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Birdsfoot Trefoil Production In Northern Idaho

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Production of high-quality forage for cattle and sheep production has traditionally been difficult in northern Idaho. A short growing season, poor soil drainage, periods of drought, low soil pH and poor soil fertility are the major factors limiting forage production. Birdsfoot trefoil (*Lotus corniculatus* L.) is a forage legume that is adapted to these adverse production conditions.

Research with birdsfoot trefoil has been conducted in northern Idaho for nearly 30 years. This research has predominately addressed birdsfoot trefoil variety performance but has also looked at soil fertility for optimum birdsfoot trefoil production. This publication summarizes research in Idaho and other states as it relates to birdsfoot trefoil production in northern Idaho.

Characteristics

Birdsfoot trefoil stems are smaller in diameter and less rigid than alfalfa stems and may grow to a height of 18 to 20 inches. Each flower (4 to 8 per stem) produces one seed pod. The seed pods are attached to a relatively long stem in a fashion that resembles a bird's foot, hence its name. Birdsfoot trefoil's root system consists of a tap root with numerous lateral branches predominantly located in the upper 15 inches of the soil profile.

Birdsfoot trefoil is a perennial legume that is adapted to production on poorly drained, low pH soils. It is capable of surviving periods of drought, responds to fertilization and does not cause bloat in animals. These characteristics have resulted in its expanded use in the northern United States and southern Canada where production of other forage legumes is limited. Birdsfoot trefoil has traditionally been used in forage grazing systems. Breeding for improved characteristics has produced varieties that are suitable for hay production.

Variety Selection

About 25 varieties of birdsfoot trefoil are currently available in the United States and Canada. These varieties are generally characterized by growth habit into two birdsfoot trefoil types, Empire and European. Both types are referred to as "broadleaf" trefoils.

Empire type birdsfoot trefoils are better adapted for use in grazing situations since they have fine stems, prostrate growth and indeterminant growth habit. The Empire types are also slower growing during establishment and regrow more slowly following harvest than the European types. European type birdsfoot trefoils are better adapted to hay production practices since they are more erect, establish faster and regrow faster after harvest. Cascade, a European type birdsfoot trefoil, has traditionally been a high-yielding variety when produced for hay in northern Idaho. Recently, other European types have been developed that are higher yielding and more vigorous than Cascade (Table 1). Newer varieties Norcen and Tretana have production attributes similar to Cascade, and they also tend to persist better under more vigorous harvest management. This characteris-

Table 1. Birdsfoot trefoil variety test results at Moscow and Sandpoint, Idaho.

Variety	Study 1 Yield*	Study 2 Yield*	Study 2 Vigor**
		tons/acre	
Cascade	3.12	2.72	3.8
Granger	3.15	-	-
Viking	3.14	-	-
Norcen	-	3.34	7.8
Dawn	-	3.88	5.8
Tretana	—	3.39	6.3

*Yield values for Study 1 represent averages of one harvest per year over a 4-year period. Yield values for Study 2 represent averages of two harvests per year over a 2-year period.

**Vigor ratings are based on observation (1 = low and 9 = very high).

tic may allow three cuttings per year in some areas of northern Idaho. Dawn is a high-yielding Empire type that has also performed well in northern Idaho tests.

Establishment

Site Selection — As with other forage legumes, birdsfoot trefoil is most productive on fertile, well-drained soils with near neutral pH. However, it has the ability to produce relatively high forage yields and quality on marginal alfalfa production land. Birdsfoot trefoil can be grown on low pH (less than 5.8) soils and will tolerate short periods of flooding with less yield reduction than alfalfa. It can also tolerate periods of drought, which makes it suited for production on both sandy and clay soils.

In soils that are well drained and have good fertility, birdsfoot trefoil will not persist or yield as well as alfalfa. Therefore, the site in which birdsfoot trefoil is to be produced should have limitations which make alfalfa production difficult.

