

SUMMARY OF RESEARCH ON THE NON-TARGET EFFECTS OF BT CORN POLLEN ON HONEYBEES

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Colony collapse disorder (CCD) has caused much concern among beekeepers nationwide and it is not clear to date what is causing the die-off. Genetically modified crops, specifically Bt corn, have been suggested as a potential cause of CCD. While this possibility has not been ruled out, the weight of evidence reported here argues strongly that the current use of Bt crops is not associated with CCD.

First, the endotoxins currently expressed in Bt corn (Cry 1 types against caterpillars; Cry 3 types against beetles) are not active against hymenopteran insects such as the honey bee, nor do the CCD symptoms resemble those expected in Bt intoxicated organisms. Yes, the increase in bee loss has somewhat paralleled the increase in Bt crops in the U.S., but severe bee losses have occurred in Europe and in areas of Canada where Bt crops were not grown.

Numerous laboratory studies have examined the potential non-target of Bt corn on honey bees by feeding high doses of Bt pollen or purified endotoxin mixed with honey or sugar syrup directly to larvae in brood cells. This approach is a standard protocol for Tier I testing of non-target effects on bees and required by EPA before transgenic crops are approved for registration. Published studies and other technical reports submitted to EPA have all shown no adverse acute effects. In particular, recent laboratory studies by Dr. Louise Malone in New Zealand and Dr. Dirk Babendreier in Switzerland exposed bees for 10 days by feeding on pollen treated with purified Cry 1 endotoxins at doses considered well above the maximum environmental exposure levels encountered in the field. They reported no negative effects on bee survival. Laboratory feeding studies by this author and Dr. Robyn Rose also showed no effects on the weight and survival of honey bees feeding on Cry1Ab-expressing sweet corn pollen for 35 days.

Potential sublethal effects of Bt corn on honey bees have also been addressed but not as extensively as the acute effects. For newly-emerged bees, the presence of Bt proteins in ingested pollen may affect hypopharyngeal gland development and thus the ability of nurse bees to make brood food. However, Drs. Malone and Babendreier showed no effects of Bt pollen or endotoxin on hypopharyngeal gland development of newly-emerged bees after 10 days of exposure. Another 2005 study conducted in indoor flight cages reported no effects of Cry1Ab protein exposure on mortality, syrup consumption, or learning capacities of free-flying honey bees, but foraging activity was slightly reduced. A field study by Drs. Rose and Dively (soon to be published in the bee journal *Apidologie*) represents the first attempt to expose functional colonies of honey bees to Bt corn pollen under open field conditions. In this study, colonies placed in Bt sweet corn plots were allowed to forage and were also fed Bt pollen cakes for 28 days. The pollen cake consumption alone represented approximately 44% of the expected daily

pollen requirements of each exposed hive. Results showed no adverse effects on bee weight, foraging activity, colony bee strength, and brood development.

Although there is no evidence thus far of any lethal or sub-lethal effects of the currently used Bt proteins on honey bees, insecticidal products expressed by other transgenes may need extended field testing on a case-by-case basis to assess the longer term consequences of sub-lethal changes in colonies and subtle modifications in bee behavior.