OBSERVATION OF NATURE A KEY PARAMETER TO PRODUCE APIMEDICA QUALITY PRODUCTS

5th Apiquality – Roma 22 November 2016

Etienne Bruneau

From nature to Apimedica products

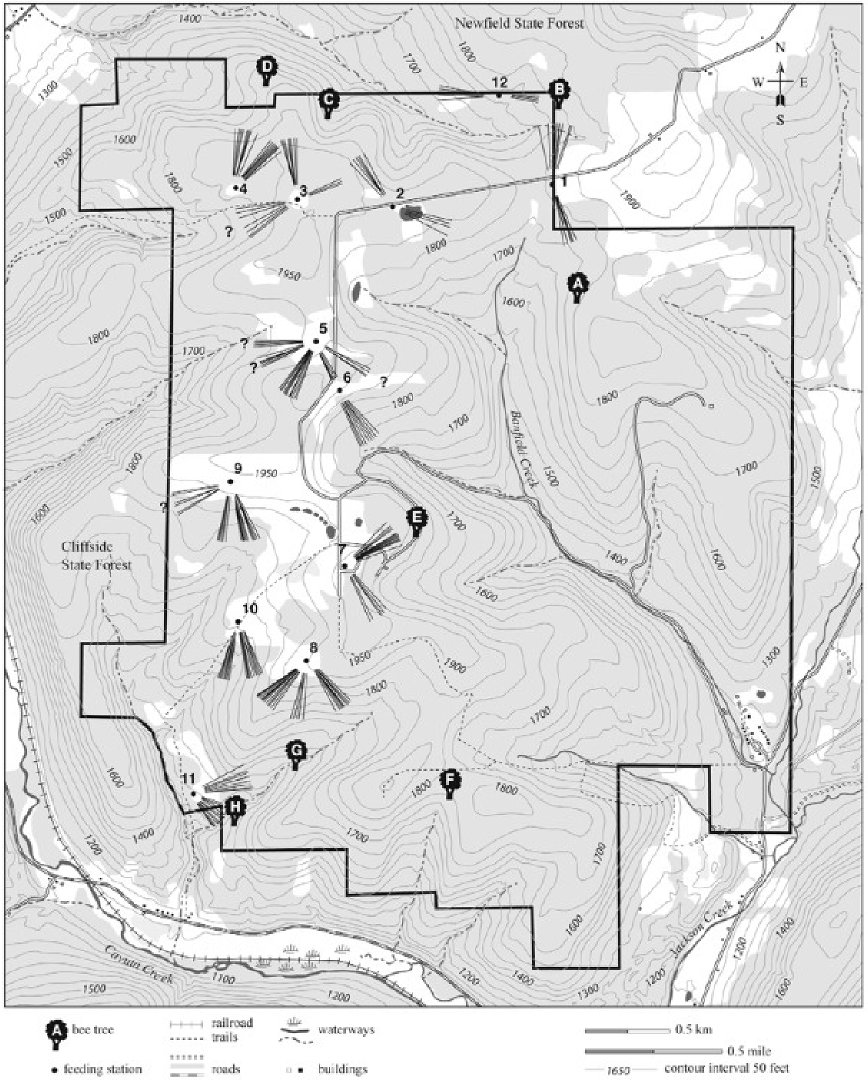
- Topics
  - Analyze the situation in nature
  - See the possible applications in beekeeping (reflexion)
  - Compare with the needs of Apimedica products
    - Limit the sources of contaminants
    - Limit the development of pathogens

- Here are some examples to illustrate these topics

Environnement of the apiary

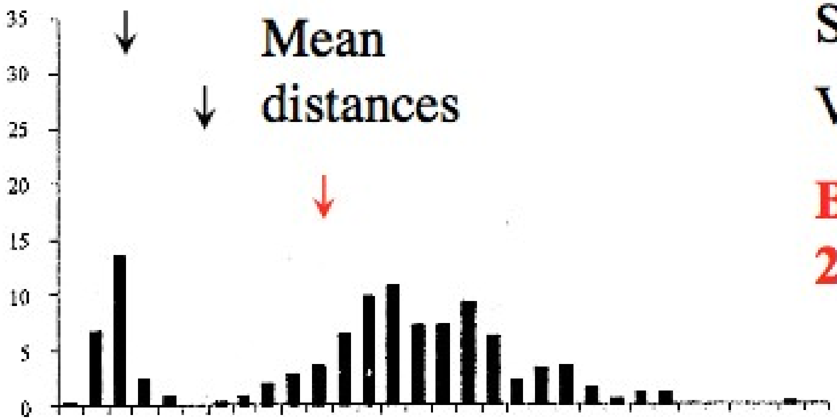
Environment of the apiary

- A supportive environment fosters reproduction
- Limit = where they can survive and have reproduction
  - Enough flora
    - During the beekeeping period
    - Diverse melliferous plants
    - Presence of water
    - Sources of propolis
  - Limited predation
  - Pathogens at a level that they can control
  - With absence of pesticides or contaminants at a toxic level



