PASTURE SPECIES FOR GRAZING-BASED DAIRY PRODUCTION UNDER IRRIGATION IN THE INTERMOUNTAIN WEST

J. W. MacAdam, R. E. Whitesides, M. B. Winger and S. Buffler
Department of Plants, Soils, and Biometeorology, Utah State University, Logan, UT 84322-4820 U.S.A.

ABSTRACT
Forage trials were established in response to producer interest in grazing-based dairy production. The quantity and seasonal distribution of yield of tall fescue (*Festuca arundinacea* Schreb.), orchardgrass (*Dactylis glomerata* L.), white clover (*Trifolium repens* var. *giganteum* L.), birdsfoot trefoil (*Lotus corniculatus* L.), and cicer milkvetch (*Astragalus cicer* L.) harvested three times were similar, with about half the production occurring in June. Legume quality was higher in June, and quality for all species was highest in late summer. Yields of perennial ryegrass (*Lolium perenne* L.), meadow bromegrass (*Bromus riparius* Rehm.) and Kentucky bluegrass (*Poa pratensis* L.) were approximately half that of the other forages, and were evenly distributed throughout the growing season. The crude protein content of perennial ryegrass and meadow bromegrass was equal to that of the legumes during July. Yields for all forages were higher than those reported for the same species grown in the humid eastern U.S., and quality was similar.

KEYWORDS
Birdsfoot trefoil, cicer milkvetch, Kentucky bluegrass, meadow bromegrass, perennial ryegrass, white clover, seasonal distribution of yield, seasonal distribution of quality

INTRODUCTION
Most dairy producers in Utah use drylot production systems. Comparisons of dairying enterprises (Parker et al., 1991, 1992; Rotz and Rod, 1994) have demonstrated that grazing-based dairies have significantly lower costs and higher profits compared with confinement dairies. However, producers in the Intermountain West have been reluctant to adopt pasture-based systems until reliable information was available on pasture species adapted to the climate and soil conditions of this region.

The management of irrigated pastures for dairy production was studied in Utah during the 1940s and 50s, (Bateman and Keller, 1956), but many new varieties and methodologies have been developed during the last 40 years. Most recent U.S. research on grazing-based dairy production has been carried out in the northeastern U.S., but direct transfer of forage yield and quality data to the Intermountain West is prevented by differences in the climates of the two regions.

A forage evaluation trial was run from 1993 to 1995, with the objective of evaluating the seasonal distribution of yield and quality of grasses and legumes appropriate for grazing in irrigated pastures of the Intermountain West.

MATERIALS AND METHODS
Four replications of all species were planted as monocultures; cultivars and seeding rates are noted in Table 1. Plots were 0.9 m wide by 6 m long, and were planted using a Carter seeder and harvested using a Carter flail-type forage plot harvester (Carter Manufacturing, Brookston, IN 47923, U.S.A.). The soil was a Millville silt loam (coarse-silty, carbonatic, mesic Typic Haploxerolls). Plots were irrigated at approximately one-week intervals from late spring through early fall.

Alfalfa was included in the study as a standard for forage production in the Intermountain West, and for this trial, stands were harvested on dates appropriate for alfalfa hay. Data are for 1995, after all stands were established. Except as noted, all species were harvested once on June 22, July 31, and September 18. Perennial ryegrass and Kentucky bluegrass were also harvested on May 19, and meadow bromegrass, which had been seeded in August of 1994, was harvested in July and September only.

RESULTS AND DISCUSSION
The distribution of yield of the forage species used in this trial fell into two distinct groups (Table 2). Mean yield of the legumes white clover, birdsfoot trefoil, and cicer milkvetch and the grasses orchardgrass and tall fescue was 12.70 ± 1.29 Mg/ha, more than twice that of perennial ryegrass, Kentucky bluegrass, and meadow bromegrass (5.90 ± 1.82 Mg/ha). About 50% of production occurred in June, and the balance was nearly equally distributed in July and September. Perennial ryegrass and Kentucky bluegrass matured earlier and thus were harvested earlier in the spring, and the yield of these grasses was equally distributed from spring through fall. The yield of alfalfa was approximately 50% greater than that of the group of higher-yielding forages, and was equally distributed throughout the season.

