Alternative Forage Species for the Rogue Valley: 1993-1997 Summary[1]

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Introduction

In southern Oregon, planted forage grass species are traditionally C_3 monocots, (cool-season grasses), such as tall fescue, orchardgrass, ryegrass, bromes, and others. Cool-season grasses typically do not grow well under the hot temperature conditions of mid- to late summer. Thus, grass forage production in southern Oregon typically reaches its maximum in spring and decreases rapidly by mid-summer, especially where irrigation is limited. Recently several new cool-season grass cultivars, legumes, and other species reported to have greater heat and/or drought tolerance have been marketed. In addition, there has been increased interest in recently selected warm-season grass cultivars. This is because warm-season grasses (C_4 plants) typically grow better under hot conditions.

Objective

To evaluate the potential forage yield of non-traditional warm season grasses, cool season grasses, non-grass species, and forage mixtures under southern Oregon conditions.

Approach

Beginning in 1993, a replicated trial with 26 entries was evaluated. Entries 1-16 consisted of pure stands of 4 warm-season grass species and 7 cool-season grass species, with more than one cultivar for some species. Entries 17-18 were pure stands of 2 non-grass species, and entries 19-26 consisted of mixes of either 2 or 3 species, including a legume and a grass (Table 1). Seed was purchased from commercial suppliers in several states.

Materials & Methods

1993

The trial was planted on May 8, 1993, in a randomized complete block design, with four replications. Each individual plot was 28 x 6 feet in size. The experiment was blocked out in such a way that two different irrigation rates could be applied, with half of the plots receiving each rate.

In 1993, plots were irrigated lightly and frequently at first, with irrigation rates and time intervals increasing later in that first season. Irrigation rates by month were as follows: May- 4.6 inches in 4 applications; June- 5.2 inches in 4 applications; July- 4.8 inches in 2 applications; August- 6.4 inches in 2 applications; September- 1.6 inch in 1 application. Yearly totals were 22.6 inches applied in 13 applications. Plots were cut

[1] Brand names of herbicides used in this experiment are mentioned for the convenience of the reader only, and do not imply registration or recommendation for use by the author or Oregon State University.

twice (late July and mid September), but yields were not measured in 1993 (seedling year).

Pure grass plots were sprayed for broadleaf weed control on July 13, using a tank mix of dicamba (Banvel) @ 0.25 lb a.i./ac + 2,4-D @ 1.5 lb ae/ac. The plot area received only light applications of N fertilizer after the two cuttings.

1994

The area was fertilized at the rate of 60-30-30-33 (lb/ac N, P_2O_5, K_2O, S) on March 29. On April 5 and April 11, the pure grass plots were sprayed for broadleaf weed control using a tank mix of dicamba (Banvel) @ 0.25 lb a.i./ac and 2,4-D (Weedar 64) @ 1.0 lb ae/ac. The area was fertilized again on June 3 (after first cutting) at the rate of 63-0-0-72. After the season, on October 6, 1994, the area was fertilized at the rate of 30-60-60-18. Plots were cut for yield on May 18, July 8, and August 31, with sub-samples taken for drying to correct yields for moisture content. Samples were retained for possible future forage quality analysis. However, the warm-season grass species were not cut on May 18 due to their slower spring growth.

1995

On February 28, the area was fertilized at the rate of 84-0-0-96. On April 10, the herbicide Curtail was applied to the pure grass plots only at the rate of 2.0 quart/acre (1.0 lb a.i./ac 2,4-D + 0.19 lb a.i./ac clopyralid). On June 8, 1995 (after first cutting), the area was fertilized at the rate of 63-0-0-72. It was fertilized again on July 26, 1995 (after second cutting) at the rate of 42-0-0-48. Plots were cut for yield on May 23, July 20, and September 14, with sub-samples taken for drying to correct yields for moisture content.

1996

The area was not fertilized prior to or during the 1996 growing season. On April 15, 1996, the herbicide Curtail was applied only to the pure grass plots, at the rate of 2.5 pint/acre (0.625 lb a.e./ac 2,4-D + 0.12 lb a.i./ac clopyralid).

Spring rains were greater than normal and lasted well into June, delaying the time for normal first cutting by nearly a month. Unfortunately, at that time the harvest equipment required extensive repairs, and thus plot yields were not measured for the delayed first cutting. The entire experimental area was cut with a commercial size swather on June 14. Plots were cut for yield on September 6, with sub-samples taken for drying to correct yields for moisture content. However, without the first cutting data the 2^{nd} cutting data was not very useful, and is not reported here.

1997

The area was not fertilized prior to or during the 1997 growing season, and herbicides were not applied during 1997. Plots were cut for yield on May 21, July 17, and September 19, with sub-samples taken for drying to correct yields for moisture content. By this time some of the warm-season grass plots had infestations of neighboring cool-season grasses. These were weeded out where possible. In addition, the warm season grass plots were mowed twice in the early spring of 1997 in a way that retarded the growth of intruding cool-season grass plants without cutting the warm-season grasses (still dormant at those times). If growth in the warm-season grass plots was compromised, yield data was not analyzed for that plot.

Irrigation and precipitation totals for the 1994, 1995, 1996, and 1997 seasons are shown in Table 2.

Results & Discussion

1994

Yield results for the 26 entries are shown in Fig. 1 & 2. Entry 18, Marion lespedeza, had a very poor stand in 1994. It requires annual self-reseeding, and while vegetative growth was moderately acceptable in 1993, seed production was not good. This may have been partially due to the limited time between the last cutting and frost. Therefore, yield results for entry 18 were not considered valid for 1994 or for the remainder of the study, and are reported as zero on the figures.