Foraging distance

16 August1996

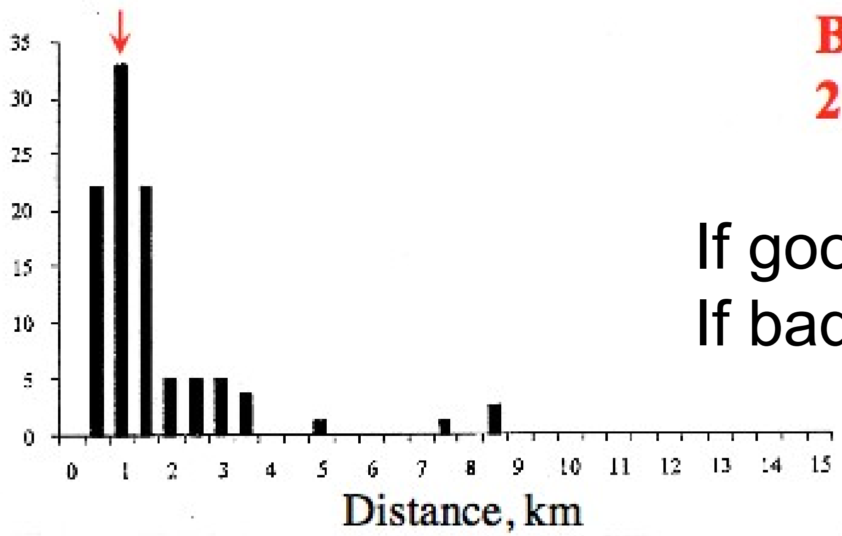


Schneider 1989

Visscher & Seeley 1982

Beekman & Ratnieks
2000, August data

1er mai 1997



Beekman & Ratnieks
2000, May data

If good conditions: 90 % < 5 km
If bad conditions: 50 % < 6 km
10 % 6 - 9 km

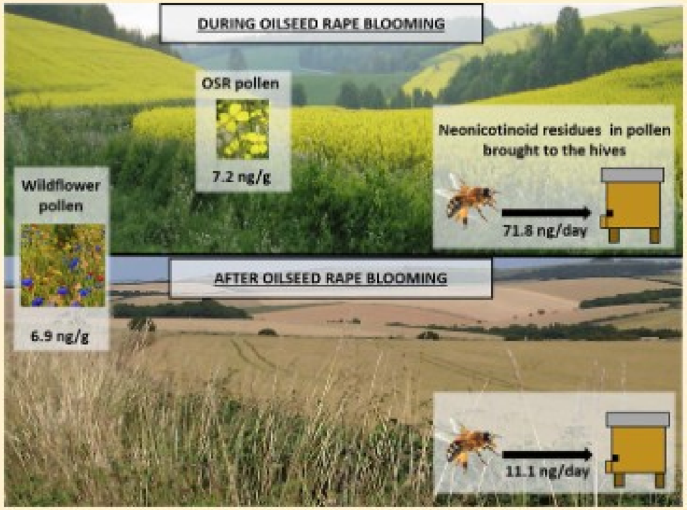
Neonicotinoid Residues in Wildflowers, a Potential Route of Chronic Exposure for Bees

Cristina Botías,* Arthur David, Julia Horwood, Alaa Abdul-Sada, Elizabeth Nicholls, Elizabeth Hill, and Dave Goulson

School of Life Sciences, Sussex University, Falmer BN1 9QG, U.K.

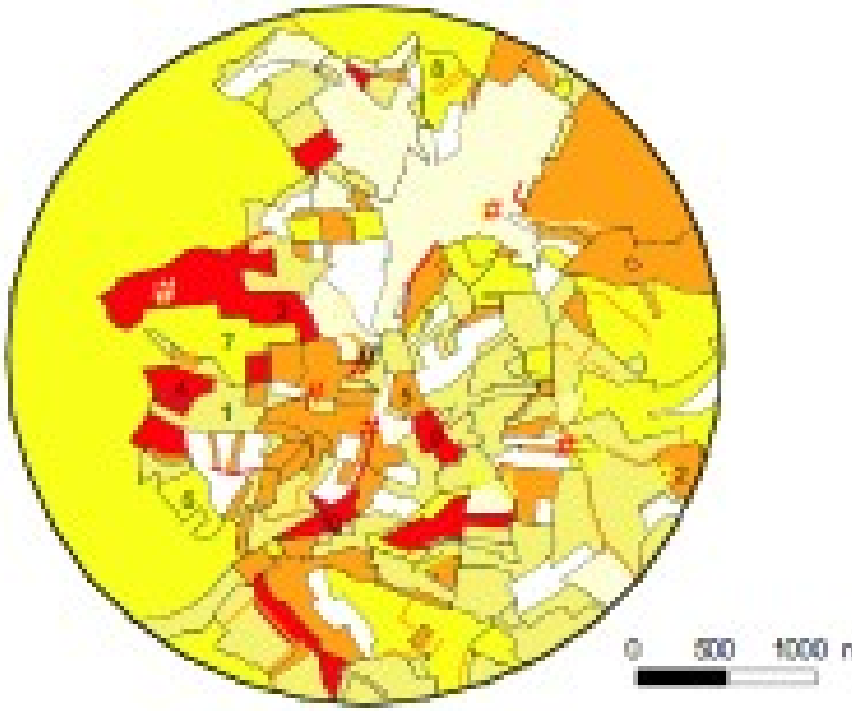
Supporting Information

ABSTRACT: In recent years, an intense debate about the environmental risks posed by neonicotinoids, a group of widely used, neurotoxic insecticides, has been joined. When these systemic compounds are applied to seeds, low concentrations are subsequently found in the nectar and pollen of the crop, which are then collected and consumed by bees. Here we demonstrate that the current focus on exposure to pesticides via the crop overlooks an important factor: throughout spring and summer, mixtures of neonicotinoids are also found in the pollen and nectar of wildflowers growing in arable field margins, at concentrations that are sometimes even higher than those found in the crop. Indeed, the large majority (97%) of neonicotinoids brought back in pollen to honey bee hives in arable landscapes was from wildflowers, not crops. Both previous and ongoing field studies have been based on the premise that exposure to neonicotinoids would occur only during the blooming period of flowering crops and that it may be diluted by bees also foraging on untreated wildflowers. Here, we show that exposure is likely to be higher and more prolonged than currently recognized because of widespread contamination of wild plants growing near treated crops.