Season-long yields in this trial were high relative to values reported from the humid eastern U.S. In an Iowa study, Kephart et al. (1990) reported yields of approximately 11.25 Mg/ha for 'Apollo II' and 'Spredor 2' alfalfa, 8.33 for 'Viking' birdsfoot trefoil, and 6.80 for 'Lutana' and 'Monarch' cicer milkvetch. This compares with 18.28, 12.13, and 10.83 for the same species in our study. In a southern Idaho study, mean annual yield over 7 y for 'Ranger' alfalfa was 19.41 Mg/ha, similar to our results. Yield of all legumes decreased from spring through late summer in the Iowa study, whereas in our study, the yield of alfalfa was constant for all harvests. In a yield trial in Wisconsin, Casler and Drolsom (1984) reported mean yields for orchardgrass and tall fescue breeding lines of 6.88 and 8.22 Mg/ha respectively, compared with yields of 14.22 and 13.31 Mg/ha for these species in our study.

In a Kentucky study, Collins (1991) reported yields in the year after seeding 'Ensilo', a diploid, and 'Reveille', a tetraploid perennial ryegrass, of 4.29 and 4.63 Mg/ha. In our study, 'Zero Nui', a tetraploid, yielded 7.84 kg/ha, also in the first year after seeding. In a study of 'Regar' meadow bromegrass conducted at Montana State University, Hall and Weisner (1990) reported mean yields of 4.40 Mg/ha for 10 seed lots in the year of planting. In our trial, meadow bromegrass yielded 5.61 Mg/ha in the year after seeding.

In our study, crude protein of the higher-yielding grass species (orchardgrass and tall fescue) was lower in the spring (112 ± 15 g/kg) than in summer and fall (157 ± 13 g/kg), and lower than that of all legumes throughout the growing season (199 ± 18 g/kg). The crude protein content of Kentucky bluegrass was as low as that of the higher-yielding grasses in May and June, and remained low through fall. However, the crude protein content of both perennial ryegrass and meadow bromegrass was similar to that of the legumes at the late-July harvest date. Collins (1991) reported a comparable mean crude protein value for the tetraploid perennial ryegrass 'Reveille'.

Neutral detergent fiber (NDF) of the higher-yielding forage grasses (548 ± 42 g/kg) was higher than mean NDF of the legumes throughout the growing season (385 ± 32 g/kg). Our season-long mean NDF values were similar to those of Kephart et al. (1990) for birdsfoot trefoil, lower than for alfalfa and considerably higher than for cicer milkvetch grown in Iowa, and lower than for perennial ryegrass as reported by Collins (1991).

In June, the acid detergent fiber (ADF) of perennial ryegrass was comparable to that of the legumes, including alfalfa (291 ± 10 g/kg), while the ADF of orchardgrass, tall fescue, and Kentucky bluegrass was higher (352 ± 28). The ADF of tall fescue and orchardgrass decreased from June through September, while that of perennial ryegrass, meadow bromegrass, and alfalfa remained constant,

resulting in similar values for all forages at the September harvest. The ADF values reported for legumes by Kephart et al. (1990) were one-quarter to one-third less than our values for the same legumes.

Crude protein values reported for mixed grass pastures throughout the growing season in Maine, Vermont, New Hampshire, New York, and West Virginia (Rayburn, 1994) were higher than in our trial, but crude protein values for mixed legume pastures were roughly comparable to our legume values, as were NDF and ADF values for both grass and legume pastures. This suggests that rotational stocking management could increase the protein content of forage grasses in the Intermountain West.

REFERENCES

Bateman, G. Q. and W. Keller. 1956. Grass-legume mixtures on irrigated pastures for dairy cattle. Utah Agric. Exp. Stn. Bull. 382.

Casler, M. D. and P. N. Drolsom. 1984. Yield testing cool-season forage grasses in pure stands vs. binary mixtures with alfalfa. Crop Sci. **24:** 453-456.

Collins, M. 1991. Nitrogen effects on yield and forage quality of perennial ryegrass and tall fescue. Agron. J. **83:** 588-595.

Hall, R. D. and L. E. Wiesner. 1990. Relationship between seed vigor tests and field performance of 'Regar' meadow bromegrass. Crop Sci. **30:** 967-970.

Kephart, K. D., L. G. Higley, D. R. Buxton and L. P. Pedigo. 1990. Cicer milkvetch forage yield, quality, and acceptability to insects. Agron. J. **82:** 477-483.

