Nosemosis

Source	Apimondia, IZSLT - Istituto Zooprofilattico Sperimental del Lazio e della Toscana "Mariano Aleandri"
Keywords	Beekeeping, Nosema apis, Nosema, honey bees
Country of first practice	General
ID and publishing year	8413 and 2015
Sustainable Development Goals	No poverty, decent work and economic growth and life on land

Summary

Nosemosis is a disease of adult bees caused by unicellular fungi belonging to the class: *Microsporidia*, family: *Nosimatidi*, gender: *Nosema*.

There are two different sub-species of Nosema that affect *Apis mellifera* with different prevalence depending on the area: *Nosema apis* (*N. apsi*) and *Nosema ceranae* (*N. ceranae*), responsible for two different forms of the disease. Both *N. apis* and *N. ceranae* have a dormant stage, a long-lived spore.

The spores are hardly morphologically distinguishable between the two species and represent the resistance and propagation form of the disease (Figure 1). Spores can remain infectious from a few days up to five years at low temperatures. Heat, as well as solar ultraviolet radiation, can kill them in a few hours.

This practice describes how to recognize the two forms of the disease caused by these pathogen types.

Description

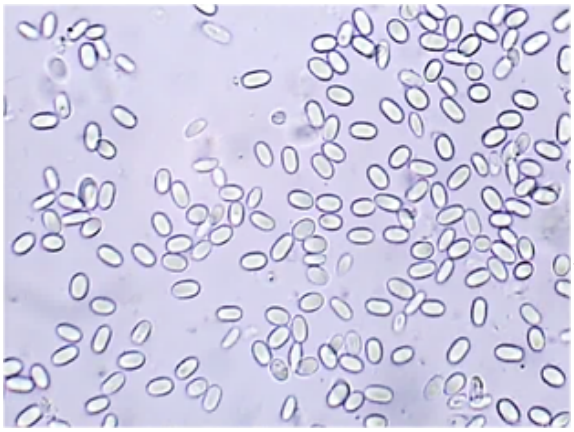
1. Sub-species of Nosema

There are two different sub-species of Nosema that affect Apis mellifera, with different prevalence depending on the area, responsible for two different forms of the disease:

- *Nosema apis*; and
- *Nosema ceranae*.

Both sub-species have a dormant stage, a long-lived spore. The spores are hardly morphologically distinguishable between the two species and represent the resistance and propagation form of the disease (Figure 1).

Figure 1. The microscopic spores of N. ceranae are hardly distinguishable from those of N. apis



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2. *Nosema apis*

Nosema apis is responsible for the "classic" known form of the disease, which is widespread especially in cold and wet areas. It appears more easily during spring and in mismanaged hives during winter. It occurs mainly with a decrease of the colony population. The disease never affects the larval stages and seldom the queen.

2.1 Pathogenesis

N. apis spores, found in feces, are directly or indirectly ingested by adult bees and develop in the intestines of the bees affecting the digestive functions. The spores are expelled with feces and, once outside, they can be swallowed by other bees that become infected.

This microsporidium also affects the nutrition glands, abruptly interrupting their secretion: the bees can no longer feed the brood and, consequently, it brings to a halt also the colony renewal.

2.2 Symptoms

After the contact of bees with N. apis the following infection symptoms will appear:

1. intestinal disorders, such as diarrhea (Figure 2);

Figure 2. Bee with diarrhea

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2. the bees become unable to secrete the royal jelly;
3. the foraging bees reduce their activity, until it stops completely; and
4. in the rare cases in which the queen is sick, egg-laying greatly decreases.

First there is a slow depopulation, the work decreases while the state of restlessness of the colony increases.

Some bees are no longer able to fly, they walk with their wings spread out in “K” form (Figure 3), paralysed, while other bees gather in small groups.

Figure 3. Paralysed bee with wings spread out in “K” form

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Finally, the presence of dead bees on the bottom of the hive with swollen abdomen and legs retracted below the chest can be observed (Figure 4). The running board of the hive entrance and the honeycombs will be smeared with diarrhea (Figure 5).

Figure 4. Top - Dead bee with swollen abdomen and legs retracted below the chest. Bottom - Normal dead bee

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Figure 5. The running board of the hive entrance and the honeycombs will be smeared with diarrhea

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2.3 Diagnosis

It is not easy to diagnose the disease in its early stages; the only suspicious sign is the presence of liquid excrement on the running board of the hive.

A field test consists of examining the colour of the terminal portion of the digestive system of some bees: in healthy bees it has a reddish colour, while in sick bees it is milky white.

This sign, however, is seen only when the disease has already reached a certain severity. Only a laboratory test can make an early diagnosis by searching with the microscope the spores at intestinal level or directly on feces.

2.4 Transmission

Transmission occurs primarily by fecal-oral route. *N. apis* can easily spread through the droppings of sick bees, especially within the hive. The spread from hive to hive and apiary to apiary may occur through:

- drifting of infected workers;
- drone displacement;
- looting of infected colonies;
- interchanging infected honeycombs from a hive to another;
- feeding of bees with contaminated honey;
- use of infected materials or equipment.

