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## *In this issue:*

For the past five years the Laboratory of Apiculture and Social Insects at the University of Sussex has been carrying out many research projects collectively called the Sussex Plan for Honey Bee Health and Well Being. These four articles summarize Sussex Plan research in two main areas: diseases and foraging. The disease work includes research on the control of varroa and on hygienic behaviour, a defence mechanism against brood diseases. The foraging work includes research that investigates honey bee foraging by decoding waggle dances, and on making urban gardens and parks more bee-friendly. In addition, the Sussex Plan is researching neonicotinoid insectides and foraging in farm land.
The Sussex Plan has been carried out by Professor Ratnieks and his team, which has included 35 volunteers, overseas visitors, undergraduate students, postgraduate students, technicians and postdoctoral researchers. The BBKA have contributed half of the funding for one student, Gianluigi Bigio, who recently completed his PhD on hygienic behaviour.

# Varroa: Towards Integrated Control

*Varroa mites are a major challenge to honey bee health. For many years varroa could be controlled using Apistan strips. However, many varroa are now resistant to Apistan. There are many alternative control methods. How effective are they and do they harm the bees? LASI research shows that oxalic acid is highly effective in killing varroa, especially when applied via the sublimation method, which can kill 97%. Applying oxalic acid in solution via spraying or dribbling can be effective at killing varroa, but also harms the colonies. Oxalic acid only kills mites sitting on the bodies of the adult bees and so is most effective just before or after Christmas when most hives are broodless. Hygienic behaviour can greatly reduce the build-up of the varroa population inside a colony, and in combination with annual oxalic acid treatment should keep varroa numbers to harmless levels.*

by Francis L W Ratnieks. Laboratory of Apiculture and Social Insects (LASI), School of Life Sciences, University of Sussex, Falmer, Brighton, UK, BN1 9QG. F.Ratnieks@Sussex.ac.uk; www.sussex.ac.uk/lasi

The mite, *Varroa destructor,* is a significant problem for honey bee, *Apis mellifera*, colonies. Varroa is native to the Asian honey bee, *Apis cerana*. Varroa does little damage to *A. cerana* as the female mites only breed in capped drone cells, resulting in low mite populations. But in *A. mellifera* the mites can also breed in worker cells and mite populations build to high levels and damage the bees directly. Varroa also vector honey bee viral diseases and this is probably their greatest harm. The main aim of LASI's varroa research is to determine the effectiveness of different control methods used by beekeepers. We have studied three methods in detail.

Beekeepers have long used oxalic acid and much research has been done on it. However, no project had compared the effectiveness of different doses and application methods. In an experiment using 110 hives we did this. Hives were treated in early January when they were broodless, as oxalic acid kills only varroa sitting on adult bees not those in brood cells. We determined the proportion of mites killed by washing the mites off of a sample of approximately 300 worker bees immediately before and ten days after treatment.

Our results showed that applying oxalic acid directly as a gas via sublimation was superior to application as a solution via spraying or dribbling. Sublimation gave greater varroa kill at lower oxalic acid doses and gave no increase in bee mortality either soon after application or four months later. In fact, colonies treated via sublimation had more brood than untreated control colonies. The sublimation method is also quick and easy because it is applied via the hive entrance. One year later, we retested the sublimation method and obtained the same result. Just 2.25g of oxalic acid per hive kills 97% of the varroa.

The second method we tested was drone brood trapping. Varroa are particularly attracted to drone brood. Our results show that half a frame of drone comb placed into a hive in early spring, when the first drones are being reared, can trap about half the varroa. The third method is via hygienic behaviour. We compared the build-up of the varroa population in hives following oxalic acid treatment. In the 42 study hives, varroa populations increased from as few as seven times to as many as 74 times in one year. Build up was significantly lower in highly hygienic colonies (average 19 times) than non-hygienic colonies (average 45 times).

Overall, our results show that annual treatment with oxalic acid just before or after Christmas, when most hives are broodless, is probably enough to control the varroa population, especially when colonies are also hygienic. Drone brood trapping is less effective. Because only half the mites are killed, one round of mite breeding is enough to restore the population given that a female mite breeding in a worker cell normally has one or two daughters. Killing 97% of the mites using oxalic acid would seem to be about twice as effective. Actually, it is five times as effective as it will take five varroa doublings to build back to the level before treatment. ■

*Treating a hive in winter with oxalic acid using the sublimation method. The oxalic acid is turned into a gas using a heated tool which is inserted into the hive entrance. For the purpose of the photo the tool has not been inserted and the oxalic acid vapour can be seen (photo by H Al Toufailia).*

## References

These projects have all been completed and written up for publication. The first is about to be published:

- Al Toufailia H, Amiri E, Scandian L, Kryger P, Ratnieks FLW. Towards integrated control of Varroa: Effect of variation in hygienic behaviour among honey bee colonies on mite population increase and deformed wing virus. *J Apicult Res* (accepted).