

# Philcrafthivecraft.com Beekeeping Information Sheet

## Nosema Disease: Diagnosis & Treatment

The antibiotic fumagillin is the only registered medication for the treatment of nosema in honey bees. It has been a reliable tool and the only one we needed until recently, but the recognition in the last few years of a new strain of Nosema has created many questions about impact, diagnosis, and treatment. The effectiveness of fumagillin is just one. Unfortunately, it's a complicated issue with no clear answers.

Nosema apis (N. apis) was first identified as a honey bee pathogen by a German scientist in 1909, however, its symptoms have been observed in bees since the mid-19th century. Nosema is a common disease of insects, fish crustaceans, and even people. It comprises numerous species, each specific to a certain insect or animal. Officially, it is classified as a microsporidian - a type of fungus - essentially a spore forming, single cell micro-parasitic organism. Spore forming means that when the pathogen dies, it releases numerous single cell spores, each of which can develop into copies of the original organism. Think of spores as seeds. Spores can be very resistant to heat and cold, but fortunately, nosema spores are not as hardy as those of that other destructive spore forming honey bee disease, American foulbrood. N. apis infects cells in a honey bee's mid gut, and spreads principally through an oral/fecal route as a result of the hive cleaning and food transfer activities of young bees. The invaded cells are responsible for nutritional uptake, and are essentially hijacked by the nosema organisms causing the host to become malnourished and weak even as it takes in ample food.

Honey bees infected with N. apis typically exhibit symptoms of dysentery, with older bees exhibiting higher levels of infection than younger ones. N. apis was traditionally considered to be a greater problem in northern climates where consistently cold temperatures prevented bees from making defecation flights during the winter. Infected bees were forced to expel feces within the hive, causing a more rapid spread of the disease. Levels of N. apis reached a peak in the early spring when most bees were older and all had been confined in the hive for extended periods. In the spring, bees capable of exiting the hive, but weakened by disease and unable to fly, would often defecate on the outside of the hive, resulting in the staining usually associated with the disease. Numerous bees, too sick to fly, crawling in front of the hive was also indicative of N. apis. Honey bees infected by nosema had reduced life spans - by as much as about 80% - resulting in fewer foragers, weaker colonies in spring, and reduced honey production. Workers, drones, and queens could all be infected, but workers exhibited much higher levels due to their cleaning and foraging duties. That is Nosema as it has been understood and described for almost a hundred years: a minor disease, one which weakened colonies in the winter and spring, but from which most would recover by summer as brood production increased faster than infection rate, and one which could be effectively treated with fumagillin.

Everything changed in 2007 when we learned that Nosema ceranae (N. ceranae) was present in the U.S. honey bee population. It is a separate species of Nosema, formerly found only in Asia in non-European honey bees, including Apis ceranae (hence the name Nosema ceranae). Subsequent testing of honey bee samples preserved at USDA bee labs showed that N. ceranae has actually been here since the mid-1990s, and seems to have essentially displaced N. apis. Today, if your bees are infected with nosema, it is almost certainly N. ceranae, and much of what we thought we knew about Nosema no longer holds true. N. ceranae is thought to be a more virulent disease, and with its discovery came a suspicion that it might be the cause or contributing cause of colony collapse disorder (CCD). That is still controversial. Researchers studying CCD and increased colony loss in recent years have described nosema, along with varroa mites, viruses, pesticides, and poor nutrition, as being possible culprits, likely working in some combination.

