



Eva Crane Trust

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## On the scientific front

### Dead bees under lime trees

When the limes were in flower in England last year, many people were disturbed to see bees lying dead, paralysed or "drunk" under the trees. There were reports that the ground was covered with dead honeybees—or, more often, with dead bumble bees—and some other species were also affected. The damage was variously attributed to the nectar or pollen of the lime trees, to toxic chemicals, or to more mysterious sources. Most reports came from localities where the soil is quickly drained, and in any case the 1976 summer was exceptionally dry (page 102). The cause of this damage seems to be rather little known, although it was established in 1960<sup>7</sup>.

The toxicity of the nectar and pollen of lime (*Tilia*) species is due to certain sugars in them, which are present in abnormally high amounts in dry years. These sugars disturb carbohydrate metabolism in bees of various species. The chief culprit is mannose, which von Frisch found was strongly toxic to honeybees, in 1930<sup>1</sup>. Mannose is a common sugar, utilizable by many organisms (including man), but not by certain insects, in which it produces a "metabolic disease". The first stage in mannose metabolism is its transformation into mannose-6-phosphate by the enzyme hexokinase, which is present in bees. The second stage is the conversion of the mannose-6-phosphate (which is itself toxic to them) into fructose-6-phosphate by the enzyme mannosephosphate isomerase. But honeybees and some other bees have no more than a trace of this enzyme; in these bees, therefore, mannose-6-phosphate is formed but is not broken down again; it accumulates in the digestive system. More than this, hexokinase produces a faster reaction with mannose than with glucose and fructose, so the latter non-toxic sugars are not metabolized in the presence of mannose, and the sugar level in the blood falls<sup>7</sup>.

Honeybees fed experimentally on the sugars galactose and rhamnose, as well as mannose, died similarly; the toxic sugars increased in the blood and thorax, while the levels of glucose and fructose dropped<sup>2</sup>. The thoracic muscles were unable to function, so the bees could not move their wings and legs—and appeared paralysed. This is what had happened to the dead and "drunk" bees under lime trees. Some wild bees are more affected than honeybees, possibly because of their different feeding habits with regard to nectar and pollen.

The lime species most implicated seem to be *Tilia tomentosa* (*argentea*) and its cultivar *T. petiolaris*, *T. orbicularis* and *T. cordata*. *T. miqueliana* has been recommended as a late species for planting instead of *T. petiolaris*, for this reason<sup>3</sup>.

The severity of the effect varies from season to season, and from place to place, being greatest in dry years and on well drained soils. The following facts have been reported from Switzerland<sup>5</sup>. In the Innertkirchen region of Canton Bern, colonies of honeybees were weakened considerably during the 1922 lime flowering; according to some reports this happened every year. In 1925 a beekeeper in Herbligen said he lost 50% of his flying bees during the flowering of *Tilia argentea*. In 1943 many paralysed bees were found in an apiary at Liebefeld-Bern, at the end of June and throughout July. They were crawling on the gravel paths, dragging the abdomen and unable to fly. Bees examined contained lime nectar and pollen; under *Tilia cordata*

trees nearby were many dead and paralysed honeybees, bumble bees and some solitary bees. When *Tilia tomentosa* followed *T. cordata* in flowering, dead and paralysed bees were found under those trees. Other similar events occurred in Switzerland that year, and it was established that the effects were not due to any recognized bee disease<sup>5</sup>.

There was an even earlier reference in England<sup>3</sup>: "In 1908 the bodies of innumerable bees, poisoned by the flowers of *T. petiolaris* at Tortworth, had so much manured the ground under its outer branches, that a very green ring of turf was visible in the autumn following, and was noted by the Earl of Ducie to be even more conspicuous in 1909."

Later in the year, after flowering has finished, honeydew produced on the leaves and branches of lime trees can upon occasion be toxic to honeybees. There was a severe outbreak at Lübeck in northern Germany in August 1928, when heavy showers washed the honeydew off the leaves and bees collected it on the street and in the gutters<sup>3</sup>. This was followed by a high mortality of bees in hives that had stored the honeydew in the combs, probably due to the sugar melezitose in the honeydew. The honeydew of *T. platyphyllos* proved toxic to bees when it was fed to them.

A few groups of plants are sources of nectar and honey that is toxic to man, although bees are not adversely affected<sup>5,6</sup>. Most such plants are Ericaceae; they include species of *Rhododendron*, *Azalea*, *Andromeda* and *Kalmia*. Although such honeys from toxic nectar are of scientific interest, they are extremely rare; rarer still are honeys from honeydew that is toxic to man, such as that excreted by the aphid *Scolytopa australis* on the New Zealand tree *Coriaria arborea*<sup>8</sup>.

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