Hygienic Behaviour Training Workshop

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LASI
LABORATORY OF APICULTURE AND SOCIAL INSECTS
www.sussex.ac.uk/lasi

School of Life Sciences
University of Sussex

Laboratory of Apiculture & Social Insects

Sussex University

LASI Goals

Research
To carry out basic and applied research on honey bees and social insects.

Teaching
To train the next generation of honey bee and social insect scientists.

Community
To extend knowledge to beekeepers and others.

To play an active role in the public communication of science.

Conservation
To help honey bees and other social insects.

LASI Researchers Spring & Summer 2011

Lab Leader		
	Professor Francis Ratnieks	England etc.
Postdocs & Reseachers		
	Dr. Karin Alton**	Denmark
	Dr. Margaret Couvillon**	USA
	Dr. Christoph Grüter*	Switzerland
	Dr. Jelle van Zweden*	Netherlands
	Dr. Francisca Seghers*	Netherlands
	Mr. Norman Carreck**	England
PhD Students		
	Mr. Gianluigi Bigio**	Italy
	Mr. Tommy Czaczkes	England
	Mr. Sam Jones*	England
	Mr.Mihail Garbuzov**	Latvia
	Mr. Martin Kärcher**	Austria
	Ms. Fiona Riddell**	Scotland
	Mr. Hasan Tofalia**	Syria
Volunteers		
	Sarah Hudson**	England
	Mike Kavanagh**	England
	Suzie Johanson**	England
Masters Degree Project Students		
	3 students*	China, Scotland
Final Year Undergraduate Project Students		
	6 students*	UK
Summer Bursary Students		
	2 students**	UK
Summer Visitors		
	1 student*	France

Bees
** 100%
* part

The Sussex Plan for Honey Bee Health & Well Being

Applied Research on Challenges to the Honey Bee

Challenges to the Honey Bee in Britain

From c.1,000,000 to 250,000 hives in past century

Suggested Causes of the Reduction

Fewer flowers in countryside/habitat loss/intensification

Honey bee diseases

Insecticides

Urbanization

Global climate change

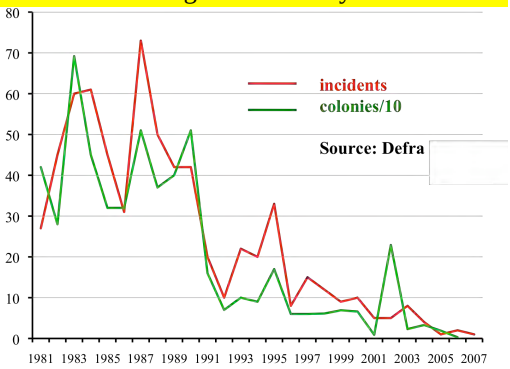
GMOs

Mobile Phones

F1 hybrid plants

Nanotechnology……HFCS……etc.

Pesticide-Poisoning British Honey Bee Colonies



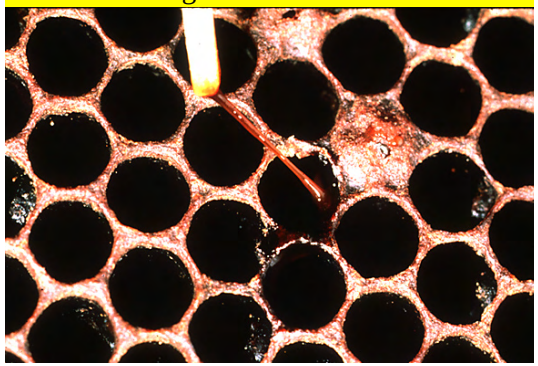
Definite Problem

Pathogens & Pests

Honey Bee Specific

New & Old

Old Pathogen: American Foulbrood



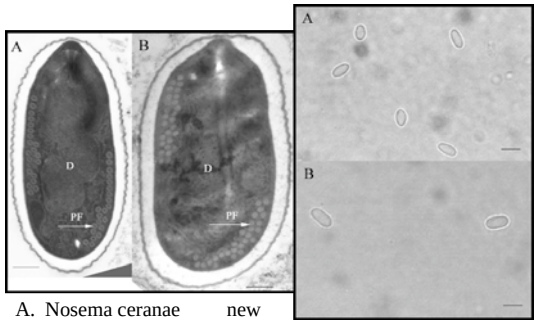
Old Pathogen: Chalk Brood

Old Pathogen: Deformed Wing Virus

New Pest: Mother Varroa on Drone Larvae

Apistan: Varroa Now Resistant

Old & Very New Pathogen: Nosema



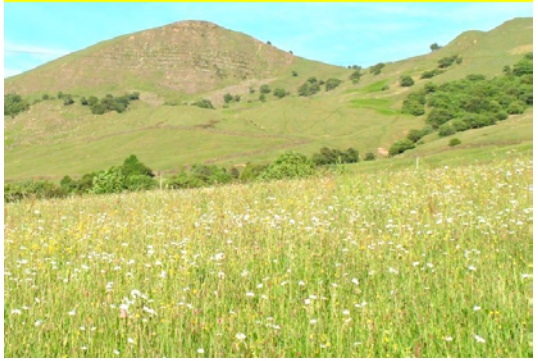
A. Nosema ceranae new
B. Nosema apis old