In general, the warm-season grass yield from the second and third cutting generally made up for the large first cutting of cool-season grasses. While entry 20 (Fawn fescue + Birdsfoot trefoil) had the highest seasonal yield, some of the mixes and especially the warm season-grasses persisted and produced well through the hot weather of the second and third cutting. While no single forage species or mix was the best for all three growth periods, these results suggested that planting different species in different fields could result in a greater and more uniform distribution of forage production throughout the spring and summer.

1995

Yields for the 26 entries are shown in Fig. 3 & 4. By 1995 no evidence of Entry 18 (Marion lespedeza) remained. Plant growth in those plots consisted of weeds only, and was ignored for this report. Likewise, mixes containing Marion lespedeza did not have any lespedeza plants remaining by 1995, and thus that component of the mix did not contribute to yields in 1995 or beyond.

As was observed in 1994, the warm-season grass yield from the second and third cutting generally made up for the large first cutting of cool-season grasses in 1995. Seasonal yield totals were greatest for Matua prairie grass mixed with Kopu white clover (entry 24), Fawn fescue mixed with Puna chicory and Kopu white clover (Entry 22), and the Grange pasture mix (entry 26, including Potomac orchardgrass, perennial ryegrass, and Ladino clover). Several other mixes, cool season grasses, and warm season grasses had yields nearly as high. Some of the mixes and especially the warm season-grasses persisted well through the hot weather of the second and third cutting.

1996

Due to the weather and equipment problems described above, meaningful data analysis was impossible in 1996. However, an interesting observation was made regarding entry 22. This entry was an attempt to mix species that exhibit maximum growth at different times of the year, with Fawn fescue assumed to dominate in the spring and Puna chicory more active in the summer. This mix was fairly successful through

1995, but by 1996 the fescue was clearly crowding out the chicory. This suggests that interplanting two species having widely varying seasonal growth rates may not be sustainable over time.

1997

Yields in 1997 were lower than 1994 and 1995 for all treatments and cuttings (Fig. 5 & 6). This is likely due to the lack of fertilization in 1996 and 1997. While it is clear that lack of fertilization reduces yields, such management is common practice among ranchers in the area. Irrigation + rainfall amounts were similar to those in previous years. As in 1994, the warm season grasses were not included in the first cutting, to allow them to grow more vigorously and be closer to their physiological maturity before they were harvested the first time. The warm season grasses had greater yields from the second and third cutting dates, so that seasonal total yields were similar to those of the cool season grasses. This result is similar to that of 1994, when warm season grasses were also not cut until mid-summer.

Virtually no puna chicory persisted by 1997, either as a single species or in a mix, and any yield from those plots was due to weeds or reseeded grasses, and was ignored. Yield depression in mid-summer was not as severe in some of the mixes as it was for the cool season grasses so that in general they accumulated the highest seasonal total yield (Fig. 6). Entries 20 (tall fescue + birdsfoot trefoil) and 21 (tall fescue + big trefoil) had the highest yields of all entries. Blackwell switchgrass (entry 2) had the highest yield among warm-season grasses, equivalent to the best cool-season grass, but with more yield in mid-summer. In previous years Cave-in Rock switchgrass (entry 3) had the highest yield among warm-season grasses.

Overall

Seasonal totals from 1994, 1995, and 1997 were combined to evaluate the multi-year forage production potential of all the entries (Fig. 7). Entries 20 (tall fescue + birdsfoot trefoil) and 24 (Matua prairie grass + Kopu white clover) were near the top in seasonal yield every year, and had the highest overall yields for the three years of the study. The cumulative seasonal yield totals showed that the warm season grasses were equal to or better than many of the cool season grasses in total yield (Fig. 7). Entries 2 & 3 (both switchgrasses) were consistently among the best of the warm season grasses. Mixing a legume with a cool season grass seemed to enhance yield, however, no mixes using warm season grasses were made.

Yields were greater for every entry in 1995 compared to 1994, sometimes by quite a bit. Yields in 1997 were less than or equal to yields of the other two years for every entry. This may have been due to greater fertilization in 1995 compared to the other two years. Also, the weather in 1995 was generally cooler during the entire season, and was wetter through July than 1994 was, possibly contributing to increased grass forage production, especially for the cool season grasses during middle and late summer.

Relative results between entries may have also differed somewhat between 1995 and the other two years due to a different cutting schedules for the warm season grasses. In 1994 and 1997, the warm season grasses exhibited little growth at the time of the first cutting, and thus those plots were not cut then, but allowed to grow. However, in 1995 there was some growth in the warm season grasses by May, and thus they were harvested at the first cutting. While this produced measurable forage for 1995's first cutting, it may have also reduced later warm season grass biomass production by cutting and thus removing leaf area just at the time they were beginning to grow rapidly. While this resulted in greater seasonal yield in 1995, other factors such as fertilization differences may have confounded this result. The persistence and vigor of the warm season grasses was observed to decrease after 1995, but results from this study cannot determine the exact reason for the relative yield reductions in 1997 compared to earlier years, especially for the warm season grass entries, and whether or not the early first cutting in 1995 contributed to the decreased stand vigor observed in the warm season entries by 1997.

In addition, plot size may have affected the results. Due the relatively small plots, seedlings from cool season grasses did become established in some warm season grass plots towards the end of the trial. While this effect was lessened by weeding and targeted early spring cutting in these plots, some data had to be discarded, and the effect of the seedlings on later warm season grass growth is unknown. Also, the plot size seemed to have an observable effect on the growth and yield of entry 1 (eastern gamagrass). The plants in these plots were much smaller than the gamagrass in another field where we planted the leftover seed from this trial in a large single block. By 1996, the difference in size was very obvious. However, the large gamagrass block was also managed somewhat differently, with only one or two cuttings taken per year. The reduced cutting schedule in the large block may have affected its growth pattern, allowing the plants to become larger and more vigorous over time. In the future, this type of trial should employ larger plots, possibly including herbicide strip borders, to lessen interplot and border growth effects.

