses of Phosmet – a non-systemic organophosphate insecticide (Imidan 50WP in Europe) used on pome fruit (apples, pears, quince etc) and potatoes in Southern Europe - in mammals and concludes that the pesticide is very toxic to honeybees[1].

Although tests usually focus on finding the dose which is lethal to honeybees, sub-lethal doses can also cause problems, either because they bio-accumulate to lethal levels or because they have behavioural effects. Colonies placed near crops of sunflowers treated with imidacloprid, a neonicotinoid systemic insecticide, displayed disrupted foraging. Colonies dwindled and died as foragers failed to return to the hive (Bortolotti et al., 2003). Bee keepers have raised concerns over the toxicity of systemic insecticides for honey bees, given that in order to work as prescribed, the active substance must remain active long term and in the parts of flowers visited by foraging bees.

Waller et al (1984) found that the possibility of chemical transfer into the hive is higher with systemic insecticides than with non-systemic insecticides. Schmuck et al (2001) and Bonmatin (2003) found that although the concentration levels found in nectar and pollen are low, the relative toxicity of the new molecules of systemic insecticides and their metabolites are very much higher than those of the past generation of pesticides. When honeybees consume even small amounts of pesticides they can show sub-lethal toxic effects. These might be cognitive disruptions and behaviours, including orientation abilities, foraging and food collection, interfering with the ability of the bee to return to the hive. Because of the mutual dependency of hives and bees, even sub-lethal effects might have lethal consequences.

In the spring of 2008, certain regions of Southern Germany reported abnormal bee deaths of approximately 11,000 colonies, which the Federal Office of Consumer Protection and Food Safety (BVL) in Germany said was caused by Clothianidin, an insecticide used to treat maize seed and rapeseed. The insecticide was found not to have properly adhered to the seeds in some batches, causing it to spread. The sowing equipment was also thought to contributing to the spread of the pesticide and subsequent exposure to bees.

EU laws require thorough and extensive toxicity tests for pesticides. However in order to avoid bee losses, it appear that a) certain active substances are more problematic for pollinating insects and b) improper handling may have unforeseen effects on bees. An increased understanding of those factors is important for future legislative actions on bee protection.

1 A Pesticide Information Project of Cooperative Extension Offices of Cornell University, Michigan State University, Oregon State University, and University of California at Davis, 1993.