Soil Fertility — Limited information is available regarding fertilization of birdsfoot trefoil at seeding. Soils should be tested for adequate levels of phosphorus (P), sulfur (S) and boron (B) before planting. When soils are deficient in these nutrients, approximately 60 pounds P_2O_5, 25 pounds S and 1 to 2 pounds B should be applied per acre. P should be banded slightly below and to the side of the birdsfoot trefoil seed at planting. S can be banded with the P at seeding or broadcast with the B onto the seedbed before seeding. For additional information regarding fertilizer placement, see University of Idaho Current Information Series 757, *Fertilizer Placement*.

Birdsfoot trefoil establishment on soils that have a pH less than 5.6 may result in molybdenum (Mo) deficiencies. Molybdenum is an essential nutrient for nitrogen fixation. When needed, Mo can be applied as a seed coating. This method of application should provide sufficient Mo levels for the life of the birdsfoot trefoil stand.

Seeding — Birdsfoot trefoil requires careful management for successful establishment because of its small seed size and poor seedling vigor. Before seeding, the birdsfoot trefoil seed should be inoculated with *Rhizobium lupini* bacteria, which are specific for birdsfoot trefoil. This will ensure sufficient nodulation of the root system and adequate atmospheric nitrogen fixation. The specific *Rhizobium lupini* bacteria are necessary because other *Rhizobium* types (e.g. alfalfa, clovers, peas, etc.) are ineffective on birdsfoot trefoil.

The small seed of birdsfoot trefoil necessitates that the seed be placed no deeper than ¼ inch in the soil to achieve maximum stand. A smooth, firm seedbed will greatly facilitate accurate depth placement of the seed.

Compacting the soil after planting will improve the seed-to-soil contact, which improves moisture uptake by the seed and ultimately enhances germination and emergence. Seeding rates of 8 to 10 pounds per acre are considered adequate under normal conditions.

Grass-birdsfoot trefoil mixtures are commonly used to obtain higher yields than are possible with a pure stand of birdsfoot trefoil. However, a 4-year study completed in 1966 and a 2-year study completed in 1987 indicate that yields obtained from pure birdsfoot trefoil stands are similar to yields from mixtures of birdsfoot trefoil and timothy, orchardgrass, smoothbrome, Kentucky bluegrass or meadow foxtail. A grass-birdsfoot trefoil mixture can reduce birdsfoot trefoil lodging and the time required for curing birdsfoot trefoil hay.

General recommendations for seeding grass-birdsfoot trefoil mixtures are to seed the grass and birdsfoot trefoil in alternate rows to reduce early seedling competition. If alternate row seeding is not possible, then seed the birdsfoot trefoil first and the grass second at a 90-degree angle to the birdsfoot trefoil rows.

In mixtures, birdsfoot trefoil should be seeded at 6 to 8 pounds per acre and the grass at 3 to 4 pounds per acre to produce a 50:50 birdsfoot trefoil:grass stand. Birdsfoot trefoil does not compete well with other legumes and is therefore not recommended in mixtures with other legumes.

The low seedling vigor of birdsfoot trefoil has brought into question the value of nurse crops when establishing this legume. Small grain nurse crops reduce root development, seedling vigor, stand density and yield of birdsfoot trefoil. If a nurse crop is used, it should be seeded in 18-inch row spacings and removed early before competition for light becomes too great and before the nurse crop begins to lodge.

Stand Management

Soil Fertility — Maximum birdsfoot trefoil production is achieved under optimum soil fertility management, but this species also produces well under less than optimum fertility levels. With proper *Rhizobium* inoculation, birdsfoot trefoil should fix adequate nitrogen (N) from the atmosphere for its needs. Consequently, fertilizer N should not be applied to pure birdsfoot trefoil stands because it will promote the invasion of grass weeds. In mixed grass-birdsfoot trefoil stands, N fertilization should be minimal to keep the grass from outcompeting the birdsfoot trefoil in the mixture.

Soil type plays an important role in P management of birdsfoot trefoil stands. On soils not influenced by volcanic ash, additions of 50 to 100 pounds P_2O_5 per acre are recommended when soil test P values are less than 4 ppm (sodium acetate extraction). All P applications should be broadcast onto established birdsfoot trefoil stands in either the fall or early spring.

