SPECIES COMPOSITION AND FORAGE QUALITY OF BIRDSFOOT TREFOIL (LOTUS CORNICULATUS L.) - GRASS MIXTURES

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ABSTRACT
This study compares yield, species composition, and forage quality of binary mixtures of two birdsfoot trefoil cultivars ('Witt' and 'Dawn') and six cool-season forage grasses. Stands were established by no-till seeding into glyphosate killed pasture sod in May and in August. Heavy autumn dandelion (*Taraxacum officinale* Weber) competition reduced trefoil survival in August seedings. The proportion of trefoil in the herbage varied widely but in spring-seeded seeding year stands it was always highest with Kentucky bluegrass (maximum of 740 g kg^{-1}, first harvest, 1994) and usually lowest (107 g kg^{-1} or less) with perennial ryegrass, reed canarygrass, or orchardgrass. Seeding-year yields generally were maximized with trefoil-reed canarygrass or trefoil-timothy combinations with the latter yielding 5410 kg ha^{-1} over three harvests in 1994. The trefoil-bluegrass or trefoil-bromegrass combinations usually gave the best relative feed values (176 maximum) and crude protein concentrations (225 g kg^{-1} maximum) as determined by NIRS analysis. Lowest quality values varied among the other grasses and were influenced mainly by proportion of grass and maturity. There usually was no significant difference between the trefoil cultivars.

KEYWORDS
Birdsfoot trefoil, grasses, mixtures, forage quality, no-till seeding

INTRODUCTION
Birdsfoot trefoil is widely recommended and used as a pasture legume. It is known to provide high quality forage and to persist well under grazing. It also does not cause bloat (Beuselinck and Grant, 1995). In northern areas it has been generally recommended that trefoil be seeded with either Kentucky bluegrass (*Poa pratensis* L.) or timothy (*Phleum pratense* L.) because of their less aggressive growth habits and trefoil's known intolerance of competition, especially during the seedling stage (Undersander et al., 1993). Sheaffer et al.(1984) found trefoil-grass mixtures to vary in composition depending on location. Only very limited work has been done examining the use of other grasses in combination with trefoil. The objectives of our trial were to compare the dry matter (DM) yield, forage quality, and competitive ability of trefoil when in binary mixtures with six cool-season grass species no-till seeded into glyphosate-killed sod in spring and in late summer.

METHODS
Two birdsfoot trefoil [BT] (*Lotus corniculatus* L.) cultivars ('Dawn' and 'Witt') and six cool-season grass species were no-till seeded as binary trefoil-grass mixtures into an old glyphosate-killed bluegrass sod in late summer and in spring from August, 1992 to May, 1994. Soil type was a Santiago silt loam, Typic Glossoboralf. Grass species included orchardgrass [OG] (*Dactylis glomeratra* L.), smooth bromegrass [SB] (*Bromus inermis* Leyss.), timothy [T] (*Phleum pratense* L.), reed canarygrass [RC] (*Phalaris arundinacea* L.), Kentucky bluegrass [KB] (*Poa pratensis* L.), and perennial ryegrass [PR] (*Lolium perenne* L.). Seedings were made with a Truax no-till drill. Seeding rates in kg ha^{-1} were: 'Dawn' trefoil- 6.7, BG-2.2, OG-3.4, PR- 4.5, RC- 5.6, SB- 6.7, and T- 3.4. The larger-seeded 'Witt' trefoil was seeded at 9.4 kg ha^{-1}. Each trefoil cultivar was first seeded in a block within each replication and the grasses overseeded in plots 1.68 m X 9.14 m. There were four replications in a split-plot design with trefoil as the main units and grass species as the subunits. Cuttings, years, and/or late summer vs spring seeding added additional main effect splits to the ANOVAs. Data included stand counts, DM yields, species composition based on hand separations, and NIRS analysis for crude protein (CP) and relative feed value (RFV), the latter calculated using ADF and NDF.

RESULTS AND DISCUSSION
Spring seedings were always more successful in establishing trefoil than late-summer seedings because of heavy competition from dandelions (*Taraxacum officinale* Weber). Only the results of spring seedings are reported in this paper. In 1993 the spring seeding (May 14) provided only one harvest in August, but in 1994 (seeded May 10) excellent summer and autumn growing conditions gave three harvests (July 18, August 25, and October 20). Results from the single harvest in 1993 and the first two harvests in 1994 are presented in Table 1.

In 1993 BT-RC gave the highest DM yield (2960 kg ha^{-1}) but also the lowest proportion of trefoil. This was due primarily to the RC being accidently seeded at twice the normal rate (11.2 kg ha^{-1}). The BT-KB combination had one of the lower DM yields (2040 kg ha^{-1}) but had the highest proportion of BT in the herbage (325 g kg^{-1}) and was among the highest in quality with CP and RFV of 164 g kg^{-1} and 144, respectively. The BT-OG combination also had good quality while RC and T had the lowest values (Table 1).