Parker, W. J., L. D. Muller and D. R. Buckmaster. 1992. Management and economic implications of intensive grazing on dairy farms in the northeastern states. J. Dairy Sci. **75:** 2587-2597.

Parker, W. J., L. D. Muller, S. T. Fales and W. T. McSweeny. 1991. Farm survey of pasture and confined feeding systems for dairy cows in Pennsylvania. J. Dairy Sci. **74:** (Suppl. 1) 314 (Abstract).

Rayburn, E. B. 1984. Forage quality of intensive rotationally grazed pastures, 1988-1990. West Virginia Univ. Extension Service.

Rotz, C. A. and J. R. Rod. 1994. A comparison of grazing and combined feeding systems on a Pennsylvania dairy farm. Amer. Forage and Grassl. Cong., Proc.

Table 1
Forage cultivars, seeding rates and seeding dates

Forage Species	Cultivar	Seeding Rate (Kg/ha PLS)	Seeding Date
Alfalfa (*Medicago sativa* L.)	DK 122	18.7	August 1992
White Clover (*Trifolium repens* var. *giganteum* L.	Ladino type[z]	6.2	April 1993
Birdsfoot Trefoil (*Lotus corniculatus* L.)	Empire type[z]	7.1	August 1992
Cicer Milkvetch (*Astragalus cicer* L.)	Monarch	17.8	August 1992
Orchardgrass (*Dactylis glomerata* L.)	Potomac	5.4	August 1992
Tall Fescue (*Festuca arundinacea* Schreb.)	Fawn	8.3	August 1992
Perennial Ryegrass (*Lolium pereene* L.)	Zero Nui	28.0	August 1994
Kentucky Bluegrass (*Poa pratensis* L.)	Troy	6.6	August 1992
Meadow Bromegrass (*Bromus riparius* Rehm.)	Regar	7.8	August 1994

[z] Certified seed, no cultivar specified

Table 2
Seasonal distribution of forage yield and quality parameters

Yield, Mg/ha ± Std. Dev.	**Mid-May**	**Mid-June**	**Late July**	**Mid-Sept.**	**Sum**
Alfalfa		5.71±0.64	6.41±0.63	6.06±0.72	18.18
White Clover		5.75±0.57	3.81±0.31	3.47±0.45	13.03
Birdsfoot Trefoil		6.47±0.60	3.42±0.17	2.24±0.29	12.13
Cicer Milkvetch		5.71±0.81	3.01±0.31	2.11±0.27	10.83
Orchardgrass		7.08±1.33	3.96±1.84	3.18±0.40	14.22
Tall Fescue		8.27±1.09	2.50±0.48	2.54±0.13	13.31
Perennial Ryegrass	2.02±0.43	1.29±0.28	1.54±0.15	2.99±1.26	7.84
Meadow Bromegrass			1.72±0.04	3.89±0.20	5.61
Kentucky Bluegrass	0.91±0.37	0.77±0.32	1.53±0.64	1.04±0.51	4.24
Crude Protein, g/kg					**Mean**
Alfalfa		217	200	209	209
White Clover		173	180	183	179
Birdsfoot Trefoil		185	198	211	198
Cicer Milkvetch		182	226	225	211
Orchardgrass		102	165	171	146
Tall Fescue		123	149	144	139
Perennial Ryegrass	140	126	193	139	150
Meadow Bromegrass			203	173	188
Kentucky Bluegrass	118	114	122	114	117
Neutral Deterent Fiber, g/kg					**Mean**
Alfalfa		401	402	387	396
White Clover		421	366	379	389
Birdsfoot Trefoil		432	393	332	386
Cicer Milkvetch		417	358	337	370
Orchardgrass		575	560	538	558
Tall Fescue		604	532	481	539
Perennial ryegrass	522	424	486	491	480
Meadow Bromegrass			492	516	504
Kentucky Bluegrass	579	522	552	598	563
Acid Detergent Fiber, g/kg					**Mean**
Alfalfa		293	304	289	295
White Clover		284	262	267	271
Birdsfoot Trefoil		303	286	239	276
Cicer Milkvetch		297	245	237	259
Orchardgrass		346	312	293	317
Tall Fescue		382	317	293	330
Perennial Ryegrass	281	277	261	280	275
Meadow Bromegrass			266	289	273
Kentucky Bluegrass	338	327	328	360	338