

Bees in Europe and Sustainable Honey Production (BEESHOP): a European Research Network

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The aims of the network

Honey has been of great value to man since prehistoric times, making apiculture a deeply rooted activity in many human cultures. Numerous regulations control honey quality in several countries, reflecting the high nutritional value and economic importance of this product. Yet, in human-modified environments with increasing chemical pollution, honey is under high risk of becoming contaminated. In addition, a broad spectrum of chemicals is used to treat honeybee diseases, further contaminating honey with sometimes highly toxic compounds.

BEESHOP (BEes in Europe and Sustainable HONEY Production) is a network of selected beekeeping industries and nine leading European research groups in honey quality, pathology, genetics and behaviour (Table 1), which all share a common interest in promoting Europe's high honey quality standards. The prime goal of BEESHOP is to reduce potential sources of honey contamination due to the foraging of contaminated nectar and the use of chemotherapy to control honeybee diseases. To reach this goal the network focuses on four main topics:

1. *Reduction of honey contamination through chemotherapy of honeybee diseases.* Provided that any chemotherapy of honeybee colonies immediately leads to contaminated honey and, ultimately, to resistant pathogens, BEESHOP aims to eliminate the need for chemicals in the control of honeybee diseases.

2. *Avoidance of chemical pollution through agrochemicals.* Not only chemicals applied directly to the hive in order to prevent infections may contaminate honey. Agrochemicals carried by foraging bees, may also cause contamination of honey. BEESHOP intends to reduce this kind of honey contamination by developing new tools based on Neurobiology and Genetics. Perception of agrochemicals, selective foraging and the genetic control of foraging behaviour are among the subjects addressed.

3. *Testing and controlling honey quality.* This section heavily relies on food chemistry to determine the quality and origin of honey. Honey quality is not only valuable for human consumers but for the colony itself, provided its antimicrobial properties and nutritional value have an important

impact on colony health. Therefore, besides determining honey quality, type and origin, BEESHOP is assessing any physiological effects of honey related to reducing or preventing honeybee diseases.

4. *Information transfer to beekeepers:* To guarantee high honey quality standards, scientific findings have to be implemented by beekeepers. Thus, the information transfer between scientists and beekeepers and vice versa is a crucial section of the project.

The structure of the network

The work plan of the BEESHOP is constructed around nine research workpackages distributed within four interconnected departments. The project is funded by the European Commission (FP6-FOOD).

The Honey Department

Is the BEESHOP unit with the closest customer links. It comprises four research institutes (Martin Luther University, Germany; Consejo Superior de Investigaciones Científicas - Spain; Slovak Academy of Science, Slovakia; and Istituto Nazionale di Apicoltura, Italy), which will develop new quality screening techniques allowing to test the authenticity of the honey in the consumer's jar, addressing both the floral and the honeybee origin. It will test if specific natural compounds in bee products (plant and bee derived) have any physiological effects on reducing or preventing honeybee diseases. The Honey Department is tightly linked to the Pathology Department and will also collaborate closely with the Genetics & Behaviour Department, where tools for the reduction of foraging on pesticide-contaminated flowers will be developed (Fig. 1).

The Pathology Department

Aims to reduce the use of chemotherapy in the control of honeybee diseases. The research program focuses in understanding the life-cycles and infection pathways of bee pathogens such as American Foulbrood (AFB) (Martin Luther University - Germany and Swedish University of Agricultural Science), viruses (Martin Luther University, Germany and Queens University Belfast, UK) and *Varroa* mites (Swedish

University of Agricultural Science and University of Hohenheim, Germany). Additionally, the Pathology Department addresses the individual and colony-levels tolerance against a variety of pathogens (AFB, *Varroa*, DWV, KV and *Nosema*). In order to initiate breeding programs for resistant bee strains, the identification of honeybee genes providing resistance against certain diseases is also being addressed through a close collaboration with the Genetics & Behaviour Department and the Extension Department.

The Genetics and Behaviour Department

Consists of three leading institutions (Martin Luther University, Germany and Centre National de la Recherche Scientifique, Toulouse and Gif-sur-Yvette, France) working in collaboration with the Pathology Department on developing DNA tools to identify genes controlling resistance traits. A screening of all European honeybee-subspecies aims to detect the genetic resistance potential of different honeybee strains. Together with the Extension department, breeding concepts to maintain indigenous resistant strains will be developed, seeking to reduce the need for chemotherapy. In addition to disease resistance, this unit seeks to reduce the influx of pesticides into the hive through the study of foraging behaviour and conditioning responses of honeybees (Centre National de la Recherche Scientifique, Toulouse, France). Aversive learning, conditioning and reception of chemicals are among some of the topics addressed, trying to canalise the foraging behaviour towards uncontaminated resources, repelling bees from treated fields.

The Extension Department

Represented by the Bee Research Institute Dol (Czech Republic), it functions as a bridge between basic research and applied apiculture, facilitation a bi-directional flow of information and resources. In order for scientific findings to be translated into beekeeping praxis the department is tightly linked to a large suite of commercial beekeeping operations throughout Europe, which will in turn be essential for providing the necessary test facilities, colonies and honey samples

Prospective achievements

At the end of the project in 2009, BEESHOP will have es-

tablished routine screening methods for honey quality, allowing the implementation of more efficient legislation on honey quality control and beekeeping. The feasibility of these procedures will be demonstrated under controlled laboratory conditions and will be ready to be adopted by apicultural institutions as routine tests for honey quality. Likewise, BEESHOP will develop a new and cost-effective DNA tool to evaluate the disease resistance of European honeybee subspecies, as well as control the quality of mating apiaries for breeding regional strains. These tools will in turn reduce honey contamination and set up the basis for a sustainable use of European honeybee strains.

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BEESHOP Web site: http://www2.biologie.uni-halle.de/zool/mol_ecol/Beeshop_pics/beeshop_home.html

Rodolfo Jaffé (left) and Dr. Robert Paxton preparing to inflate balloon to carry trap for flying drones.

Photo; M. MacGiolla Coda



Drone trap with pheromone lure.

Photo: Low De Vries



Extracting semen from captured drones.

Photo: Redmond Williams.

Photos from visit of BEESHOP researchers to Galtee Bee Breeding Group, 2007.