Good beekeeping practices

- Choice rich and diverse flora in a radius of 3 km around the hives:
- Without sources of contamination or poisoning
- Avoid linear or large apiaries
- Bees prefer
  - south orientation
  - Not on the ground (in nature 5m > 1m)
  - little entrance (5 > 75 cm2)
- Avoid drifting



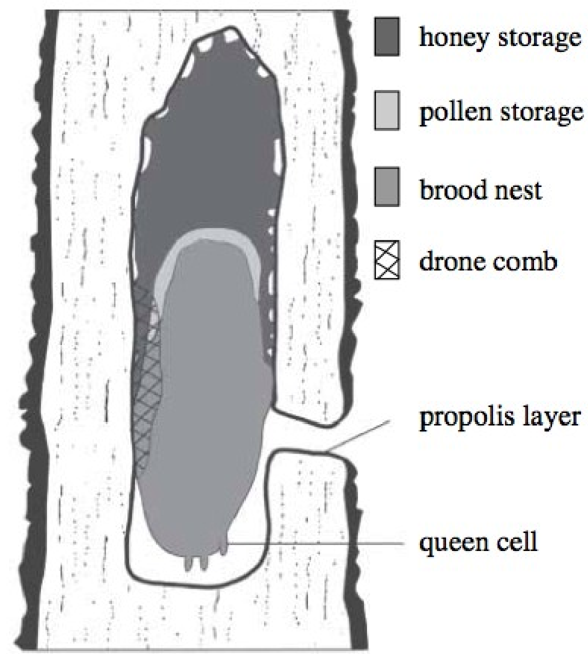
The hive

- Material
- Maintenance
- Wax

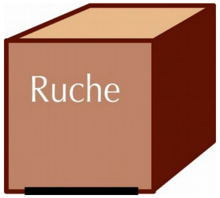
Hive and frames

Ruche

- Bee can choose a lot of different cavities
  - Well-insulated
    (≈ hollow shafts)
  - Neutral (no emissions)
- Frames and hives = 1 element
  - Frames attached to the top
    - Limited ventilation
    - thermal control



Good beekeeping practices



- Wood production hives
  - non-toxic protection, use of propolis
- Other materials: straw ...
  - Non adapted for Apimedica products
- Plastic production hives (without emission) ?
- Other hives: ≠ parts
  - mobile frames
  - Distance between elements…

Volume: natural nest

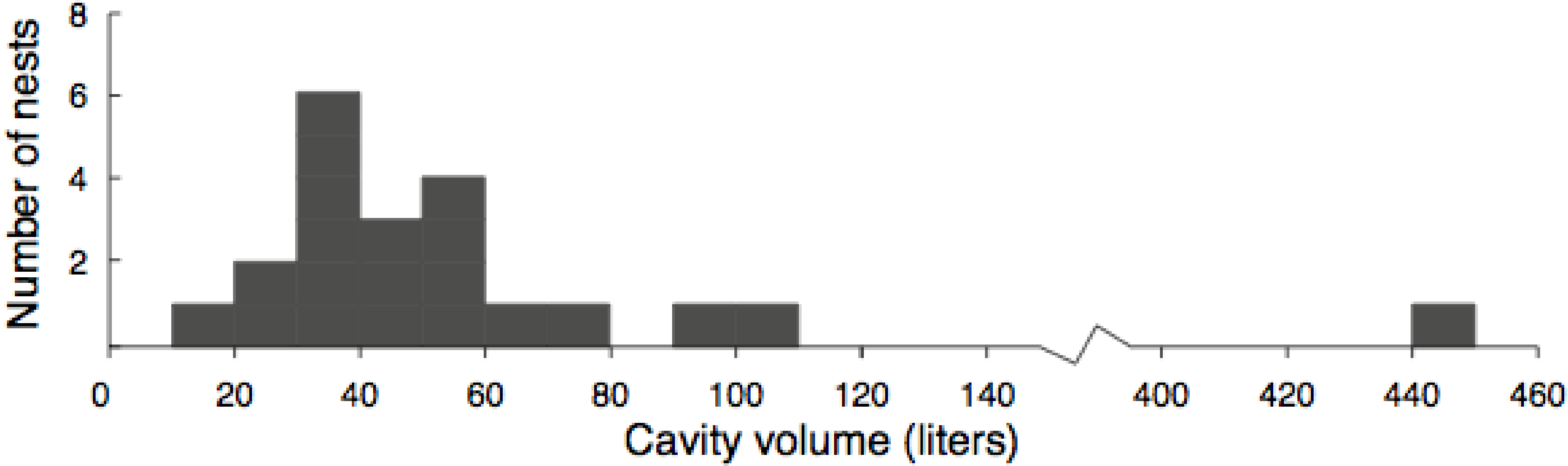


Fig. 3.4 Distribution of nest-cavity volumes for 21 nests in hollow trees.

Hive and frames

In nature

The natural cavity
from 30 to 60 liters.

Beekeeping

- In USA global volume 120 – 160 l
- Langstroth = ± 42 l
- DB 10 frames = ± 67 l
- Warré body 1 = ± 19 l

http://www.bio-creation.com/blog/architecture-animale/ruches-sauvages-et-domestiques

The frame wax

In nature

- natural secretion
- Base of the frame: 0.089 mm
- Italian, Caucasian and Carniolan
  - Workers: ± 857 c
  - Males: ± 520 c
- Black: ± 897 c
- ± 100 000 cells for the entire colony: reserves + brood.

