



WORM-TRAPPING FUNGUS TO REDUCE PASTURE WORM BURDEN FOR GRAZING RUMINANTS

A common question is “How can pastures be cleaned up to reduce transmission of gastrointestinal nematodes (worms)?” Nematode-trapping fungus may be the answer.

The Worm Life Cycle

To understand how nematode-trapping fungus might help, a basic understanding of the worm life cycle is necessary. Briefly, the worm life cycle consists of two parts: one that takes place inside the animal and one that occurs on pasture. Adult worms reside in the gastrointestinal tract of the animal and after mating, female worms lay eggs that are passed out in the feces. The eggs hatch in the feces and develop through two larval stages until reaching the third larval stage that migrates out onto the surrounding vegetation where it is ready to be consumed by grazing animals. Once ingested, the larvae develop into adult worms (which do damage to the host animal) and the life cycle is complete.

When an animal is dewormed with an effective dewormer, worms inside the animals are eliminated which reduces the number of worm eggs that are passed in the feces to contaminate the pasture. The more worms that dewormers kill, the fewer the number of eggs on pasture, but eventually worms become resistant to dewormers and egg shedding returns to higher levels. Reliance on dewormers for reducing worm burden within the animal and on the pasture has proven to be unsustainable.

Besides deworming, there are other strategies to help reduce worm burden and egg shedding, including copper oxide wire particles (COWP), forages containing condensed tannins (e.g. sericea lespedeza), and genetic selection for resistance to parasites. But they also have limitations.

In addition, all these approaches target the worms in the animal. Until a few years ago, there was no proven product on the market to specifically target the worm burden on pasture. Nematode-trapping fungi may be the first.

How the Fungus Work

Nematode-trapping fungi have been shown to be efficient biological control agents against the worm larvae in livestock feces. These fungi are found naturally in environments that are rich in organic matter where they produce a variety of mycelial (vegetative part of the fungus) structures that trap, destroy, and feed on non-parasitic soil worms. Spores of various species of these fungi have been isolated, concentrated, and introduced into feces that contain developing gastrointestinal worm larvae. Of those investigated in livestock, *Duddingtonia flagrans* spores (Figure 1) have the best ability to survive passage through the ruminant gastrointestinal tract. When passed in the feces, *D. flagrans* spores germinate. The mycelia grow rapidly into sticky, sophisticated traps/loops that trap and digest the developing larvae (Figure 2). These larvae emerge from nematode eggs within the fecal pat alongside the fungus, but because they are trapped and killed by the fungus, they remain in the fecal pat (do not escape to the environment).

The trapping structures are usually present within the first few hours after defecation, and a sticky substance is present within 48 hours to help with larval contact, followed by hyphal cuticle penetration (Figures 3 and 4). The moving parasitic larvae are trapped by the structures of the mycelium. Once the larvae are trapped, the hyphae penetrate the larval cuticle and grow, filling the body of the



larvae and digesting the contents. Most importantly, trapped larvae and/or the fungus are unable to migrate out of the fecal mass and onto plant material that could be consumed by the grazing host animal. Fewer larvae on the pasture result in healthier animals.