In 1994 BT-T gave the highest yields in both the first and second harvests (Table 1) and was highest for the season over the three harvests at 5410 kg ha^{-1}. BT-BG was lowest in total season yield with 4200 kg ha^{-1}. CP and RFV levels were again significantly superior for the BT-KB combination and varied less among most other mixtures compared with 1993 (Table 1). The proportion of trefoil in the herbage was generally higher in 1994 than in 1993 and likely influenced CP and RFV levels. CP and RFV were generally higher at second harvest in 1994 (Table 1).

Data for the first harvest of second-year stands seeded in spring 1993 and 1994 are shown in Table 2. BT-T and BT-RC were highest yielding with 3080 and 3050 kg ha^{-1}, respectively. The proportion of BT in the stand decreased significantly during the first year in all combinations except BT-KB seeded in 1993. Many stands had about 100 k kg^{-1} or less at first harvest of the second year. The BT-KB and BT-SB combinations maintained the highest proportions of BT. Forage quality was significantly lower at first harvest in the second year compared with the seeding year (Table 2).

Our results indicate that BT can be successfully established with most cool-season grasses but that to maintain significant proportions of the legume in the stand beyond the seeding year it may be necessary to reduce grass seeding rates significantly from those used in this study. Excellent yields were obtained from most of our mixtures and quality was generally high for BT-KB and BT-SB combinations.

REFERENCES
Beuselinck, P.R. and W.F. Grant. 1995. Birdsfoot Trefoil. *in* R.F. Barnes et al. ed. Forages. (5th ed.) Iowa State University Press, Ames, IA.

Sheaffer, C.C., G.C. Marten, D.L. Rabas. 1984. Influence of grass species on composition, yield, and quality of birdsfoot trefoil mixtures. Agron. J. **76**: 627-632.

Undersander, D., L. Greub, R. Leep, P. Beuselinck, J. Wedberg, D. Smith, K. Kelling, J. Doll, D. Cosgrove, C. Grau, S. Peterson, M. Wipfli, and J. English. 1993. Birdsfoot trefoil for grazing and harvested forage. N. Cent. Regional Pub. 474, Coop. Ext. Pub., Univ. of Wisconsin, Madison, WI.

Table 1
Total dry matter (DM) yield, crude protein (CP) concentration, relative feed value (RFV), and species composition of spring seeded trefoil-grass mixtures and harvested in seeding year.

	Seeded 1993					Seeded 1994									
	1 Harvest					1st Harvest					2nd Harvest				
Grass Seeded With Trefoil	DM kg ha^{-1}	CP g kg^{-1}	RFV	Trefoil g kg^{-1}	Grass g kg^{-1}	DM kg ha^{-1}	CP g kg^{-1}	RFV	Trefoil g kg^{-1}	Grass g kg^{-1}	DM kg ha^{-1}	CP g kg^{-1}	RFV	Trefoil g kg^{-1}	Grass g kg^{-1}
Kentucky Bluegrass	2040	164	144	325	150	2360	168	165	740	30	950	221	176	607	173
Orchardgrass	2060	160	142	269	198	2250	155	105	260	670	1350	163	108	60	909
Perennial Ryegrass	2150	150	124	107	729	2380	162	131	380	540	1100	182	120	172	760
Reed Canarygrass	2960	130	99	55	886	2560	153	107	330	610	970	218	140	329	488
Smooth Bromegrass	2270	156	122	166	643	2400	167	125	370	560	970	225	159	485	375
Timothy	2710	134	119	167	629	2670	147	115	490	420	1520	170	119	190	670
LSD (0.05)	260	11	8	112	86	120	9	11	110	110	60	12	10	98	12
CV, %	10.8	7.1	6.2	60.5	15.6	10.3	5.6	8.5	24.2	23.3	11.5	6.1	6.9	31.3	20.2

Table 2
Total dry matter (DM) yield, crude protein (CP) concentration, and relative feed value (RFV) of trefoil-grass mixtures seeded spring 1993 and 1994 at first harvest one year later.

	Seeded spring 1993					Seeded spring 1994				
	1st Harvest 1994					1st Harvest 1995				
Grass Seeded With Trefoil	DM kg ha^{-1}	CP g kg^{-1}	RFV	Trefoil g kg^{-1}	Grass g kg^{-1}	DM kg ha^{-1}	CP g kg^{-1}	RFV	Trefoil g kg^{-1}	Grass g kg^{-1}
Kentucky Bluegrass	2480	144	111	355	288	2330	148	105	195	399
Orchardgrass	2410	135	111	136	572	1980	115	94	28	909
Per. Ryegrass	2310	114	109	68	669	1490	156	114	62	552
Reed Canarygrass	2490	125	95	110	673	3048	124	85	48	761
Sm. Bromegrass	2670	129	103	209	485	2670	148	104	122	575
Timothy	3080	109	93	128	792	2800	118	89	31	863
LSD (0.05)	290	9.7	9	93	166	310	11.6	11	55	101
CV, %	11.1	7.6	8.1	54.4	28.0	12.7	8.4	10.6	66.9	14.7