



Nolo Bait™ Information Fact Sheet

In the interest of helping you understand the nature of the active organism in Nolo Bait™, we have generated the following information.

TECHNICAL INFORMATION

Nolo Bait is a grasshopper suppression agent made of flaky wheat bran sprayed with a suspension of distilled water, a sticking agent, and *Nosema locustae* spores. It is nontoxic to humans, livestock, wild animals, birds, fish or life forms not closely related to grasshoppers.

Nosema locustae spores are single-celled animals commonly known as protozoans. The spores that are sprayed on the wheat bran attractant are in the "resting" or "protected" stage of the protozoan's life cycle.

"Resting" or "protected" stage means that the spores are in a stage of their life cycle when they form a protective layer around the cell that neither takes in nor lets out matter including water or waste. It is in this stage that they wait to be ingested by a grasshopper. The spore stage can viably persist in the soil for years.

Once *Nosema* spores are ingested by a grasshopper, an ionic reaction takes place in the grasshopper's mid-gut. The spores "germinate" or extrude a polar filament from the cell wall, (much like a plant root from a seed) into the grasshopper mid-gut. Along this filament, cytoplasm (the liquid inside the cell) leaks out and forms new cells (spore reproduction).

The spores then continue to reproduce, attacking the fat body in the grasshopper. It is this action that causes infected grasshoppers to become lethargic and reduce their feeding and reproduction ability. In essence when a grasshopper consumes the spores, it is like giving them giardia. It's a deadly disease and it takes time for symptoms to develop to the point of death.

The severity of disease symptoms is dependent upon the age and species of the grasshopper at the time of treatment, the amount of spores consumed, and the overall health and vigor of the grasshopper at the time it becomes infected. Field observations of infection symptoms may be seen in the following manner:

Infected grasshoppers will become lethargic and their equilibrium is affected. When they are disturbed, they will typically hop and, upon landing, fall to one side or the other. They then crawl unsteadily a little way before hopping again and often will not hop at all unless forced to do so. Infected grasshoppers typically crawl up a grass stalk or seek somewhere to "roost" or cling immobile to. It is often in this position that dying grasshoppers will remain and sometimes evidence of cannibalism will be apparent. Healthy grasshoppers will feed on infected 'hoppers from the abdomen up to the thorax just behind the front legs. They don't usually cannibalize the head or the "plate-like" hard shield, which covers the thorax behind the head. This cannibalism is a good indication that the disease is spreading within the grasshopper population from sick to healthy grasshoppers.

Holding live grasshoppers just behind the head along the hard thoracic plate you can visually examine a grasshopper for evidence of infection. Turn the grasshopper over and look at the underside of the abdomen. On each side of the abdomen there are two depressions, which run the length of the abdomen beside the segments on the sides. In many species of healthy grasshoppers, the depressions will be a darker color than the rest of the abdomen, or even look like lines running the length of the abdomen. When a grasshopper becomes infected with *Nosema*, often these lines will disappear and the entire abdomen will become a "creamy" whitish or grayish color. This is a good indicator that spore reproduction is heavy. Often, in a severely infected individual, the eyes will also lose their dark color and become whitish or hazy looking. Ultimately if

the head turns whitish, be amazed the grasshopper is still alive. A *Nosema* infection can bring about quick death for grasshoppers already carrying other commonly associated diseases. An example of an associated disease is *Malamoeba locustae*. *Malamoeba locustae* is commonly occurring in most grasshopper populations, though not in heavy enough numbers to cause death. Once the grasshopper ingests *Nosema* however, both organisms compete for the fat bodies to reproduce and *Malamoeba* numbers soar. Death when *Malamoeba* and *Nosema* are both present is identified by dark brownish-black coloration of the abdomen and dark body fluids seeping out. The abdomen will hang limp and readily fall apart. Not a pretty sight but extremely lethal for grasshoppers.

