

Forage-based Parasite Control in Sheep and Goats in the Northeast U.S.

Establishing Birdsfoot Trefoil for Pasture and Hay: A Guide for USDA OREI Project Demonstration Farms – April 2014

Introduction

Parasitic worms are a major problem in pasture based sheep and goat enterprises. In the Southeast U.S., consumption of *Sericea lespedeza*, a forage legume containing condensed tannins, has reliably reduced infections of the important strongyle worms parasitizing sheep and goats. However, *Lespedeza* is not winter hardy in Northeast climates. Birdsfoot trefoil (*Lotus corniculatus* L.), is another forage legume that contains condensed tannins. It too has shown some anti-parasite effects in preliminary studies and is well suited to the Northeast. Therefore a 4-year study is underway to better determine if the condensed tannins in Birdsfoot Trefoil (BFT) reduce worm infections in sheep and goats, and the practicality of including pastures high in BFT as an organic method of parasite control for Northeast sheep and goat farms. For more information about this project, please visit <http://web.uri.edu/sheepngoat/orei>.

As part of this project, we are asking a group of farmers to establish 1-to 3-acre fields of BFT under organic practices and graze a small group of lambs or kids on these fields the following year for 6 to 8 weeks to compare their worm loads with those of lambs and kids grazing conventional pastures.



Birdsfoot trefoil (*Lotus corniculatus* L.)
Photo courtesy of Cornell Univ. Forage Breeding Project, Dr. Don Viands.

This information sheet provides farmers with guidance and recommendations for establishing and managing BFT using methods that are also in keeping with organic farming principles. The following information reinforces important points from existing resources (listed at the end of this sheet), as well as experiences from land grant universities and growers in the region. It emphasizes non-chemical weed control options.

Properties of Birdsfoot Trefoil (*Lotus corniculatus* L.)

- Birdsfoot Trefoil is a perennial legume known for providing high quality forage with good yields on fields that have poor drainage or pH too low for alfalfa production. It yields less than alfalfa on optimal soils. BFT has a small seed size, as well as slow germination and seedling growth. Careful management is needed to allow for optimum germination and minimize competition from weeds or companion forages.
- BFT contains condensed tannins (CT), also called proanthocyanidins, which are naturally occurring plant compounds that significantly affect the nutritional value of forage by forming complexes with proteins, carbohydrates and minerals. Some proanthocyanidins are also detrimental to worms.

- Effect on protein: The protein in fresh forage legumes such as alfalfa and clover that do not contain CT is highly soluble. It is easily degraded by rumen microbes into amino acids and ammonia to serve as nitrogen sources. However, excess ammonia may be released into the environment while the high concentration of soluble protein encourages the formation of stable froth that can lead to bloat. In contrast, Birdsfoot Trefoil does not predispose ruminants to bloat and is an excellent source of “rumen bypass” or “escape” protein. This is because the CT binds with forage protein to form complexes which are not readily degraded by rumen microbes but instead escape into the abomasum and small intestines as complete proteins ready to be absorbed to provide extremely high quality protein. This allows for increased animal productivity when animal protein needs are particularly large such as in early and peak lactation.
- Effect on palatability: Forages high in CT may decrease appetite in cattle and particularly horses. Horses may preferentially avoid grazing forages high in CT in pasture mixes. However, goats and sheep are better adapted to consuming CT and find many CT-containing forages highly palatable.

BFT Varieties for USDA OREI Demonstration Farms – April 2014:

The project will provide the farmers with commercially available varieties of BFT for on-farm planting and evaluation. The varieties provided this year (2014) include Bruce and Pardee. These two varieties (out of seven commercial varieties being evaluated) were selected based on initial tissue analysis for CT levels. However, research is on-going and in the future will include characterization of the CT profiles, evaluation of performance traits and of the possible anti-parasitic effects and mode of action in sheep and goats for both commercial and non-commercial BFT varieties. Therefore, the BFT varieties we ask farmers to test may change in future years based on further research results.

That being said, farmers participating in the study in 2014 need to choose one of the following two varieties and estimate how much seed they will require to plant their acreage. Both varieties have yielded similarly in field comparison trials at Cornell Univ. and the Univ. of Minnesota.

- 1) Bruce:** very winter hardy, late maturing, semi-erect growth habit, rapid grazing regrowth, leafy, multi-branched stems, not resistant to Fusarium wilt (*Fusarium oxysporum f. sp. Loti*). Initial tissue analysis revealed a considerably higher CT level than Pardee.
- OR**
- 2) Pardee:** not quite as winter hardy as Bruce but still very well suited to Northern New York, early maturing, upright growth habit, rapid regrowth, about 50% of the plants are fusarium wilt resistant (developed by Cornell University for this trait – fusarium wilt wiped out the Champlain Valley BFT seed industry). Initial tissue analysis revealed the next highest CT level of the commercially available varieties although considerably lower than Bruce.

Planting Birdsfoot Trefoil:

Fertility needs are best determined by soil testing. Take a soil sample as soon as the ground is dry enough – if it is too wet to plow, it is too wet for a soil sample.