Conclusions

In any given year, no single forage species or mix was the best for all three growth periods (spring, mid-summer, late summer). However, these results indicate that different species planted in different fields may result in a more uniform distribution of forage production throughout the spring and summer. Utilizing the different growth habits of different species in this way would be best suited to a rotational grazing or haying situation.

Future studies could include plantings of warm-season grasses mixed with legumes, to determine whether forage quality and yield could thus be improved. This idea has not been greatly studied. Preliminary results using Fawn fescue and Puna chicory suggest that mixing species with widely varying seasonal growth rates could result in a more uniformly high yield production, but that both may not persist well in a mixed planting. If so, dramatically different species such as warm and cool season grasses may produce better when planted and managed in separate areas. However, this study did not directly examine cool and warm season grasses grown together, and a more definitive answer to the question of mixed species plantings requires further study.

Seed Sources

Seed for this experiment was either donated or purchased from the following sources (Table 3). We appreciate the companies who donated seed in support of this research. Whether seed was purchased or donated, representatives of each company provided valuable insight into the management requirements of their seed/crop.

Table 1. Entries in alternative forage species trial. Southern Oregon Research and Extension Center, Medford, OR.

Entry No.	Species	Cultivar
1	Eastern Gamagrass, *Tripsacum dactyloides*	PMK-24
2	Switchgrass, *Panicum virgatum*	Blackwell
3	Switchgrass, *Panicum virgatum*	Cave in Rock
4	Switchgrass, *Panicum virgatum*	Alamo
5	Big Bluestem, *Andropogon gerardi*	Champ
6	Big Bluestem, *Andropogon gerardi*	Kaw
7	Indiangrass, *Sorghastrum nutans*	Oto
8	Indiangrass, *Sorghastrum nutans*	Cheyenne
9	Prairiegrass, *Bromus wildenowii* Kunth.	Matua
10	Rescuegrass, *Bromus catharticus*	(common)
11	Intermediate Wheatgrass, *Agropyron intermedium*	Oahe
12	Pubescent Wheatgrass, *Agropyron trichophorum*	Luna
13	Orchardgrass, *Dactylis glomerata*	Potomac
14	Tall Fescue, *Festuca arundinacea*	Fawn
15	Perennial Ryegrass, *Lolium perenne*	(tetraploid, common)
16	Perennial Ryegrass, *Lolium perenne*	Greenstone
17	Chicory, *Chicorium intybus*	Puna
18	Lespedeza, *Lespedeza striata*	Marion
19	Tall Fescue, *Festuca arundinacea*	Fawn
	+ White Clover, *Trifolium repens*	Kopu
20	Tall Fescue, *Festuca arundinacea*	Fawn
	+ Birdsfoot Trefoil, *Lotus corniculatus*	(common)
21	Tall Fescue, *Festuca arundinacea*	Fawn
	+ Big Trefoil, *Lotus corniculatus arvensis*	Maku
22	Tall Fescue, *Festuca arundinacea*	Fawn
	+ Chicory, *Chicorium intybus*	Puna
	+ White Clover, *Trifolium repens*	Kopu
23	Tall Fescue, *Festuca arundinacea*	Fawn
	+ Lespedeza, *Lespedeza striata*	Marion
24	Prairiegrass, *Bromus wildenowii* Kunth.	Matua
	+ White Clover, *Trifolium repens*	Kopu
25	Orchardgrass, *Dactylis glomerata*	Potomac
	+ Lespedeza, *Lespedeza striata*	Marion
26	[Grange Co-op Pasture Mix]	
	Orchardgrass, *Dactylis glomerata*	Potomac
	+ Perennial Ryegrass, *Lolium perenne*	(tetraploid, common)
	+ Ladino Clover, *Trifolium repens latum*	(common)

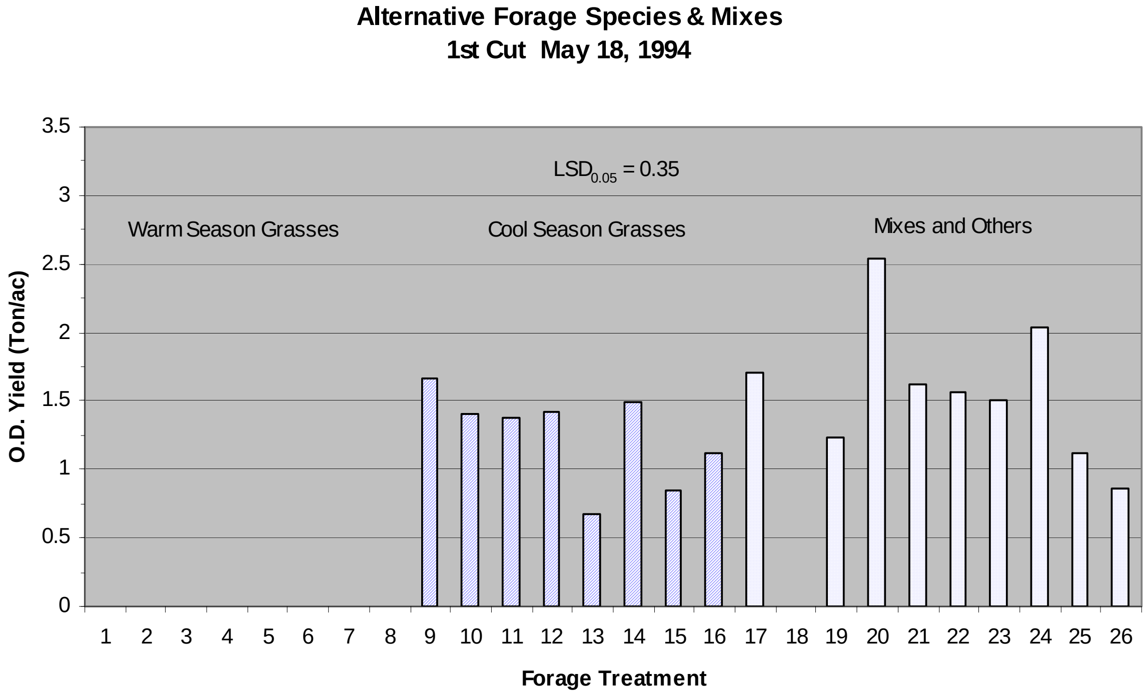
Table 2. Alternative Forage Species Variety Trial Irrigation and Precipitation, 1994-1997. Southern Oregon Research and Extension Center, Medford, OR.