Table 2. Effect of phosphorus fertilization rate on yield of alfalfa and birdsfoot trefoil at Sandpoint, Idaho, in 1982 and 1983.

Crop	P_2O_5 applied	Forage yield		
		1982	1983	Total
	lb/acre			
Alfalfa	0	375	2,911	3,286
	82	875	3,563	4,438
	160	1,420	3,991	5,411
	250	1,616	4,473	6,089
Birdsfoot trefoil	0	1,062	4,857	5,919
	82	2,866	4,633	7,500
	160	3,152	5,393	8,545
	250	4,759	5,500	10,259

Soils containing large amounts of volcanic ash (typical of many soils in Boundary, Bonner and northern Kootenai counties) require large P applications for sustained birdsfoot trefoil production. Established birdsfoot trefoil stands on soils containing large amounts of volcanic ash in Bonnner County were responsive to P applications up to 250 pounds P_2O_5 per acre per year (Table 2). When these soils contain less than 4 ppm P (sodium acetate extraction), application of 90 to 260 pounds P_2O_5 per acre are recommended to achieve acceptable yields. The P fertilizer should be surface-broadcast in the early spring while the birdsfoot trefoil is still dormant.

Sulfur is often deficient in northern Idaho soils. Soils testing less than 10 ppm S require application of 20 to 25 pounds S per acre. The S should be applied as a surface broadcast in either the fall or early spring.

Broadcast 1 pound B per acre to established birdsfoot trefoil when soil test levels are less than 0.5 ppm B. If sulfur and boron are both deficient, 100 pounds borated gypsum per acre will supply 18 to 22 pounds of S and 1 pound of B.

Most northern Idaho soils contain sufficient levels of potassium (K) for birdsfoot trefoil production. If soils test less than 85 ppm K (sodium acetate extraction), 20 to 40 pounds K_2O per acre should be surface-broadcast in either the fall or early spring.

Harvest — When harvested as hay, the first cutting of birdsfoot trefoil should be taken at 1/10th bloom and a second cutting in mid to late August. Sufficient time for regrowth between cuttings or grazing is also necessary for stand maintenance. Continuous defoliation by cutting or grazing will stress the stand and result in stand thinning. Root reserves may not be sufficient to initiate regrowth if the birdsfoot trefoil plant is totally defoliated in midsummer when root reserves are low. Harvesting or grazing between September 1 and the first killing frost is not recommended. This period is needed to allow root reserves to accumulate to improve winter survival and growth the following spring.

Stockpiling — The recommended practice is not to harvest birdsfoot trefoil during the second half of the summer and then to graze it in the fall after the first killing frost, a practice known as stockpiling. Birdsfoot trefoil is well suited for stockpiling since it holds its leaves at maturity and after frosts and thus maintains a relatively high level of quality. Stockpiling also allows root reserves to accumulate during the fall, which improves plant survival and spring growth.

Quality and Use — Birdsfoot trefoil quality is comparable to that of alfalfa. Loss of quality with maturity is less pronounced with birdsfoot trefoil than alfalfa. When grazed, birdsfoot trefoil is more palatable than alfalfa and produces greater average daily gains of heifers and sheep. Unlike alfalfa, birdsfoot trefoil when grazed does not cause animals to bloat.

Summary and Conclusions

Birdsfoot trefoil yields less than alfalfa on well-drained, fertile soils but is superior to alfalfa on soils that have marginal fertility and production capabilities. In areas of northern Idaho where alfalfa production is not optimal, birdsfoot trefoil may be a viable alternative in forage production systems. Its excellent grazing potential and bloat-free characteristics are ideal for pasture production. Poor seedling establishment has been a major complaint of birdsfoot trefoil. Careful management at seeding can reduce this problem considerably, however. Careful harvest or grazing management is necessary, but when properly managed, birdsfoot trefoil will persist and remain productive for several years.

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