Fertilization

- While BFT can tolerate acidic soils, maximum nodulation of its nitrogen fixing bacteria, *Rhizobium loti*, occurs at pH 6.0 – 6.5. Therefore, liming the soil to a pH of at least 6.0 is beneficial. Liming is best done a year in advance. If time is short or the lime is not incorporated into the soil prior to seeding, use the smallest particle size available (80 to 90 grade or finer). The lime in products such as aragonite is reputed to be highly soluble and fast-acting but may be more costly.
- General rules of thumb: phosphorus (P) is particularly critical in low fertility soils and is best utilized if banded 1½ - 2 inches directly below the seed. Otherwise it is best applied to the soil during seedbed preparation. Applications of P and potassium (K) will be needed in low to medium fertility soils to establish and maintain BFT. Sulfur and boron are also important and may be deficient in some regions. Recommendations for these micronutrients generally range from about 1 to 2 lbs. per acre in deficient soils. Molybdenum (Mo) deficiencies may result with a pH less than 5.6. When needed, Mo can be applied as a seed coating. However, liming will also address Mo deficiencies.
- The soil test will provide recommendations for lime and nutrients needed (if any). A list of crop fertilizers and soil amendments allowed for use in certified organic operations under the USDA National Organic Program is provided by the Organic Materials Review Institute, http://www.omri.org/sites/default/files/opl_pdf/crops_category.pdf.
- Some resources on planting BFT discourage the use of manure or bedding as fertilizer because of fears that excess nitrogen will interfere with *Rhizobium* nodulation and encourage competition from any companion plants or weeds. As a N-fixing legume, Birdsfoot Trefoil requires very little added nitrogen. If using manure and compost, avoid over-application of either nitrogen or phosphorus. A laboratory analysis can provide the nutrient content of these sources. Book values can also be obtained from Extension and USDA Natural Resources Conservation Service resources.

Seeding rates:

- When seeding BFT alone as a pure stand, we are recommending a rate of 12 lbs./acre.
- A small grain nurse crop may be seeded at a rate of 1 to no more than 1.5 bushels/acre. Oats or barley are usually recommended. Due to the poor seedling vigor of BFT, careful management of this nurse crop will be needed to minimize competition. Gently graze (avoid damaging BFT seedlings), mow or harvest when oats are in the boot stage. Another option is to gently graze when oats reach 6 to 8 inches in height, repeating when necessary. Otherwise, clip the vegetation (sickle bar mower preferred), being careful not to create too thick a mulch layer. If oats are seeded with BFT in late summer, the oats should winterkill (hardiness zone 6 and colder, much of zone 7), eliminating harvest management concerns the following spring.
- While we are striving for “pure stands” of BFT, some farmers may opt to add a little grass seed to their planting to help compete with weeds. Grasses with a slower seedling growth, such as Timothy (or Kentucky Bluegrass – be sure to use forage varieties and not turf-type varieties), are typically used to minimize competition. Plant Timothy at 2 to 3 lbs. per 10 to 12 lbs. of BFT per acre. Again, careful management will be needed to minimize competition. Another option is to add 1 lb. of seed from a smaller white clover variety such as Dutch or New Zealand to the BFT. See more under First Year Management.

Timing of establishment:

The best time to seed BFT is usually early spring, although late summer seedings may be successful if moisture conditions are favorable. The advantage of a late summer seeding is reduced weed problems, but higher risk of insufficient rainfall for germination.

- 1) Spring – BFT seeds like germination temperatures that are slightly warmer than for alfalfa. However, BFT is unable to compete with increased weed germination as temperatures warm and soil moisture may also become limiting. In Rhode Island, BFT is commonly planted from April 1st through May 15th. Optimal spring planting generally occurs from late April until May 15th in Ithaca, NY. However in higher altitudes and/or Northern regions of New York, it may be impossible to get into fields by mid-May. Instead, planting may have to be delayed until late May. However, keep in mind that June plantings of BFT often fail due to low soil moisture and severe competition from weeds and forage grasses. If planting must be delayed past May 15th in warmer parts of New York or past the end of May in colder regions, it is generally best to postpone planting until July.
- 2) Late Summer – Summer plantings should occur in July in most of New York. Delaying until August or September usually results in poor survival of the BFT stand. However, late summer seeding dates of August 15 – September 10 have been successful in Rhode Island.

Seeding Method:

- BFT seed requires a specific strain of Rhizobium inoculum (*Rhizobium loti*). The project will provide a commercial inoculum which should be thoroughly mixed with the seed upon planting. Inoculant and seed should be stored in a cool, dark area until use.
- BFT seed may contain 15 percent or more "hard seeds," which do not take up water and are slow to germinate. If this is of concern, scarify the seed by using a cement mixer for about 3 minutes, then mix in the inoculant and any other seeds (e.g. nurse crop of oats). Otherwise plant a little extra seed.
- The majority of sources on BFT recommend seeding into a conventionally-tilled, firm, smooth seedbed no deeper than ¼ inch in the soil. A seed drill provides the best results and many have a packer wheel system that firms the soil immediately after placing the seed. Firming the soil before and after planting (some field crop specialists recommend rolling it twice after planting) will improve the seed-to-soil contact that is crucial to adequate moisture for germination. If broadcasting the seed, be sure to use a cultipacker or roller to firm the seedbed before and after seeding.