This disease is influenced by many climatic factors:

- bad weather increases the chances of infection among the bees of the same hive because it forces the bees indoors;
- seasonal pattern can also affect the spread of infection. During long, cold winters and cold, rainy springs the bees may not find nectar and pollen;
- frequent hive inspections with adverse weather conditions (e.g. winter season, windy or rainy weather) can trigger the onset of the disease as well as its propagation due to the induced stress;
- the presence of other diseases (such as amebiasis or viruses) exacerbates the symptoms of nosema.

2.5 Control

1. Prevent the infection by adopting good management practices and by taking special care when selecting the apiary location (non-humid, not exposed to cold winds) and the correct orientation of the hives (prefer sunny and slightly ventilated areas).
2. Adopt correct wintering measures (removing honeycombs not populated by bees, providing good quality food if necessary and applying appropriate treatments against varroa).
3. Place pollen plants near the hives that can provide protein food to the colony in the late summer and autumn.
4. In cold climates, keep the hives warm during wintering until late spring.
5. Use an adequate number of honeycombs in relation to the colony population.
6. Disturb the bees as little as possible during winter.

Unfortunately when N. apis occurs, the prognosis is frequently serious because

its onset is almost always unnoticed and symptoms occur only at an advanced stage. Generally the affected colonies do not heal spontaneously, therefore the beekeeper's intervention becomes necessary.

If the disease is well developed, particularly in weak families its destruction is definitely suggested. It is possible to retrieve the materials after killing the bees, sterilising the hives (with boiling water, soda 6% and blue flame) and destroying the combs. Infected honey and pollen should absolutely not be used to feed other bees to avoid their infection.

In case the affected family is very strong, move it in an area exposed to the sun (not windy and cold), with clean hive and combs thus decreasing the possibility of re-infection from diarrhea and provide proper feeding (e.g. molasses, herbs or medicated feed). The infected combs should be destroyed and the hive should be sterilised as mentioned above or destroyed.

The honey can be used for human consumption. To destroy a hive and avoid further contamination, a hole deep at least 50 cm should be dug in the ground, the hive and combs should be burnt and the hole should be duly covered.

3. Nosema ceranae

Nosema ceranae is a new species of microsporidium isolated for the first time in 1996 by Fries on *Apis cerana*, a bee species widespread in Southeast Asia.

In 2006 it was isolated for the first time by Higes in *Apis mellifera*. *N. ceranae* has spread in vast areas of Europe replacing the indigenous form of *Nosema apis* on *Apis mellifera*, resulting in quite different clinical signs from the classical nosemosis. Typical of this disease are the severe injuries and the absence of gastro-enteritis (diarrhea) as a typical symptom and the appearance of the disease in different periods from those of N. apis. It was listed among the possible causes of depopulation of the hives, even though its pathogenic effect on the honeybees is still unclear.

3.1 Pathogenesis

The ingestion of microsporidium by the bees occurs directly or indirectly (e.g. through honey contaminated by the spores). *N. apis* develops and attacks the intestines of the bees inducing malabsorption. The spores of *N. ceranae* are very resistant in the environment (they can withstand very cold or very hot temperatures), facilitating the re-infection of the colonies and the recurrence of the disease after a long time.

3.2 Symptoms

The disease can occur throughout the year. Typical is the absence of diarrhea in foraging bees. It seems that they go to die away from the hive, causing a progressive depopulation of the colonies (without noticing the presence of dead bees) until the total loss of the family.

3.3 Diagnosis

The microscopic spores of *N. ceranae* are hardly morphologically distinguishable from those of *N. apis*. It is possible to make a diagnosis only through the PCR (polymerase chain reaction), a biology molecular technique, which allows the sequencing of a very specific and characteristic part of *N. ceranae* genome on the spores. Cost and availability of this exam depends on each country and laboratory.

4. Further reading

- Palazzetti M., La nosemosi. In "Aspetti igienico-sanitari in apicoltura" published

by the Istituto Zooprofilattico Sperimentale del Lazio e della Toscana “M. Aleandri”, Italy, August 2007, 22-24
- Ellis J., Honey Bee Research and Extension Lab at the University of Florida, Video Field Guide to Beekeeping – Nosema Disease, February 2012. (https://www.youtube.com/watch?v=AMDN7r1SfbY)

5. Related/Associated Technologies

- Good beekeeping practices: TECA ID 8409
- Main diseases of honey bees: TECA ID 8412
- Varroa mites (Varroatosis or Varroosis): TECA ID 8416
- AFB (American Foulbrood): TECA ID 8417
- EFB (European foulbrood): TECA ID 8418
- Bee viruses: TECA ID 8419
- Uso de la harina de ortiga y de aceto balsámico en apicultura: TECA ID 8205
- Buenas Prácticas Apícolas - Chile: TECA ID 8217
- Preparación de alimentos para abejas: 8393

4. Objectives fulfilled by the project

- Women-friendly;
- resource use efficiency; and
- pro-poor technology.