Beekeeping

- wax foundation: melting, mixtures,…
- base of the frame: 0.635 -> 0.2 mm
- Presence of wire
- Waxes: 750 (795) c
- Langstroth = ± 67 000 c

Renewal of beeswax

In nature

- Moth will clean unoccupied frames
- A swarm rebuilt completely its waxes
- Conservation
  - No use of chemicals
  - No action against moths

Good beekeeping

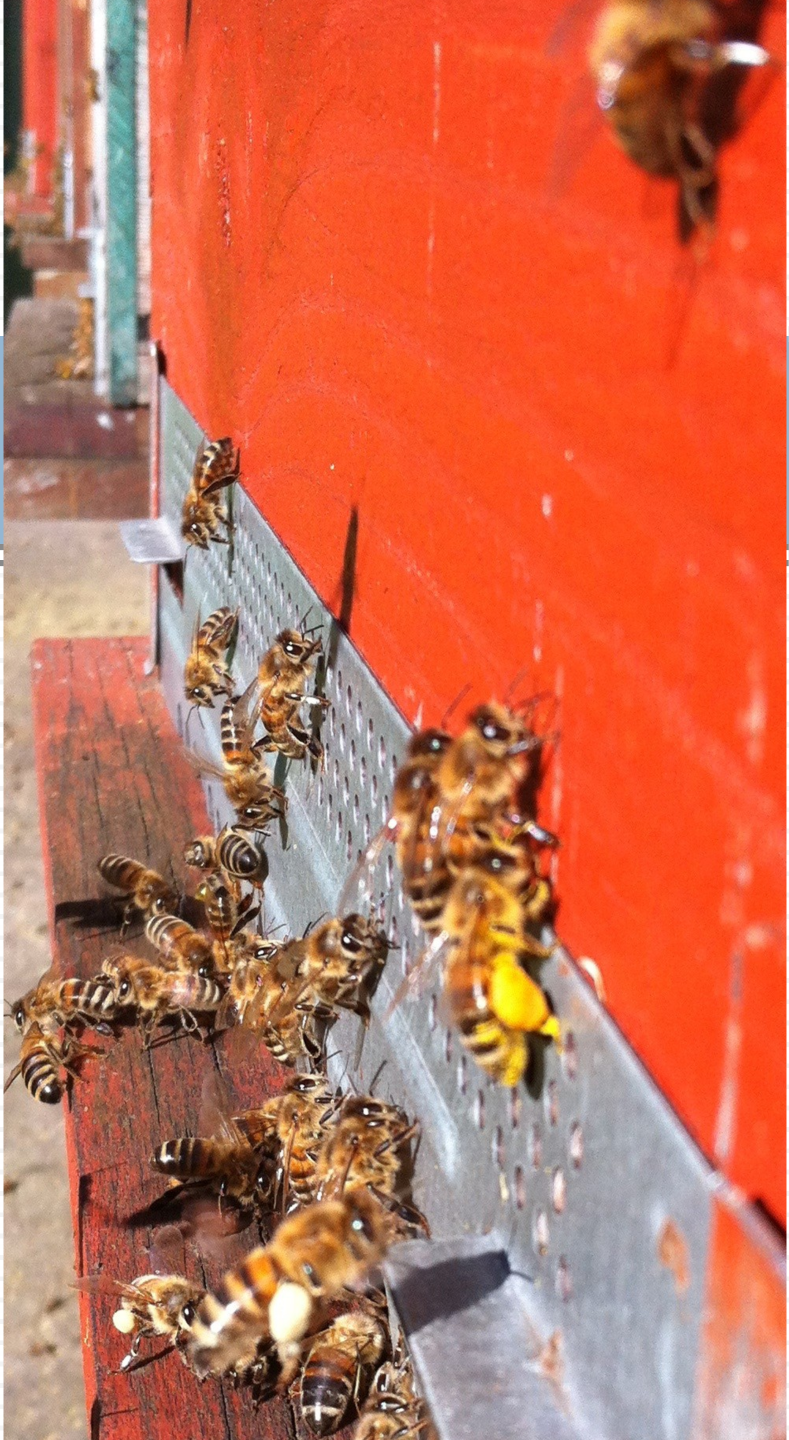
- Sort - Melting or elimination if old (min 20 %)
- If clinical signs of bacteria => destruction
- Licking of residual honey
- Against moths
  - Ventilation: wind, light, cold
  - glacial acetic acid
- Measures agains nosema: glacial acetic acid, essential oils

Good beekeeping practices

- The hives must be made basically of **natural materials presenting no risk of contamination** to the environment or the apiculture products.
- Only natural products such as propolis, wax and plant oils can be used in the hives
- The breeding equipment (cups, etc.), the feeder, the floor can be plastic.
- Natural wax frames are the best for the bees
- If it’s not possible, the wax for new foundations shall come from organic production units ("usable in organic farming").
- Waxes body of the hive must be replaced as and based on hardware capabilities (no brood) at least after 3 years.

Bees

Race, origin, breeding and multiplication



Bees

- Swarming is the natural way of reproduction for strong colonies
- Communication between the hives f (distance)
  - Robbing is possible
  - Drifting is usual between colonies (mostly males)
- There is no exchange of brood between colonies
- The new colony stay with the old queen and build new combs
- The first new queen stay in the colony with the old frames.
- Local colonies are more adapted to there environment.
- Possibility to adapt themselves in few generations (epigenetic?)