Interval	Precipitation (in)	Irrigation (in)	Applications
1994			
April 1 - 1st Cut	2.55	0	0
1st Cut - 2nd Cut	0.36	12	7
2nd Cut - 3rd Cut	0	6.4	2
3rd Cut - 1st Frost (Oct.16)	0.64	7.2	2
1994 Total	3.55	25.6	11
1995			
April 1 - 1st Cut	4.57	0	0
1st Cut - 2nd Cut	2.35	7.3	2
2nd Cut - 3rd Cut	0.02	8	2
3rd Cut - 1st Frost (Oct. 22)	0.26	0	0
1995 Total	7.2	15.3	4
1996			
April 1 - 1st Cut	4.17	0	0
1st Cut - 2nd Cut	0.22	16	4
2nd Cut - 1st Frost (Oct. 21)	0.87	4	1
1996 Total	5.26	20	5
1997			
April 1 - 1st Cut	2.49	0	0
1st Cut - 2nd Cut	2.78	6.4	2
2nd Cut - 3rd Cut	2.1	9.6	2
3rd Cut - 1st Frost (Oct. 25)	1.63	0	0
1997 Total	9	16	4

Table 3. Sources of seed used in alternative forage variety trial, Southern Oregon Research and Extension Center, Medford, OR.

Species	Cultivar	Source
Donated		
Switchgrass	Blackwell	Bamert Seed Co., Muleshoe, TX
	Alamo	Bamert Seed Co., Muleshoe, TX
	Cave-in Rock	Bamert Seed Co., Muleshoe, TX
Big Bluestem	Champ	Bamert Seed Co., Muleshoe, TX
	Kaw	Bamert Seed Co., Muleshoe, TX
Indiangrass	Oto	Bamert Seed Co., Muleshoe, TX
	Cheyenne	Bamert Seed Co., Muleshoe, TX
Prairiegrass	Matua	Modern Forage Systems, Ferndale, WA
Rescuegrass	(common)	Collected locally
Perennial Ryegrass	Greenstone	Modern Forage Systems, Ferndale, WA
Chicory	Puna	Burlingham & Sons Seed Co., WA
Lespedeza	Marion	Hartzler's Seed Co., Harrisonville, MO
White Clover	Kopu	Burlingham & Sons Seed Co., WA
Big Trefoil	Maku	Modern Forage Systems, Ferndale, WA
Purchased		
Eastern Gamagrass	PMK-24	Shepard Farms, Clifton Hill, MO
Intermed. Wheatgrass	Oahe	Ramsey Seed Inc., Manteca, CA (purchased locally)
Pubescent Wheatgrass	Luna	Ramsey Seed Inc., Manteca, CA (purchased locally)
Orchardgrass	Potomac	Purchased locally
Tall Fescue	Fawn	Purchased locally
Perennial Ryegrass	(tetraploid, common)	Purchased locally
Birdsfoot Trefoil	(common)	Purchased locally
Ladino Clover	(common)	Purchased locally

Fig. 1. Alternative Forages Yield, 1st & 2nd Cutting, 1994. Southern Oregon Research and Extension Center, Medford, OR.