Brillion seeder with cultipacker. Photo courtesy of Cornell University Forage Breeding Project, Dr. Don Viands.

First Year Management:

- During the establishment year, BFT should ideally reach a height of 8 to 12 inches or have 1/10th bloom before being seriously grazed or harvested. However, weeds and companion crops may outcompete the planting if mowing is delayed until this stage. When other plants appear to be starting to out-compete the BFT, mow the stand just above the BFT level. Mowing is also indicated when broadleaved weeds such as pigweed and ragweed reach heights of 8 - 15 inches tall or when companion forages reach 8 to 10 inches tall.
- When nurse or companion crops are grown with BFT, harvest, clip or gently graze these crops when they reach a height of 8 to 10 inches tall (boot stage in small grain forages) to minimize competition.
- Grazing is an option when conditions are too wet for mowing. It should be done quickly and gently to minimize damage to the BFT seedlings.
- Avoid cutting the BFT plants to <5 inches. Mowing young stands of BFT shorter may kill the stand.
- If possible, allow BFT to go to seed at some point in the first year to start building a seed bank. This practice should be repeated in subsequent years to maintain the seed bank.
- It is important that BFT get a minimum of 4 to 5 weeks of regrowth before the first killing frost. Therefore, avoid grazing, mowing or haying from about Sept 1st to the first killing frost to allow energy reserves to build up in the roots for winter survival and spring emergence. After this period, the stockpiled growth may be used, but avoid extremely close grazing.
- Depending on soil type and sod/snow cover, consider frost seeding the following late winter/early spring after initial planting to boost the seed bank and percentage of BFT in the stand.

Grazing and Harvest Management:

- BFT plants should never be completely defoliated. This is because the speed of regrowth in BFT is determined by the number of leaves allowed to remain on the stems. Unlike alfalfa and clover, BFT does not store carbohydrates in its roots during the growing season to use for regrowth. Instead, BFT waits until the cold temperatures of fall to begin to build up root reserves. Complete defoliation results in slow growing, stressed plants susceptible to disease. However, excessive stockpiling, especially under warm, wet conditions, may result in too much lush growth, shading and humidity which can lead to stem diseases and insect infestations.
- Allow animals to graze pure stands of BFT when the first flowers appear, unless weeds are an issue. Earlier grazing of pure stands reduces trefoil's growth potential for the remainder of the season. However, if there are weeds or grasses in the stand, early grazing (when grasses reach 6 – 8 inches) will benefit the BFT. Leave a minimum stubble height of 3 to 4 inches when grazing.
- When harvesting for hay, the first cutting ideally should be taken at 1/10th bloom and a second cutting in mid to late August. Hay harvest should leave at least a 5-inch stubble height.

Resources:

Birdsfoot Trefoil – Penn State Agronomy Facts 20
<http://pubs.cas.psu.edu/freepubs/pdfs/uc087.pdf>

Birdsfoot trefoil for grazing and harvested forage
North Central Regional Extension Publication 474 (Univ. of Wisconsin)
<http://www.uwex.edu/ces/forage/pubs/birdsfoot.pdf>

Birdsfoot Trefoil as a Grazing or Hay Crop
University of Vermont Extension
<http://www.uvm.edu/pss/vtcrops/?Page=articles/BFT.html>

4 - *Birdsfoot Trefoil* - Plant Fact Sheet
USDA NRCS Plant Materials Program – Plants Database
http://plants.usda.gov/factsheet/pdf/fs_loco6.pdf

5 - *Birdsfoot Trefoil, a Valuable Tannin-Containing Legume for Mixed Pastures* – MacAdam, J. et al., 2006. Online. Forage and Grazinglands doi:10.1094/FG-2006-0912-01-RV.
<http://naldc.nal.usda.gov/download/11931/PDF>

Proper soil sampling

1. Cornell Univ. Fact Sheet on Soil Sampling for Field Crops -
<http://nmsp.cals.cornell.edu/publications/factsheets/factsheet1.pdf>
2. Univ. of Massachusetts Fact Sheet on Sampling Soils for Meaningful Results -
<http://extension.umass.edu/cdle/fact-sheets/sampling-soils-meaningful-results>.

For more information about this information sheet:

Cooperative Extension:
tatiana Stanton; ts7@cornell.edu
Dept. Animal Science, Cornell University

Holly Burdett; hburdett@uri.edu
Dept. Fisheries, Animal and Veterinary Sciences,
University of Rhode Island

Jim Kotcon; jkotcon@wvu.edu
Div. of Plant and Soil Sciences, West Virginia University

Rebecca Brown; brownreb@uri.edu
Dept. Plant Sciences and Entomology,
University of Rhode Island

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