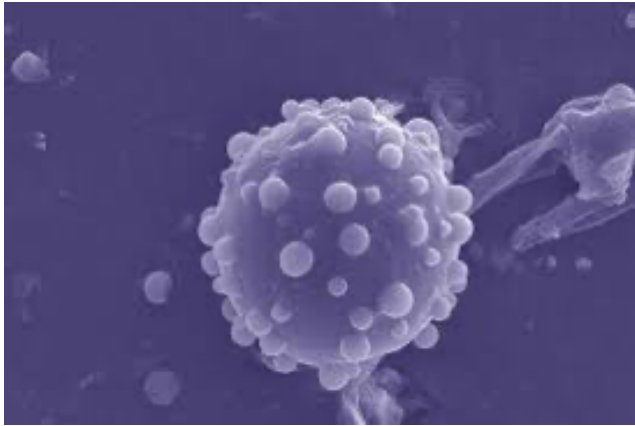


Figure 1. *D. flagrans* spore

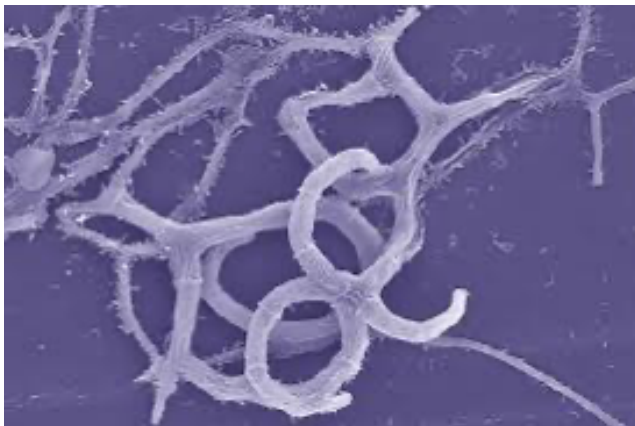


Figure 2. *D. flagrans* trapping network

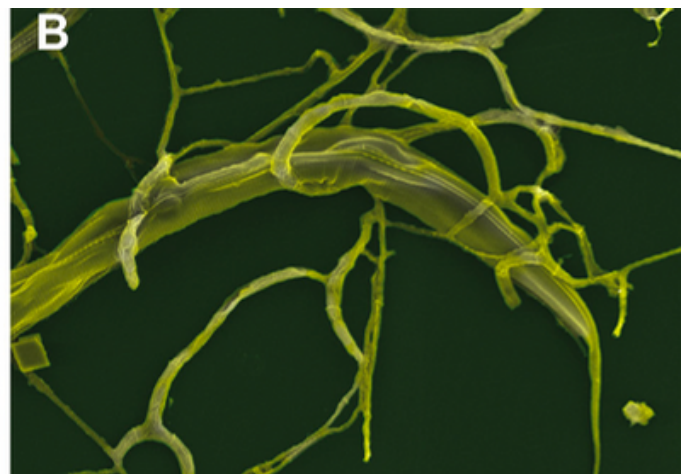
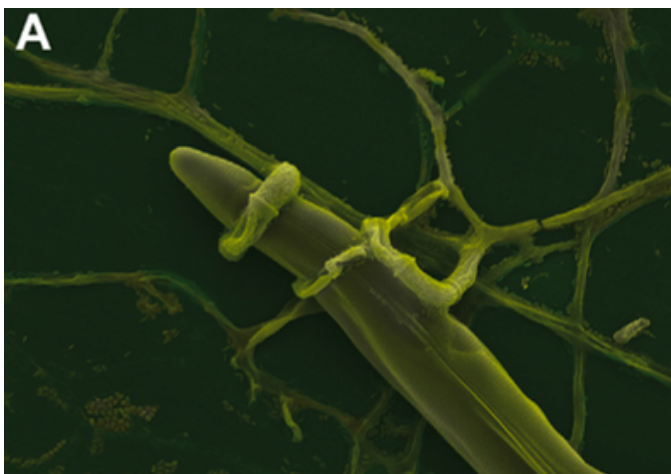


Figure 3. Infective larvae of parasitic nematodes immobilized by sticky loops/traps of *D. flagrans*.

Feeding the Fungus

The primary delivery system of the spore material is thorough mixing with supplemental feedstuffs which provides a continuous source of the fungus in the feces. Daily feeding so that each animal consumes an adequate amount of the feed/spore mixture is necessary. Another delivery system would be thoroughly mixing the fungal spore material (BioWorma®) into a loose mineral supplement. The mineral needs to be kept covered and dry. This method does not require daily feeding, but the mineral supplement would need to be available and regularly consumed to provide a constant source of spores for the duration of the treatment period. There have been two studies conducted in sheep at the USDA, Agricultural Research Service in Booneville, AR, and Louisiana State University, Baton Rouge, LA, showing that including BioWorma® in a mineral mix was as effective at killing larvae as including it in the feed. This provides a good alternative for producers who do not provide supplemental feed to their livestock. Unfortunately, the spores cannot be incorporated into pellets or cooked blocks as the heat of the pelleting process will kill the spores. In Mexico, spores were included in “tortillas” and fed to small ruminants individually, though there is no commercial product that was developed for the U.S. market.



Feeding should commence with the beginning of the grazing season, especially for young, freshly weaned livestock. Similarly, to help curb the periparturient egg rise, feeding spores to females during late pregnancy and lactation should help to reduce pasture contamination for lambs/kids that graze the same pastures with their dams. Feeding studies with sheep, goats, and cattle have shown a reduction of 68 to 86 percent of larvae in feces and on pasture. Fecal egg counts can be expected to decrease over time due to the reduced reinfection but not due to feeding the fungus. During periods of drought or low transmission (winter and other non-grazing periods), it would not be necessary to feed spores as there would already be a reduced number of larvae in the feces and on pasture. There would also be no need to feed the spores to animals being raised on a dry lot, since there is little to no source of parasitic infection.

In the US, two formulations of *D. flagrans* are FDA-approved and commercially available: BioWorma® and Livamol® with BioWorma®. Livamol® with BioWorma® is a protein supplement that can be mixed with other feed supplements or top-dressed over feed. Anyone can purchase and feed Livamol® with BioWorma®. BioWorma® is a concentrated feed additive that is meant to be mixed with other feeds, supplements, or trace mineral mixes. Its distribution is limited to veterinarians and EPA-certified feed manufacturers.

The cost of feeding BioWorma® is relatively expensive compared to dewormers, but the long-term benefit of reduced pasture contamination is a factor that must be considered.

Both products are the only control method that specifically targets the worm population on pasture (and have no direct effect in the animal), where the majority (estimated at more than 90 percent) of the total worm population resides during the parasite season. This form of control has been successfully applied under field conditions and is an environmentally safe, biological approach for pasture-based livestock production. When introducing anything new into the environment, the long-term effect on trapping advantageous native free-living worms that help recycle fecal matter also needs to be considered. It has been demonstrated that *D. flagrans* had no adverse effect on such advantageous worms, and the fungus was no longer detectable in the environment two months after treatment.

Although proven effective against barber pole worm and other gastrointestinal nematodes of sheep and goats, it was noted in recent studies using mixed nematode parasites in feces that *Strongyloides papillosus* [see [Strongyloides \(threadworms\)](#)] was not reduced by BioWorma® feeding.

Nematode trapping fungi are the only product to specifically target the worm population on pasture, reducing re-infection of grazing animals.



Figure 4. Formulations of *D. flagrans* spores produced by International Animal Health Products (Australia).

It is important to understand and emphasize that these products are just one component of an integrated parasite control program and should not be relied on alone for gastrointestinal worm control. One still needs to address the worm population in the animal using the targeted selective deworming approach to conserve the longevity of effective dewormers.

For more information about BioWorma®, go to www.bioworma.com or www.duddingtonia.com.



Image by Dave Scott

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