In addition to being a more aggressive parasite, N. ceranae differs from N. apis in symptoms, pattern, and perhaps transmission. Though both affect the digestive tracts of honeybees, N. ceranae does not always produce the heavy defecation within hives and the staining on the fronts which are the characteristic signs of N. apis. Heavily infected hives can even appear healthy, displaying no overt indications. On the other hand, in some colonies infected with N. ceranae, the dysentery symptoms are even more pronounced. Whereas N. apis operates on a definite cycle, peaking in the spring and abating in the summer, N. ceranae is considered a year round disease. Some recent studies have indicated that one reason for its persistence

is that it is transmitted in more ways than *N. apis*. In addition to spreading through direct contact with contaminated fecal matter, it may also be transmitted through food to larvae. It is found in drones and queens as well as in workers, and even affects more organs in the bees' bodies. Though concentrated in the gut, *N. ceranae* cells are also found in other body tissues, including the ovaries of queens. *N. ceranae* has rapidly become a worldwide problem. It now exists on every continent where beekeeping is practiced. In Spain, it has been directly implicated in extremely high colony losses. So far, in North America, it is being viewed with increasing concern, but has not reached the crises level it has achieved in Spain. There are some indications that it thrives better in hotter climates. It has also been suggested that there is more than one genetic variation of the disease, some more virulent than others. In addition, variation in the genetics of honey bee sub-species may cause some to be more susceptible than others.

Diagnosis of *N. ceranae* in infected colonies can be difficult, not only because they may not display any obvious signs, but also because symptoms they might display can also indicate different problems. Dysentery, weakened colonies, and crawling bees may point to Nosema, but can also have other causes such as varroa mites, viruses, poor nutrition, or poisoning. Laboratory testing, including microscopic examination of the contents of digestive tracts of a sample of bees, provides the only definitive diagnosis. The level of infection is determined by estimating the number of spores present. Counts are described in millions per bee, with fewer than one million indicating a low level, one to ten million moderate, and over ten million high. Some individual bees have been found to contain over 100 million spores, but that is considered extreme. I congratulate you on taking the initiative to get a microscope and learn how to perform the test. Most beekeepers don't own one, or are not comfortable using one. I have often thought this could be a good project for a beekeeping association, with the group buying the equipment, and several members learning how to do the testing and either training others or performing tests for them. Those without such resources can send samples to state bee labs, or to the USDA bee lab in Beltsville, Maryland, for testing. Your spore count of around two million per bee indicates a moderate level of infection, and could be related to your supersedure problem. Evidence suggests that infected queens, those not succumbing to *N. ceranae*, may still suffer impaired function.

When we first became aware of *N. ceranae*, it was felt that the antibiotic fumagillin, then used for the control of *N. apis*, could successfully be used to control both varieties. Many experts even recommended prophylactic treatments, in other words, routinely using fumagillin to prevent Nosema without regular testing to determine whether or not it was present. This has now changed. Recent research at the University of Illinois indicates that fumagillin may not be effective in controlling *N. ceranae*, and may even further damage the health of the colony. At this time, researchers in Canada still find it to effective there, and recommend treating with it. Here in the U.S., many commercial beekeepers use it regularly and believe that it helps. Others, like you, have tried it without positive result.

My recommendations to beekeepers is to test - either by doing it themselves, or by sending a sample to a bee lab. Do not treat prophylactically. When collecting bees for samples, it's best to take them from the entrance where older, more severely infected bees are most likely to be found. Include some crawling bees if you see any. If the test reveals high nosema spore counts, consult about treatment with the experts at the lab doing the testing. I'm not trying to dodge the question of treatment, but I hesitate to give general advice on fumagillin. Seven or eight years is only a blink of an eye in terms of research on a new disease. Studies are being carried out constantly, and many pose as many questions as they answer. If fumagillin doesn't seem to be working for you, then it's not working for you. In the absence of any other registered treatment, there are a few things you can do. Keep a close watch on the health of your hives. Help them nutritionally by feeding sugar syrup and protein supplements when their stores are low. Monitor and treat for mites if necessary; any colony is more susceptible to Nosema when it is already weakened by another parasite. Pay special attention to the presence and productivity of your queens. There is some evidence that frequent re-queening can be helpful in reducing or containing Nosema levels. Also, keep reading these pages and others. A lot of good minds are at work on the problem, so try to stay informed of developments.