APPLICATION INFORMATION

USDA has set a known standard that 8 or more grasshoppers per square yard can be considered economically damaging. To the casual observer, grasshoppers may not seem to be a noticeable problem until infestations reach 40 or more per square yard. That's when they become alarmingly apparent and by this time you want a "belly-up overnight" control. This instant type of suppression is extremely hard to achieve using bio-pesticides. It is very important to understand that Nolo Bait or "*Nosema locustae*" does not work rapidly. It is a subtle disease that is naturally occurring and takes time to develop to levels that can be readily identified. Nolo Bait does however offer a long term suppression once the disease is reproducing in the grasshopper populations. Let's examine Nolo Bait application rates and timing for you optimal Nolo use.

When you put Nolo Bait out at the minimum label rate of 1 lb per acre, equivalent, you are performing what is called an "inoculative" application. This will begin the disease process in the present grasshopper population. However, depending on the population densities and varying age groups at the time of broadcasting Nolo Bait, the rate of infection will vary. For example: if you have more than 8 grasshoppers per square yard and put out 1 lb to the acre, you will have competition for each flake of bran out there. It's possible there will be a large percentage of grasshoppers that won't

have the opportunity to ingest *Nosema*. Thus, there may be many grasshoppers that will not become infected until the sick 'hoppers are cannibalized, thereby spreading the disease, but at a slower rate than expected.

Grasshoppers are extremely migratory and can move over great distances to get to your plants. It is optimal therefore to inoculate your area and surrounding borders frequently through the season to infect these migrants as they move in. This will help spread the infection further and aid in long term control. Due to the nature of the disease, the infection will vary according to age of the grasshoppers. In the very young newly hatched grasshoppers, death may occur within a week. Unfortunately, if you are not planning follow up treatments this may not be the optimal time to infect simply because it doesn't offer long term carryover. The young grasshoppers die too quickly for the spore to effectively reproduce.

In the third stage of growth, grasshoppers have developed enough body mass to allow the spores to reproduce in the mid-gut. They will become lethargic and dramatically slow or quit feeding but will not die immediately. This stage of development allows the disease to spread as healthy grasshoppers move in and consume the infected one.

Once grasshoppers are almost to adulthood *Nosema* infection results in loss of appetite, lethargy, increase spore production inside their bodies, therefore optimal spread of the disease. It is actually good to see them slowly moving about yet not feeding because it is in these lethargic, but living, grasshoppers that the disease continues to propagate and eventually spread the infestation.

In young adults, reproduction and egg laying may be severely depleted or destroyed. When reproduction does take place quite often, the *Nosema* spores will be passed on in the sticky substance that surrounds the egg pods and newly hatched grasshoppers will become infected as they chew their way out of the egg pod. This usually results in a quick death of the young 'hoppers. All these complexities of the infection process help explain why you may see better results in grasshopper control the following season

after you spread (inoculate) Nolo Bait. Yearly follow up applications may be necessary while general grasshopper populations are on the rise until you achieve a low density population of these varmints. Grasshopper populations are very cyclic. Population densities peak with large populations approximately every 7 years (1 to 3 years variability) but basically every 7 years they will hit an all time high or low. It is helpful to check with the Dept. of Agriculture in your state to find out what the population predictions are for your area on a yearly basis then plan your releases accordingly, taking into account the severity of your winter and spring. If you start early applications and a large percentage of grasshoppers are inoculated, you may deter severely escalating populations from actually occurring. The more area treated on a frequent basis, the more control you can expect to take place.

PRODUCT STORAGE

Nolo Bait is guaranteed 100% viable for 13 weeks from the formulation date. Optimal storage stated on the label is 42 degrees F. Further shelf life studies indicate Nolo Bait will remain viable unrefrigerated for the 13-week period of time. The most critical factor is moisture. Please store in a dry area, refrigerated or not. If the bait becomes moist, it may mold and become unattractive to the grasshoppers. Nosema is affected by ultraviolet light so avoid prolonged exposure to sunlight before application.