Reproduction

- Only viable colonies will breed
- Colonies in opulence will produce male
- Populous colonies will produce a breeding queens
- The strongest males fertilize the queens.
- Fecondation is multiple
- Each half-sister will have specific and particular sensitivity. More important is the number of different half-sister and greater the response capabilities of a colony will be
- The swarms disperse in the environment
- Bees choose their new nest (quorum)

Drones

- Natural fecundation is made by males:
  - who resist to pathogen in their hives
  - who a good power to fly
  - who can find the fecundation site
  - who can smell correctly
  - are the stronger
- Number of males during the fecundation determine the quality of the bee colony (brood, communication, immunity…)

Good beekeeeping practices

- Respect the brood and the defences of colonies
- Division must respect the natural repartition of bees
- Reproduction of colonies is important (management of the swarming) - Beekeeping season should include a reproductive phase
- Passage by naked swarm with the old queen and full building
- No reintroduction of swarms in the colony of origin
- Use of non intrusive techniques to control colonies

Food

Feeding

To bee

- Feeding only with
  - nectar or other vegetal secretions transformed in honey
  - Diversity of pollen transformed in bee bread

Natural beekeeping

- Ideally honey (the apiary - the hive)
- Sugars
  - Closest to the nectar sugars
  - Do not keep colonies that consume too much
- Stimulation
  - Avoid!
  - Frozen pollen or bee bread from apiary

Good beekeeping practices

- Feeding generally prohibits
- Unless the survival of the hives is endangered by climate and only conditions for a period from the last harvest up to 15 days before the next nectar flow.
- Feeding with honey, (limited use of sugar or organic sugar syrup).
- Primarily obtaining food from the apiary or other organic farms in the same region

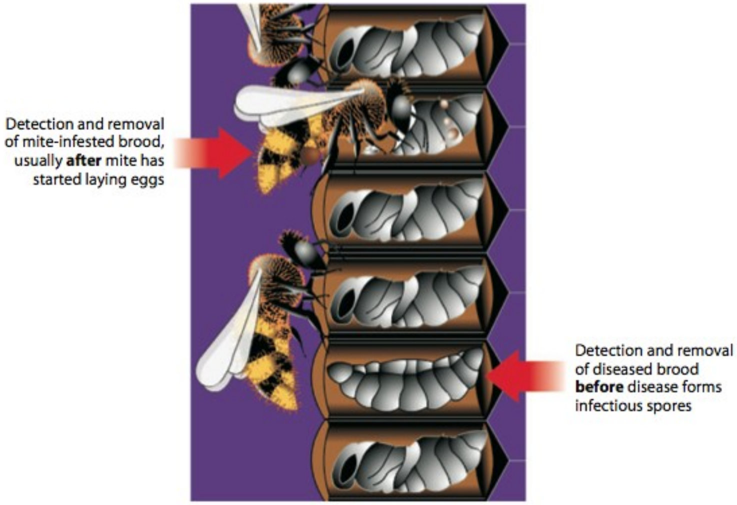
Pathogens

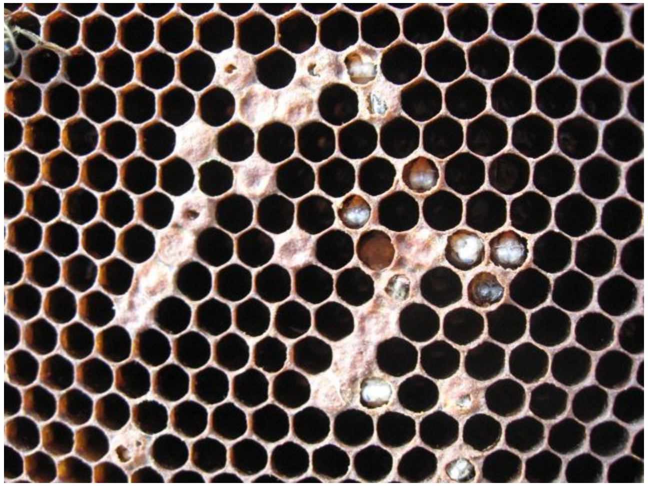
Individual defense of the bee

- Complex system ...
  - which consumes energy: production hemocyte, blood proteins => importance of pollen!
    - quantitatively: especially glucose oxydase, a little phenoloxydase
    - qualitatively: glucose oxydase, fat
  - which changes with age of the bee / her place in the social organization.

Hygienic behavior

- Sanitary lines
  - = better performance in the removal of infected larvae
  - origin = odor threshold
- 2 tasks:
  - detect and drill the infected cells -
  - complete the uncapping and removing larvae
- behaviour prevention / avoid many diseases (chalk brood ...)





source:
Wilson-Rich
2009

Thermoregulation

- **Regulation optimized by the number and variety**
  - Of age class
  - Of paternal lineages = wide range of sensitivities to stimuli => better regulation
  - Genetic diversity = asset!