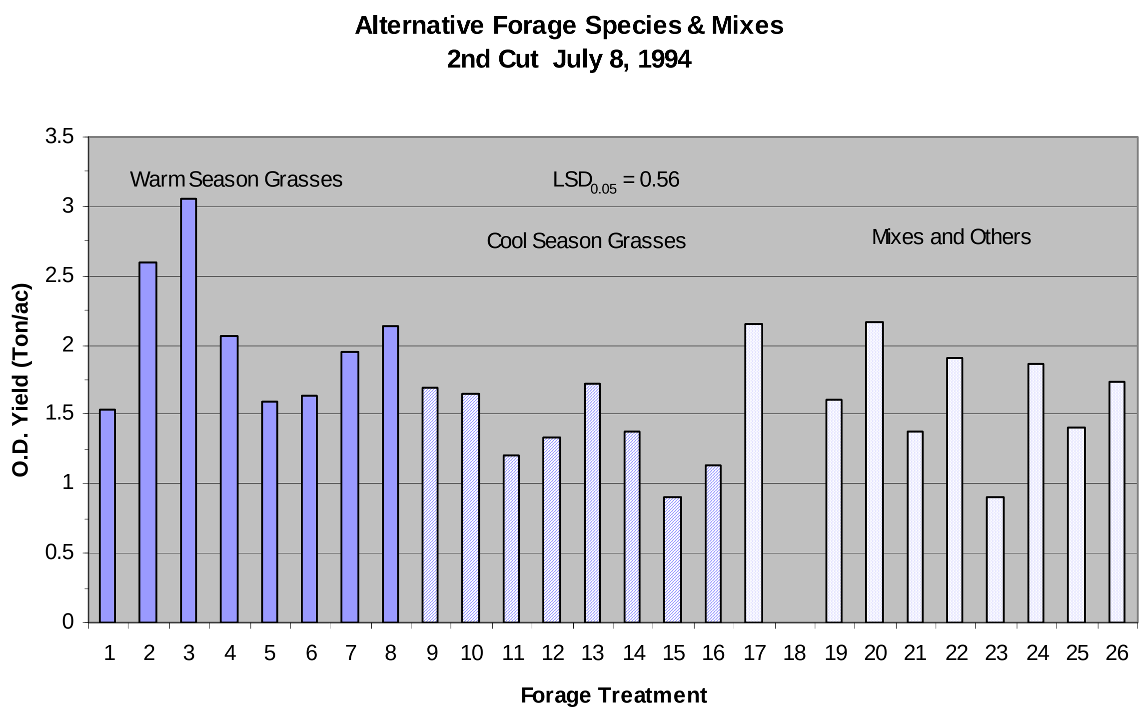
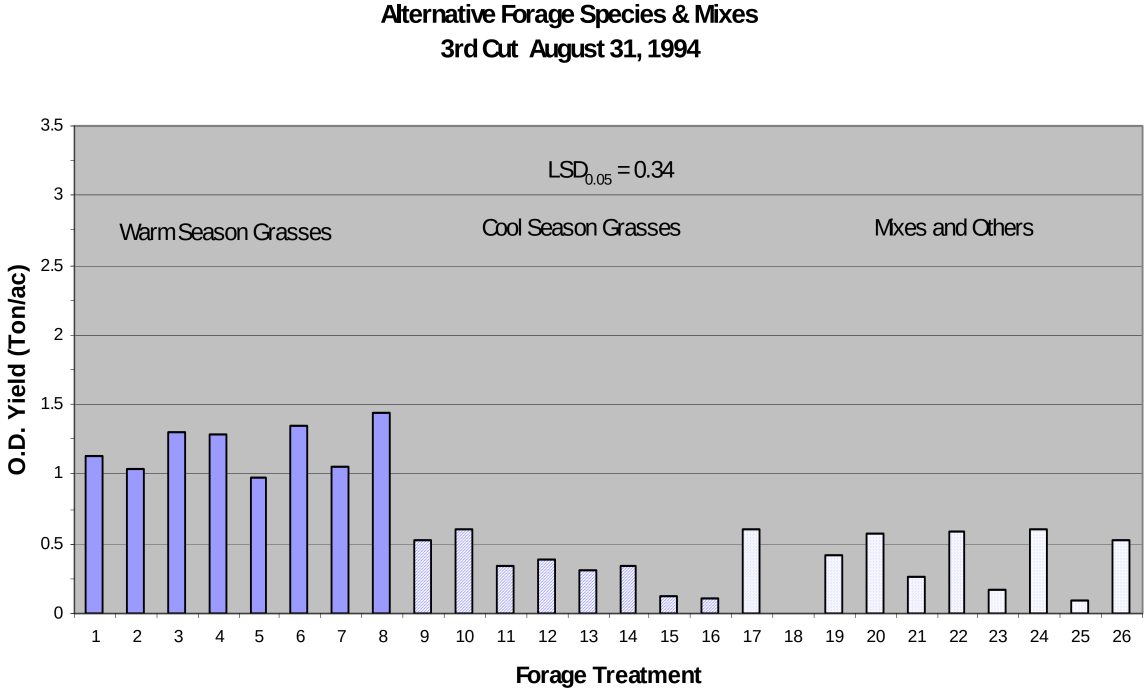


Fig. 2. Alternative Forages Yield, 3rd Cutting and Annual Total, 1994. Southern Oregon Research and Extension Center, Medford, OR.



