

Nosema disease in honey bees

What is it?

Nosema disease is caused by two gut-infecting fungal parasites: *Nosema apis* and *Nosema ceranae*. These microscopic spores infect worker bees, drones, and queens. Once ingested, the spores invade the gut cells, multiply, and rupture them – releasing new spores that infect additional cells or are excreted, spreading the infection to other bees.



Spores are highly resilient and can survive in the environment for years.

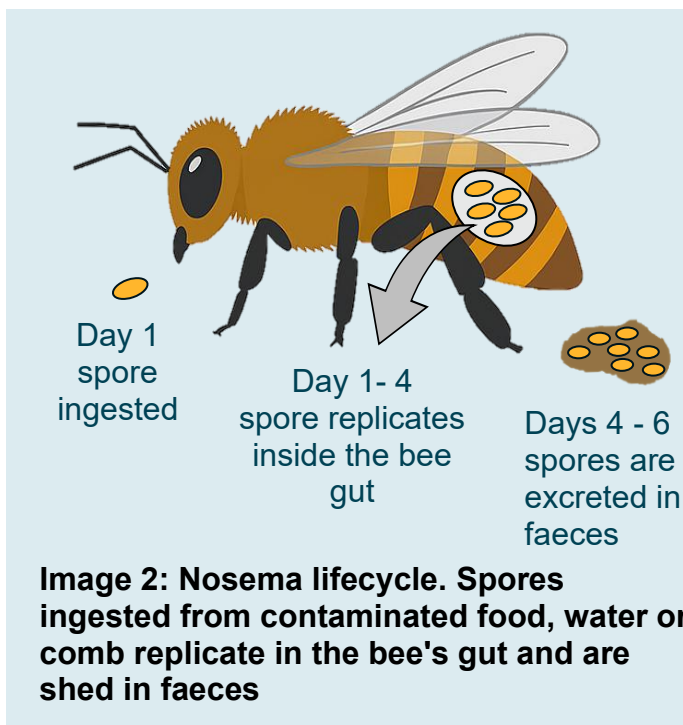
Image 1: Electron microscope image of a Nosema spore (scale = 0.003 mm)

How do Nosema infections spread in the hive?

- Contaminated food and water
- Cleaning contaminated faeces from comb (worse after winter)
- Dead bees crushed during hive work
- Trophallaxis (food sharing between bees)

Effects on bees and colonies

- Reduced lifespan (notably with *N. ceranae*)
- Malnutrition and increased energy demands
- Impaired cognition causing disorientation
- Reduced foraging efficiency
- Reduced immunity
- Underdeveloped hypopharyngeal gland
- Reduced egg-laying by queens
- Lower sperm viability in drones
- Higher risk of colony death with other stressors (e.g. disease, chemicals, poor nutrition)



Symptoms

IMPORTANT: Nosema cannot be confirmed by symptoms alone. Symptoms may be absent or resemble those caused by other diseases or conditions. Microscopic examination is required to diagnose Nosema.

***N. apis*:** Faecal streaks on the inside and outside of the hive and crawling or flightless bees near the entrance. Spore loads peak in spring, with a smaller peak in autumn.

***N. ceranae*:** Declining adult bee numbers. *N. ceranae* may multiply more rapidly at warmer temperatures than *N. apis*. Spore loads can increase in spring and summer.

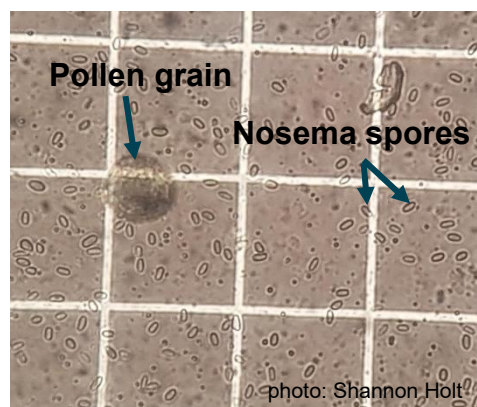


Image 3: Nosema spores visible under 400× magnification on a haemocytometer counting slide

Prevent and manage Nosema by maintaining strong and healthy colonies

- **Nutrition:** Ensure adequate honey and pollen stores; feed sugar water and high-quality pollen substitutes when stores are low (note protein-deficient pollen is linked to increased Nosema levels)
- **Hive size:** Reduce the hive size to an appropriate level for the colony by removing unnecessary supers, especially before winter
- **Barrier system:** Implement or review measures to reduce beekeeper cross-contamination between hives
- **Hygiene:** Clean tools between hives, regularly replace brood frames, and wash gloves and bee suits
- **Hive placement:** Keep hives in a sunny and warm position during winter
- **Water placement:** Ensure water sources are not located directly beneath hive flight paths to reduce contamination from bee faeces
- **Queen management:** Ensure the colony has a young, vigorous queen and requeen regularly
- **Genetics:** Select for Nosema tolerant or resistant stock



Image 4: Example of a colony with a strong adult bee population

Had a Nosema outbreak?

Cleaning and disinfection of beekeeping equipment

Heat treatment can eliminate *N. apis* spores from beekeeping equipment. However, *N. ceranae* spores are more heat tolerant, and the treatments effective against *N. apis* should **not** be assumed to eliminate *N. ceranae*. More research is needed to validate the effective temperatures required for *N. ceranae* sterilisation.

While no practical heat treatment has been validated for *N. ceranae*, research has shown that storing empty drawn comb at -20°C for 7 days substantially reduces *N. ceranae* spore viability and infectivity. This effect was not observed in honey, where spores remained highly viable during freezing.

Table 1: Effectiveness of common disinfection and comb management treatments for *Nosema* spp.

Equipment / material	Treatment	<i>Nosema apis</i>	<i>Nosema ceranae</i>
Hive tools / heat-tolerant equipment	60°C for 15 min	Effective	Not effective
Empty comb	49°C for 24 hrs	Effective	Not effective
Empty comb	-20°C for 7 days	Not effective	Reduces viability and infectivity
Heavily contaminated comb	Replace comb	Recommended	Recommended

Freezing empty comb at -20°C for 7 days can substantially reduce viable *N. ceranae* spores; however, complete sterilisation should not be assumed.

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