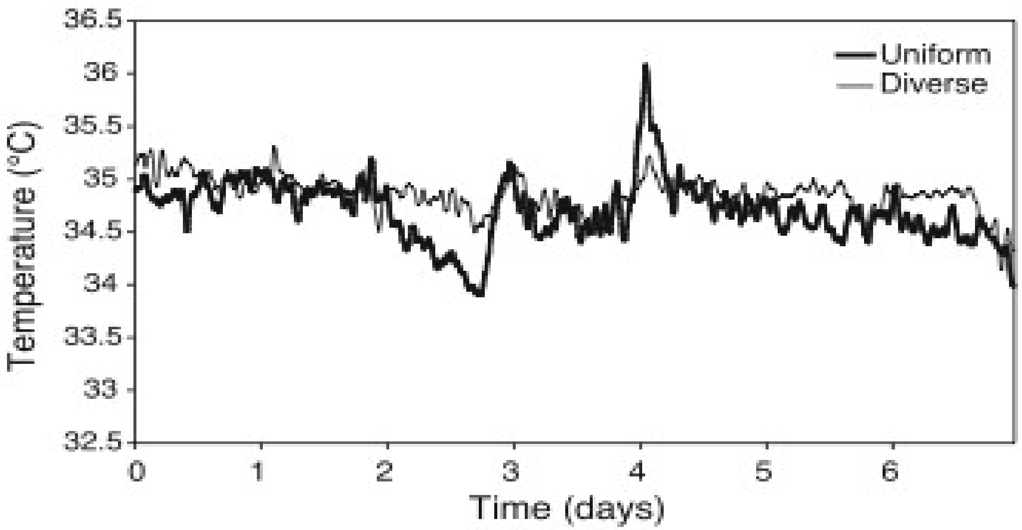


Fig. 1. Temperature variation in genetically diverse and uniform honey bee colonies. This graph shows the average hourly temperature for one representative pair of colonies in the first experimental week. Other colony pairs can be seen in Fig. S1.

source: Jones JC et al 2004

- Importance of **antenna sensitivity**
  - perception of temperature => induction heating, ventilation ...

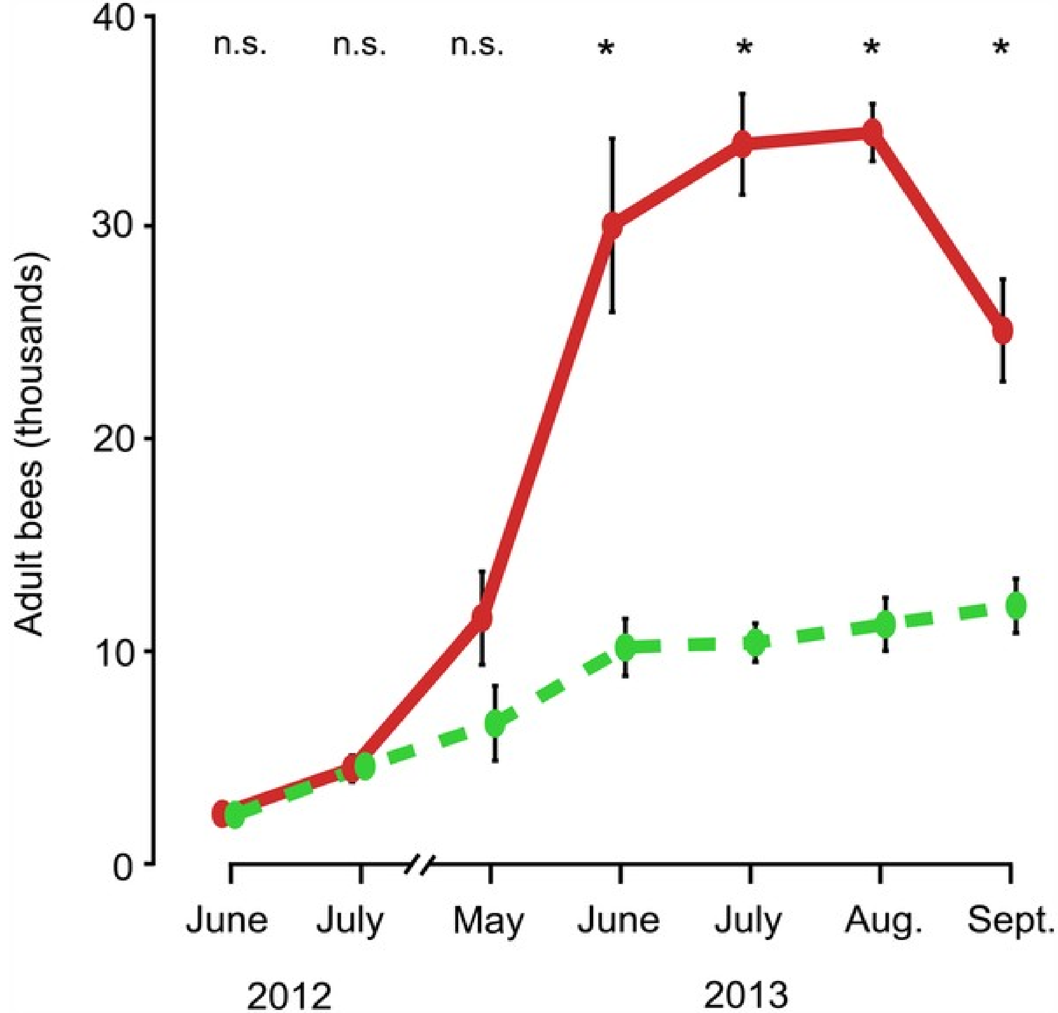
How Honey Bee Colonies Survive in the Wild: Testing the Importance of Small Nests and Frequent Swarming

J. Carter Loftus, Michael L. Smith, Thomas D. Seeley

Published: March 11, 2016 • http://dx.doi.org/10.1371/journal.pone.0150362

- Colonies in small hives swarmed more often, had lower *Varroa infestation rates, had less disease, and had higher survival compared to colonies in large hives.*
- *These results indicate that the smaller nest cavities and more frequent swarming of wild colonies contribute to their persistence without mite treatments.*

Fig 1. Dynamics of the adult bee population in colonies housed in small hives (dashed, green line) and colonies housed in large hives (solid, red line), from June 2012 to September 2013.



Loftus JC, Smith ML, Seeley TD (2016) How Honey Bee Colonies Survive in the Wild: Testing the Importance of Small Nests and Frequent Swarming. PLoS ONE 11(3): e0150362. doi:10.1371/journal.pone.0150362
http://journals.plos.org/plosone/article?id=info:doi/10.1371/journal.pone.0150362

Fig 2. Dynamics of the amount of brood in colonies housed in small hives (dashed, green line) and colonies housed in large hives (solid, red line), from June 2012 to September 2013.