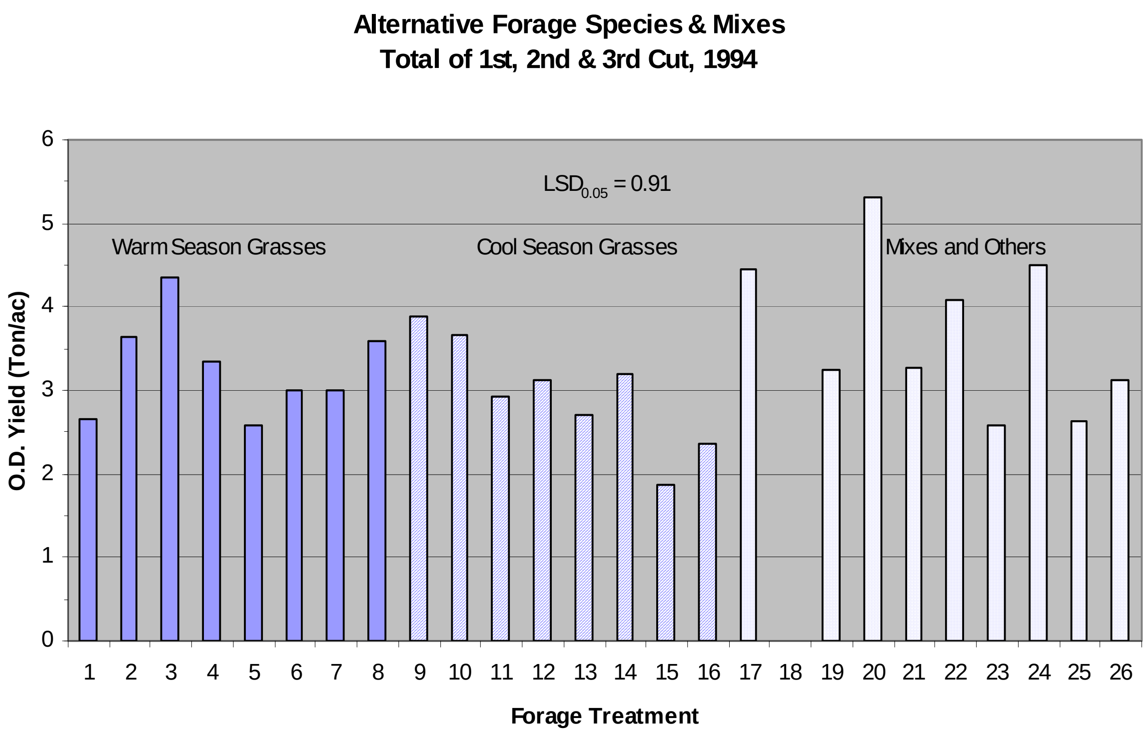
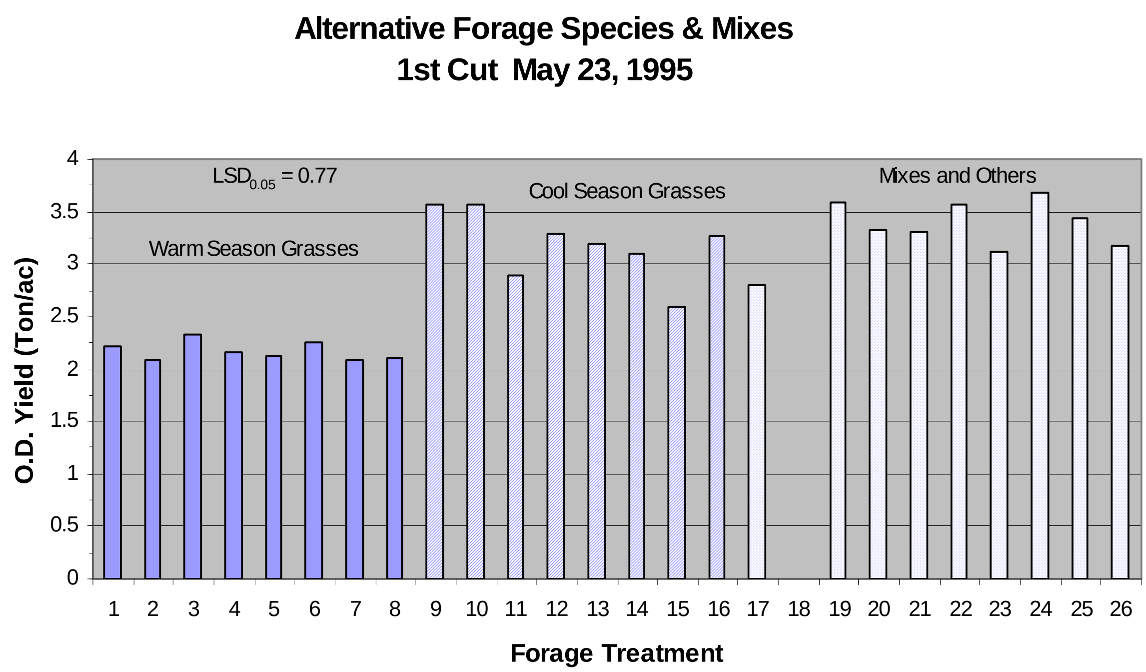


Fig. 3. Alternative Forages Yield, 1st & 2nd Cutting, 1995. Southern Oregon Research and Extension Center, Medford, OR.