Definite Problem

Fewer Flowers in the Countryside & Agricultural Intensification

Affects Many Species

Loss of Hay Meadows



Loss of Wild Flowers

Intensification: Loss of Heather

Fewer Flowers in Grazing Land

Less Clover More Chemical Fertilizer

Fewer Arable Weeds

Land Use Changes

Reduction in hay meadows (97% loss)

Reduction in flower rich pasture

Fewer weeds in arable fields

Conversion of heathland into arable land, development

Increasing urbanization Etc. Etc.

Overall effect is to reduce forage and habitat for bees

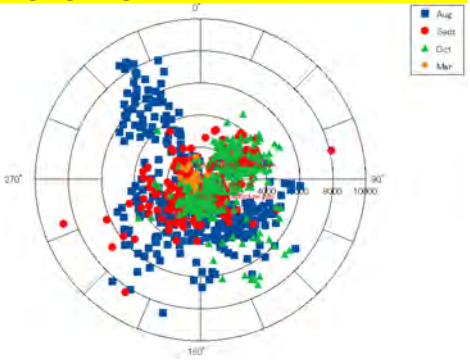
Comparing Lavender Varieties & Other Garden Plants

Observation Hive & Video Camera

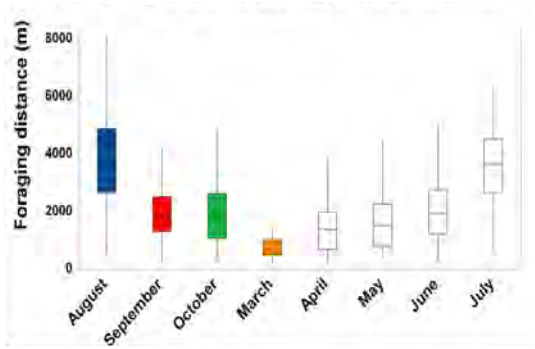
Decoding Dances Using iMovie

University & Surroundings

Foraging Aug-Oct 2009 & March 2010



Foraging Distances: Aug 2009 - July 2010



Breeding Hygienic Honey Bees

LASI Contribution to the Honey Bee Disease Issue

LASI Hygienic Behaviour Research

Previously

Postdocs & Reseachers

Dr. Steve Martin	England
Dr. Nigel Raine	England

PhD Students

Mr. Luis Medina	Mexico
Mr. Antonio Perez-Sato	Mexico
Mr. Nicolas Chaline	France

Currently

Postdocs & Reseachers

Dr. Karin Alton	Denmark
Mr. Norman Carreck	England

PhD Students

Mr. Gianluigi Bigio	Italy

Collaborators

Dr. Annette Bruun Nielsen	University of Copenhagen

What is Hygienic Behaviour

Generally

Removal of dead and diseased colony members and material

Generalized defence against disease

Specifically

Removal of dead and diseased brood from cells

Defence against brood diseases

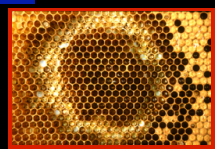
Honey Bee Disease Resistance

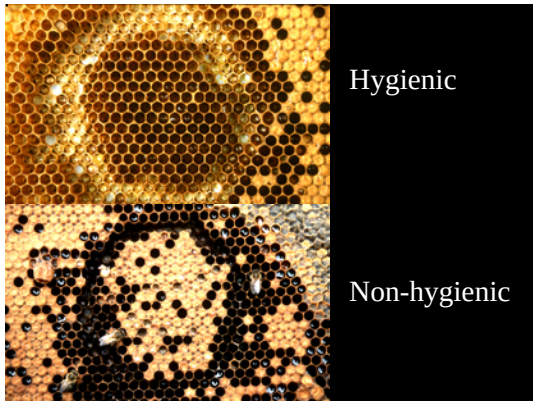
Hygienic Behaviour: general defence against brood diseases