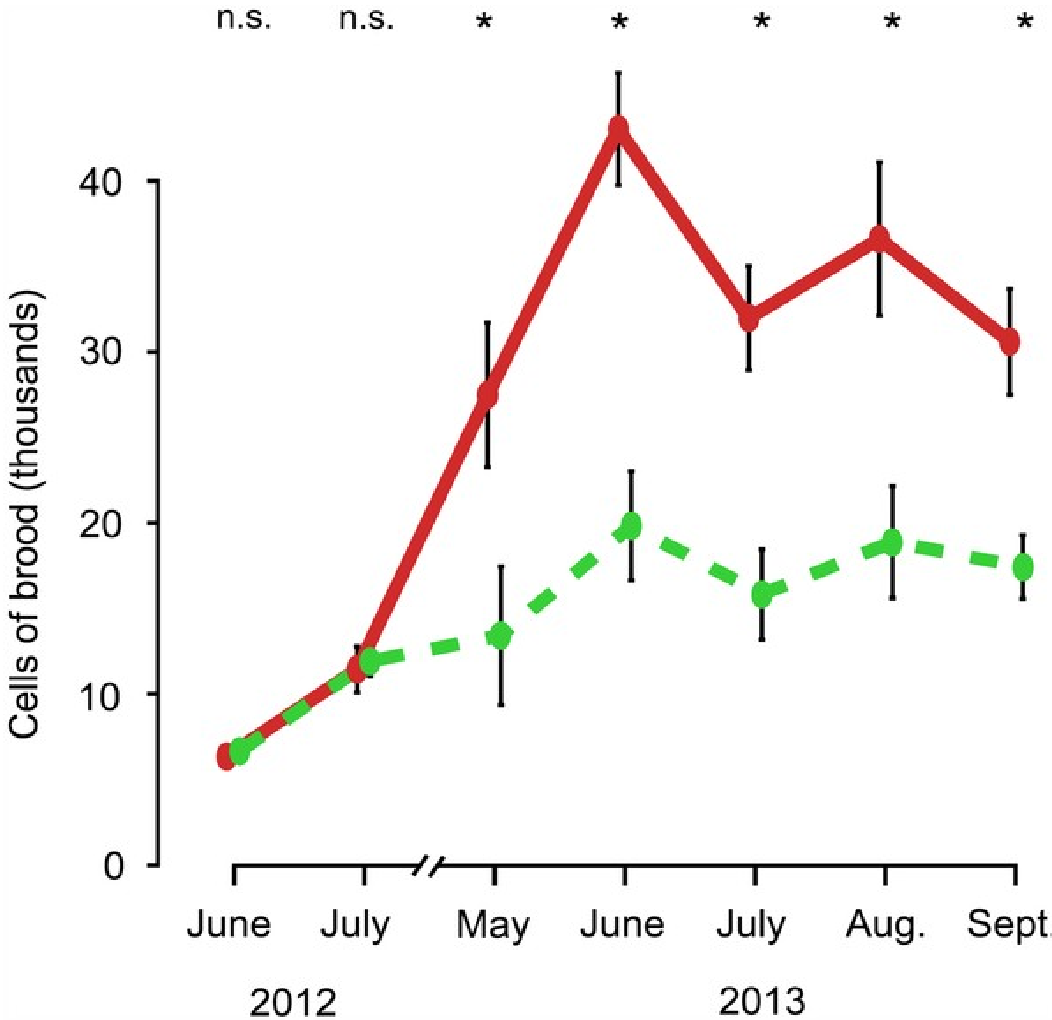


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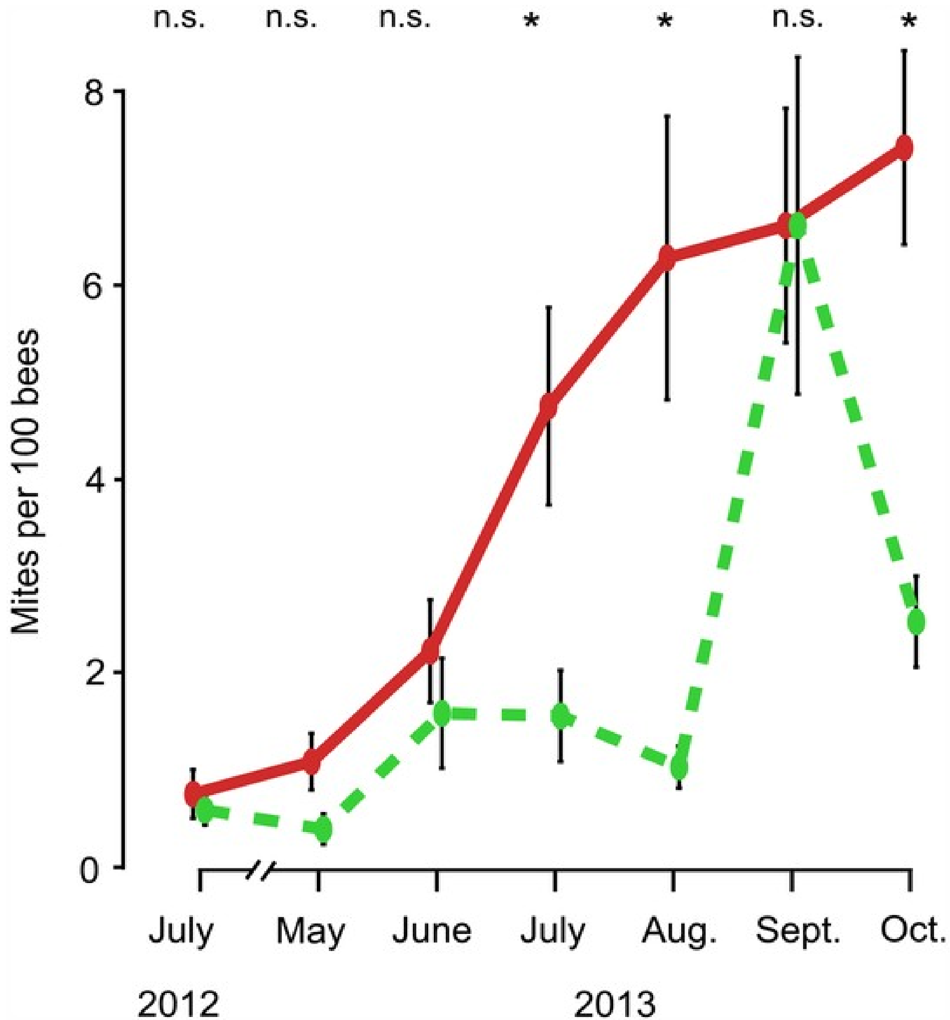
Fig 3. Dynamics of Varroa infestation rates on adult bees in colonies housed in small hives (dashed, green line) and colonies housed in large hives (solid, red line), from July 2012 to October 2013.