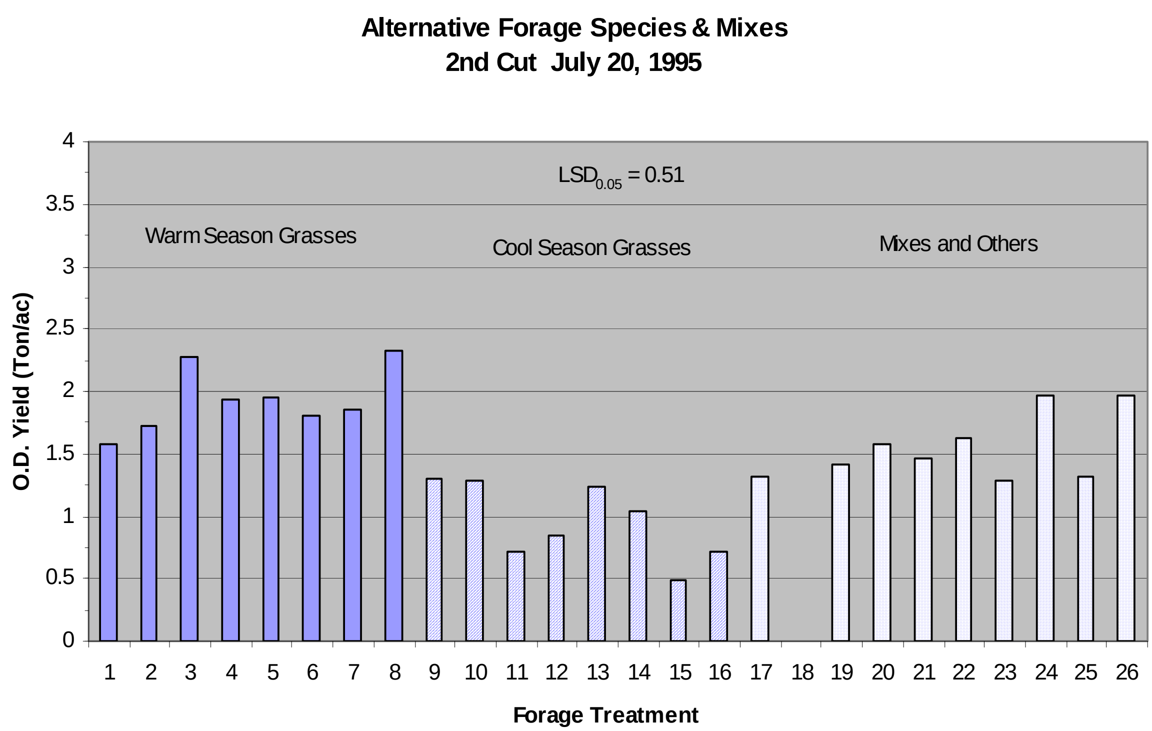
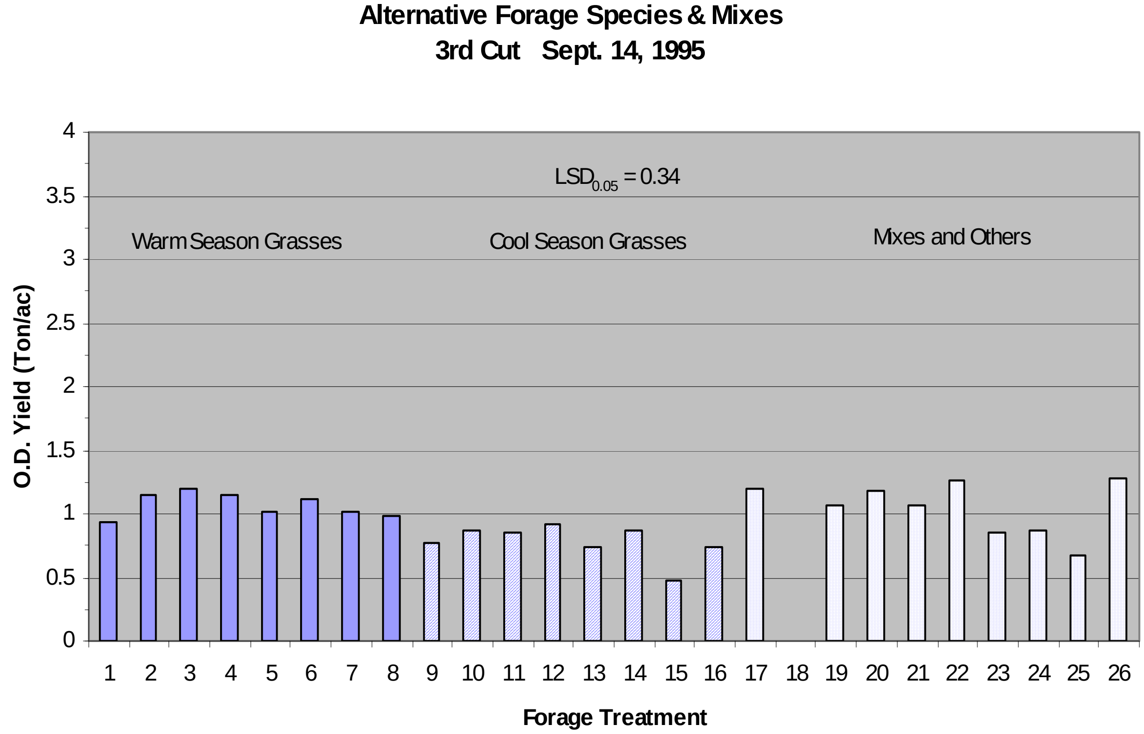


Fig. 4. Alternative Forages Yield, 3rd Cutting and Annual Total, 1995. Southern Oregon Research and extension Center, Medford, OR.



