

Forage Legume Management Studies on Muck Soils¹

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Abstract

Most forage legumes do not persist for more than one year on muck soils in Northern Indiana. This lack of persistence is presumably due to the poorly drained conditions and low winter temperatures. Several experiments were conducted with Redland red clover (*Trifolium pratense* L.), Regal Ladino clover (*Trifolium repens* L.) and Empire birdsfoot trefoil (*Lotus corniculatus* L.) on the shallow Edwards muck soil located on the Pinney-Purdue Agricultural Center at Wanatah, Indiana. The experiments involved method of seeding, time of seeding, and fall mulching versus non-mulching.

The data obtained showed that some tillage is beneficial for legume establishment in a dense Kentucky bluegrass (*Poa pratensis* L.) sod even with the use of paraquat. Birdsfoot trefoil was successfully established from an August seeding although the common practice is to seed this species in the spring. Ladino clover did not survive the winter without the application of a straw mulch in October. Only a few red clover plants did not winter kill without mulch, however, birdsfoot trefoil plants appeared not only to survive, but started earlier and grew more vigorously with the protection of a mulch cover.

Introduction

Although the muck soils of northern Indiana are capable of producing high yields of corn, yields are frequently low due to adverse weather conditions. Often it is too wet in spring resulting in late planting of corn and the low-lying muck areas are subject to later summer frosts resulting in a shorter growing season. The low yields result in corn often being an uneconomical crop to grow on these muck soils of northern Indiana.

A possible alternative to grain production is to seed these muck soils to forage crops to be used as pasture or hay. Many cool-season forage grasses are known to be well adapted to muck soils. This is especially true of Kentucky bluegrass (*Poa pratensis* L.). This species soon predominates on these muck soils if taken out of grain production. The problem is to find a forage legume which will persist on the acid, poorly drained muck soils and also be able to compete with Kentucky bluegrass.

The following study was initiated in the spring of 1977 to determine the effect of seedling management on the establishment and persistence of birdsfoot trefoil, red clover, and ladino clover. These three legumes, and especially

¹Journal Paper No. 7441, Purdue University Agricultural Experiment Station

birdsfoot trefoil (1), were known to be the forage legumes most likely to succeed on these shallow muck soils.

Materials and Methods

Three experiments were initiated on the Pinney-Purdue Agricultural Center at Wanatah, Indiana in 1977. The soil type was an Edwards muck.

Experiment 1. Empire birdsfoot trefoil (*Lotus corniculatus* L.) was broadcast seeded on May 1, 1977 into an established stand of Kentucky bluegrass at the rate of 11.2 kg/ha. A 2 x 3 factorial set of treatments was imposed consisting of two soil fertility levels and three methods of handling grass competition. Fertility levels were unfertilized and 336 kg P₂O₅ and 336 kg K₂O/ha spring applied. Grass competition treatments were; check or no control attempted, paraquat applied 10 days prior to seeding legume at rate of 1 l/ha, and clipping at 1-2 cm above soil surface just prior to legume seeding. The plots were 2 by 3 m and replicated 4 times.

Experiment 2. On May 1, Redland red clover at 16.8 kg/ha and Regal ladino clover at 2.2 kg/ha were seeded into an established Kentucky bluegrass sod. Plots 3.3 by 5 m were established and paraquat at the rate of 1 l/ha was applied to half of the plots on April 20. The experimental area was rototilled just prior to seeding. Three replications were employed.

Experiment 3. This experiment was initiated to determine the feasibility of an August seeding of Empire birdsfoot trefoil. Prior to seeding on August 18, an area 5 by 7 m was rototilled, divided into 4 replications, and broadcast seeded by hand and covered shallowly with a rake.

On October 20, half of each plot of the August seeded birdsfoot trefoil was mulched with wheat straw and anchored in place by criss-crossing the mulched areas with twine. The red clover and ladino clover plots were divided in thirds, 1/3 was clipped and straw mulched, 1/3 was clipped and clippings removed, and 1/3 was not clipped or mulched. The mulch remained in place over winter and was removed on April 6, 1978.

Stand counts in the three experiments were obtained by randomly throwing a 20 by 50 cm quadrat.

Results and Discussion

Experiment 1. Stand counts of the birdsfoot trefoil nine weeks after seeding revealed that close clipping or the application of paraquat to bluegrass was necessary for establishing birdsfoot trefoil in a bluegrass sod (Table I). No plants survived in the plots that were not clipped or sprayed with paraquat. Spraying with paraquat resulted in nearly three times the population of trefoil seedlings as compared to close clipping of the bluegrass.