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PLOS ONE

Natural predators in the nest

- *Chelifer cancroïdes*, a pseudo scorpion can be present in natural hives. He is destroy by the chemical treatments
- *Varroas* and *Galeria* constitue a food for him but not the bees or the larvae
- To create a symbiosis, they must be around 150.
- Reintroduction in hives with little cavities where he can reproduce

Conclusions pathogens

- Importance
  - diversity of paternal lineages, "hive mind" (sufficient number of bees)
  - Swarming – period without brood
  - Colony structure (≠ ages, brood – nurses,…)
  - Quality of food (honey and pollen)
  - hygienic behavior (in the nest) => adaptation to the strength of the colony

Good beekeeping practices

- Technique (driving)
  - volume / colony
  - think temperature
  - Think structure of the colony
- Resources
  - location of the apiary (concentration, drifting)
  - monitoring
- Genetic
  - eliminate sensitive strains who will not survive alone or/and that multiply excessively the pathogens

Integrated control plan

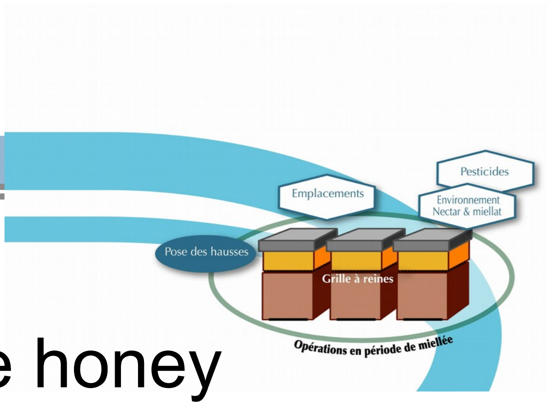
- Control plan based on monitoring
- Help the bees to develop resistance
- Promote gentle techniques (natural products without residues)
  - Veterinary medicinal products may be authorized in the Member State.
  - Acids as well as essential oils can be used in cases of infestation with *Varroa destructor*
- Choose the treatments according to the infestation and the season
- Colony must never arrive to a point of collapse

Harvest of bee products

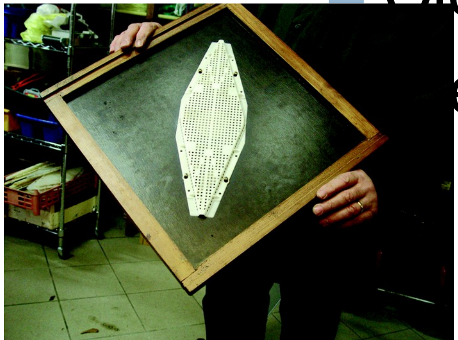
In nature

- Honey is dry under 18% by the bees and protected by a cap
- Pollen is directly place in the frames and transformed in bee bread
- Propolis is placed when the bees want to control infestation and in the cool places of the hive
- Royal jelly is produce by colonies in reproduction (with a lot of quality food and bees)
- Bee venom is produce when they need it.

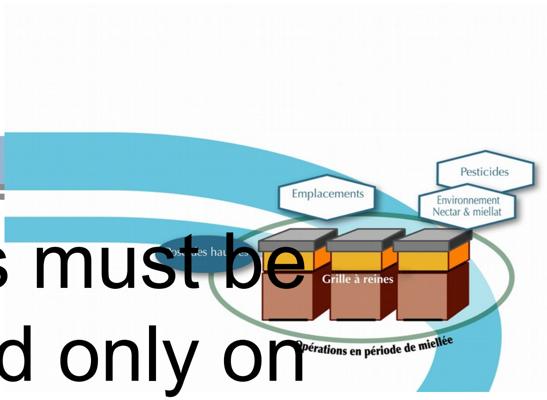
Good beekeeping practices



- Before the use of supers
  - Remove excess reserves in the hive
- Recommended queen excluder
- Before taking out the supers
  - Put out a maximum of bees
  - Little or no smoke
  - Blower, brush...
- Harvest
  - mature honey
  - Frames without brood
- Let honey to bees in late season
- Transport
  - Closed supers
  - ean transport



Good beekeeping practices



- Pollen must be harvest twice a day and frozen in a short time.
- Royal jelly must be produced during the breeding period and on strong colonies with a lot of natural food.
- Propolis must be collected only on specific material and must be kept in the fridge or frozen.

Thank you for your attention