Kill brood, liquid nitrogen

48h later dead brood gone

c. 10% British hives hygienic



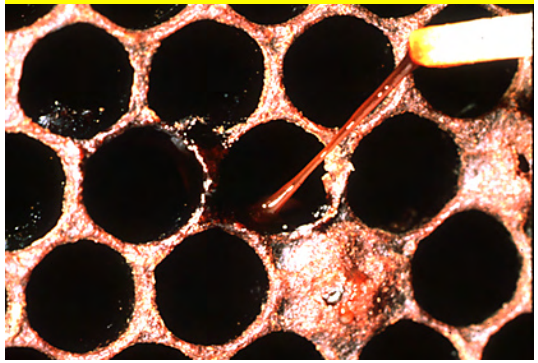


Undertaking: A Type of Hygiene

Hygiene Background & Basic Facts

- Discovered c. 1930s in USA in connection to AFB research
  - chewing out of contaminated comb to remove scales
  - removal of cell cappings; removal of dead brood (“Brown” line)
- Found in honey bees wherever it has been looked for
- Always quite rare, c.10% colonies are hygienic
- Heritable (meaning it can be bred for)
- Environmental effects (nectar flow etc., affect performance)
- Behavioural dominance (20% hygienic workers make colony hygienic)
- Can prevent brood diseases (AFB, Chalkbrood)
- Can slow down growth of Varroa population in a hygienic colony
- Hygienic colonies yielded same or more honey as non-hygienic
- Testing: with diseased brood; cyanide-killed brood; freeze-killed brood
- Liquid nitrogen: can be used to freeze-kill brood in 5 mins in the apiary

American Foulbrood



Chalk Brood

Mother Varroa on Drone Larvae

Deformed Wing Virus

Screening of 31 Colonies

All hives in one apiary, similar populations. Average of 3 trials at 2 week intervals in spring. Great variation among colonies exists—the raw material for breeding.
Pérez-Sato, J. A., Châline, N., Martin, S. J., Hughes, W. O. H., Ratnieks, F. L. W. 2009. Multi-level selection for hygienic behaviour in honeybees. Heredity 102: 609-615.

General Plan of LASI Breeding Program

- Screen as many colonies as possible
- Obtain hygienic colonies
- Carry out queen rearing and intracolony selection
- Multiply hygienic stocks
- Increase levels of hygiene via continued breeding
- Test stocks
- Make breeder queens available to beekeepers

- Beekeeper involvement is essential for success

- Project is long term

Using Hygienic Breeder Queens

Hygienic colony headed by a hygienic breeder queen mated to hygienic males

W W W W W W W W W W

Queen rearing — Q Q Q Q Q Q Q Q Q Q

Queen mating — D D D D D D D D D D

4 colonies

1. W W W W W W W W W W
2. W W W W W W W W W W
3. W W W W W W W W W W
4. W W W W W W W W W W

When a queen carrying hygienic genes mates, it is likely that 1 or 2 of the males she mates with will also carry hygienic genes, so resulting in a colony that is hygienic even though not all the workers are hygienic.

Intracolony Selection

Behavioural Dominance
Not all bees in a hygienic colony are hygienic

1. Obtain hygienic colonies
   Find our which "patrilines" are hygienic
   observation hive: observe workers
   genetic markers (DNA microsatellites)

2. Rear queens from hygienic colony
   DNA test on virgin queens
   Keep only queens of hygienic patrilines
   Allow to mate or inseminate

Intracolony Selection for Hygienic Behaviour

Hygienic colony with an open mated queen from a typical apiary

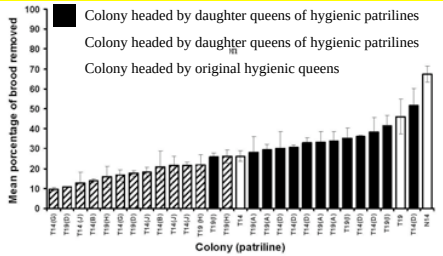
W W W W W W W W W W

Queen rearing

Without intracolony selection	With intracolony selection
Q Q Q Q Q Q Q Q Q Q	Q Q Q Q Q Q Q Q Q Q
Q Q Q Q Q Q Q Q Q Q	Q Q Q Q Q Q Q Q Q Q

Queen honey bee mates to c. 10 males. Colony can be hygienic if only 1 or 2 patrilines are hygienic. Only 10% or 20% queens reared will be of hygienic patrilines unless intracolony selection is used.

Intracolony Selection Works



The following year colonies headed by daughter queens were tested for hygiene. Those headed by queens from a hygienic patriline were on average twice as hygienic as those headed by a queen from a non-hygienic patriline, and similar to the levels of hygiene seen in the three colonies headed by the hygienic queens from the original screening. Overall, the level of hygiene was lower, probably due to environmental effects.