Visual estimates revealed that eighteen months after seeding birdsfoot trefoil in the paraquat treated plots, birdsfoot trefoil comprised slightly over 50% of the mixture. The close clipping resulted in a mixture of 28% birdsfoot trefoil and 72% Kentucky bluegrass.

TABLE I *Effect of seedling management on the establishment of Empire birdsfoot trefoil sod-seeded in a Kentucky bluegrass sod on Edwards muck soil at Wanatah, Indiana, 1977-78.*

Stand Evaluation	Check	Clipped	Paraquat
Plants/ Plot*	0	8.8	22.4
% Birdsfoot trefoil**	0.1	28.1	54.0

*Ave. of 4 reps 9 weeks after seeding.

**Ave. of 4 reps 18 months after seeding.

Experiment 2. As shown in Table II, the beneficial effect of paraquat when sod-seeding red clover and ladino clover was very similar to that obtained in Experiment 1 with birdsfoot trefoil. Nine weeks after seeding red clover and ladino clover, the number of plants in the plots sprayed with paraquat was approximately three times that of the plots receiving no paraquat (Table II). However, by late summer the foliar growth of the plots which did not receive paraquat appeared to be very similar to those sprayed with paraquat (visual appraisal).

TABLE II *Effect of treating Kentucky bluegrass sod with paraquat at time of seeding on the establishment of sod-seeded red clover and ladino clover on Edwards muck soil at Wanatah, Indiana, 1977.*

Species	-Paraquat	+ Paraquat
	Plants/0.1m ²	
Red clover	4.3	13.4
Ladino clover	1.1	3.3

Ave. of 3 reps 9 weeks after seeding.

Experiment 3. August seeding of Empire birdsfoot trefoil was successful despite an unusually cold winter in 1977-78 (Table III). The late fall application of a straw mulch did not benefit the trefoil seedlings. It appeared that the soil in the unmulched plots warmed up quicker and enabled the seedlings to start growing earlier and more vigorously in the spring than the plants that had been mulched.

TABLE III *Effect of a fall applied straw mulch on winter survival and vigor of Empire birdsfoot trefoil seedlings grown on Edwards muck soil at Wanatah, Indiana, 1977-78.*

Treatment	Crowns*	Stems	Flowers	Pods
	Per 0.1m ²			
Mulched	2.3	44.0	0	8.5
Unmulched	4.3	498	3.3	74

*Ave. of 4 reps 1 year after seeding.

The effect of mulching red clover and ladino clover was very striking. Ladino clover was completely winter-killed without a late fall applied mulch. A few red clover plants survived without mulch but not enough to warrant

keeping the stand. However, an excellent stand of both species remained in the plots which were covered with straw mulch.

These data suggest that possibly red clover and ladino clover would overwinter if grown in association with a grass which would provide a mulch to protect the clover plants. Also, grazing in the fall may be detrimental to winter survival of red clover and ladino clover. However, these results imply that heavy fall grazing of a trefoil-bluegrass pasture may be beneficial since the removal of residue by grazing would permit earlier spring growth of the trefoil, which is very winter-hardy.

Conclusions

The following conclusions are based on the data reported in this paper.

1. When sod-seeding a legume in a cool-season grass sod such as Kentucky bluegrass, it is necessary to reduce the competition of the grass by means of one, or more, of the following practices:
 - a. Some type of tillage for partial destruction of the sod.
 - b. Application of paraquat.
 - c. Close clipping or heavy grazing prior to seeding.
2. A late summer seeding of birdsfoot trefoil can be successful if properly managed.
3. A fall applied straw mulch will reduce winter-killing of red clover and ladino clover.
4. Birdsfoot trefoil seedlings are very winter-hardy and mulching is not necessary. In fact, heavy fall grazing may be beneficial since the removal of residue permits earlier spring growth.
5. Birdsfoot trefoil appears to be the only forage legume adapted to muck soil in northern Indiana.

Literature Cited

1. BLAIR, B. O., C. L. RHYKERD, R. E. MULLEN, W. O. JONES, and J. J. VORST. 1977. Ecological adaptation of certain forage species on shallow muck soils. *Ind. Acad. Sci.* **86**:217-223.