

## Effects of neonicotinoid dust from maize seed-dressing on honeybees

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### Abstract

In the last years bee and colony losses have been reported in numerous countries worldwide and many factors were taken into account to explain these phenomena. However, time-space differentiation of bee mortality factors needs to be considered. In Northern Italy since 2000 to 2008, the spring bee mortality was clearly linked to the maize seed dressing. In fact, it was shown that pesticides may be dispersed from the pneumatic drilling machine during sowing and bees may enter in contact with these contaminated dusts in several ways: by direct contact (when bees fly through the toxic cloud in the sown field), by indirect contact (when bees walk on contaminated leaves of the vegetation surrounding the sown field) or by ingestion (when bees collect nectar or dew from the vegetation contaminated with the dispersed dusts).

The pesticides used for maize seed dressing are extremely toxic for bees with lethal and sublethal effects depending on the level of exposure. In Italy, the high bee mortality during the sowing of coated seeds resulted in the suspension of use of the active ingredients imidacloprid, clothianidin, thiamethoxam and fipronil for seed coating (Ministerial Decree 17/09/2008). At the same time a research project "APENET monitoring and research in apiculture" was financed in order to establish the causes (external and internal to the hive) of bee mortality and the possible ways of mitigation. In our studies we investigated the effects of clothianidin derived from corn seed dressing on honey bees in laboratory (indirect contact) and semi-field conditions (ingestion, direct and indirect contact) in order to evaluate possible effects at individual and at colony level. In laboratory test, the effects of the dust emitted by the clothianidin-based product Poncho®, were compared to those of a liquid formulation of the same active substance (trade name: Dantop®). To do so, forager bees (10 bees per cage) were allowed to walk for 3 h on treated apple leaves, placed on the bottom of plastic cages. The tested quantities of active ingredient corresponded to the amount deposited on the ground during sowing at 5 m distance from the edge of the field. Talc was used as a dispersing agent for the dust of Poncho formulation. In the control, leaves were treated with talc only.

Our results showed that, up to the 24<sup>th</sup> hour, mortality induced by the two products was comparable, with both products proving to be 'slightly toxic'. During the subsequent hours, instead, the number of dead bees increased more in the Poncho dust treatment than in the Dantop spray treatment. In the semi-field test, the flowering oilseed rape was contaminated with the same concentration of a.i. as the one applied in the laboratory. The effects of the clothianidin-dust treatment in comparison to the control (plant treated with talc only) were evaluated by introducing bee nuclei into tunnels cultivated with oilseed rape (1 nucleus per tunnel of 40 m<sup>2</sup>). A total of 6 tunnels were used, three for each treatment. In each tunnel we assessed the following parameters one week before and two weeks after treatment: bee mortality, colony strength, flight activity, foraging behavior, socio-physiological parameters linked to the colony vitality (temperature and humidity inside the hive, capacity in the construction of a honeycomb).

During the first two days after dust application bee mortality was significantly higher in treated than in control tunnels, while at a colony level no effects were observed, even eight months after treatment. Our results showed that contaminated dusts dispersed during sowing operations have negative effects at individual level, but no effects seem to exist at the colony level in the our experimental conditions.