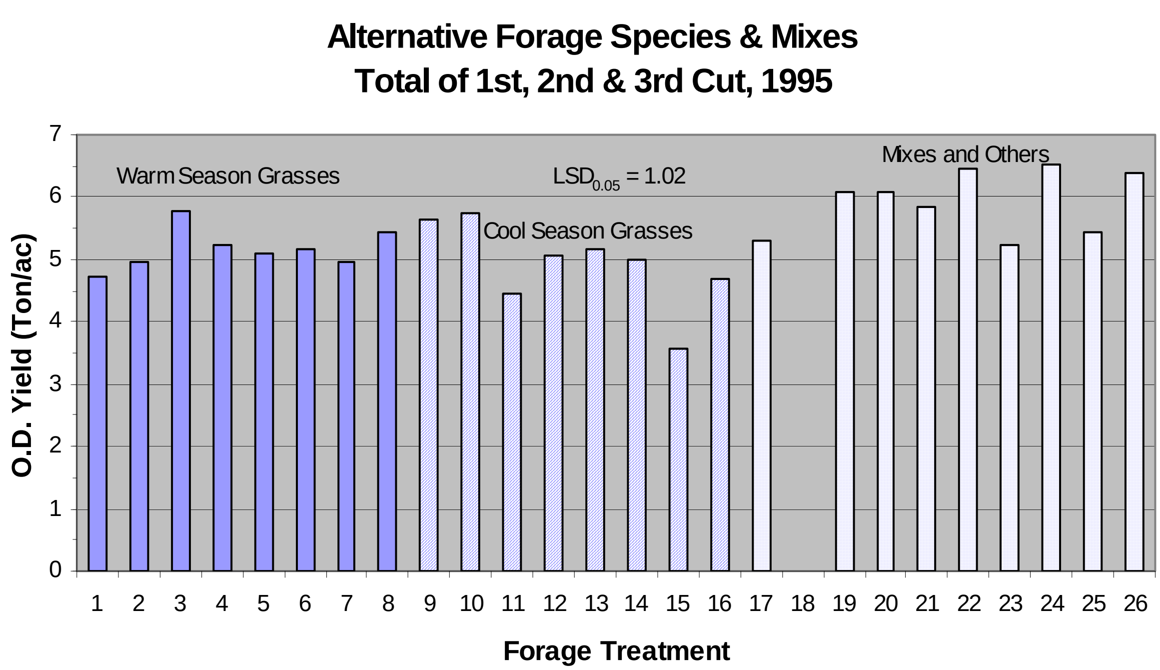
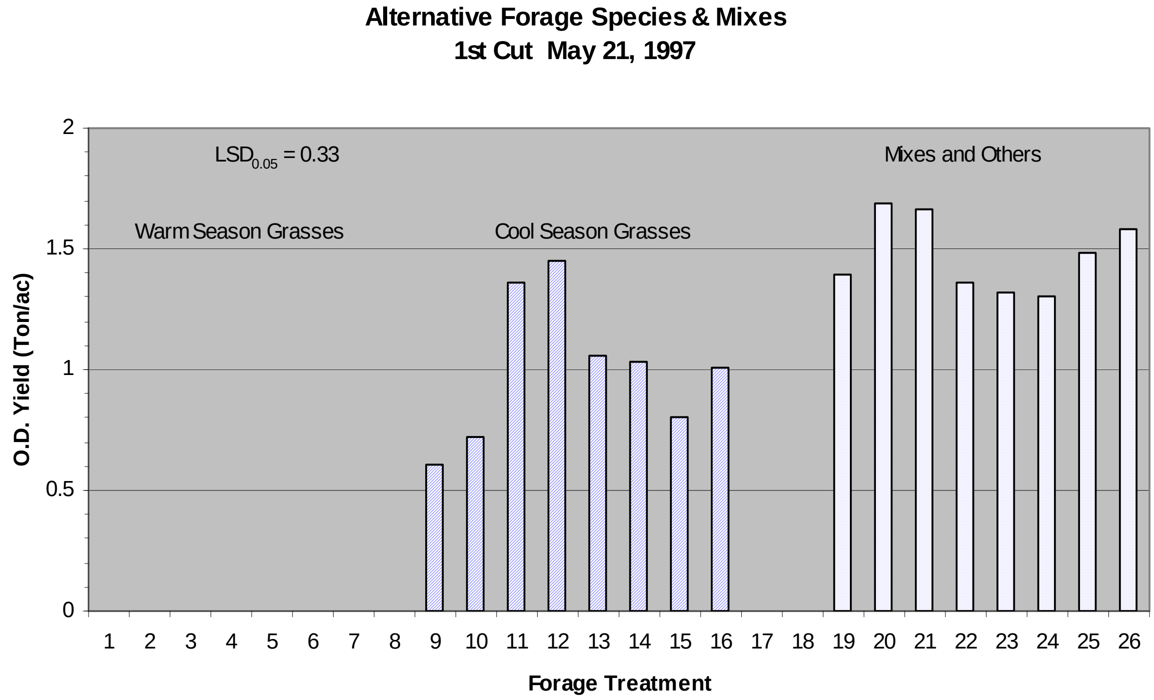


Fig. 5. Alternative Forages Yield, 1st & 2nd Cutting, 1997. Southern Oregon Research and Extension Center, Medford, OR.



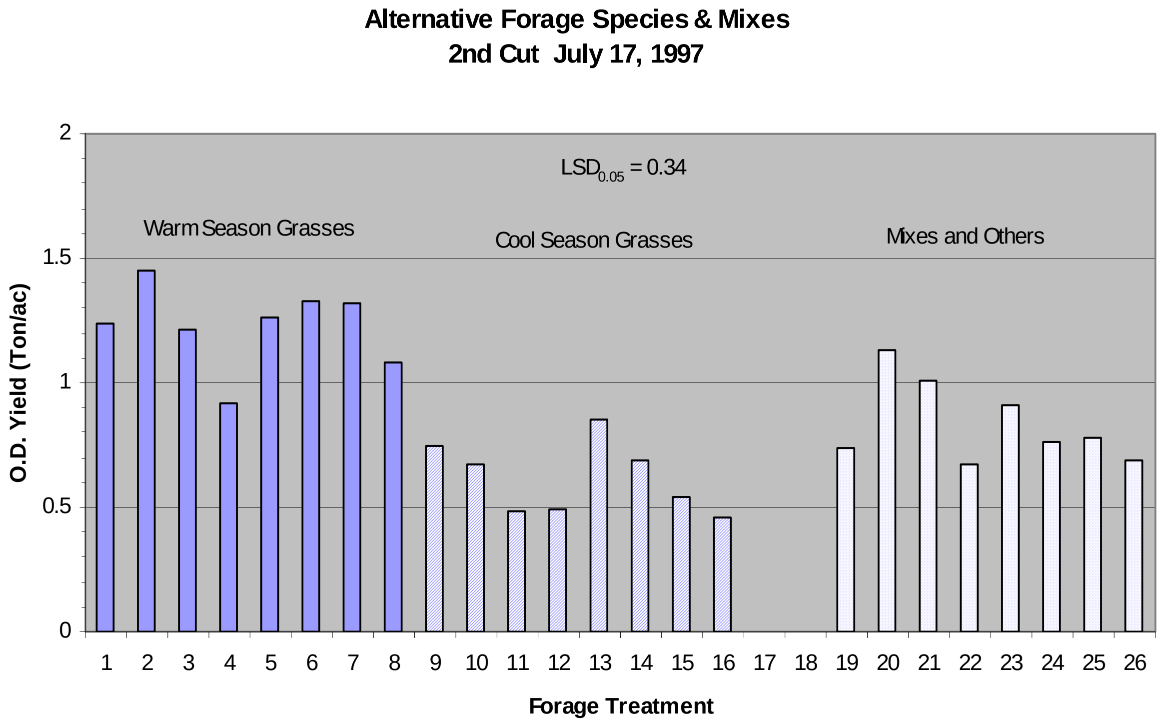
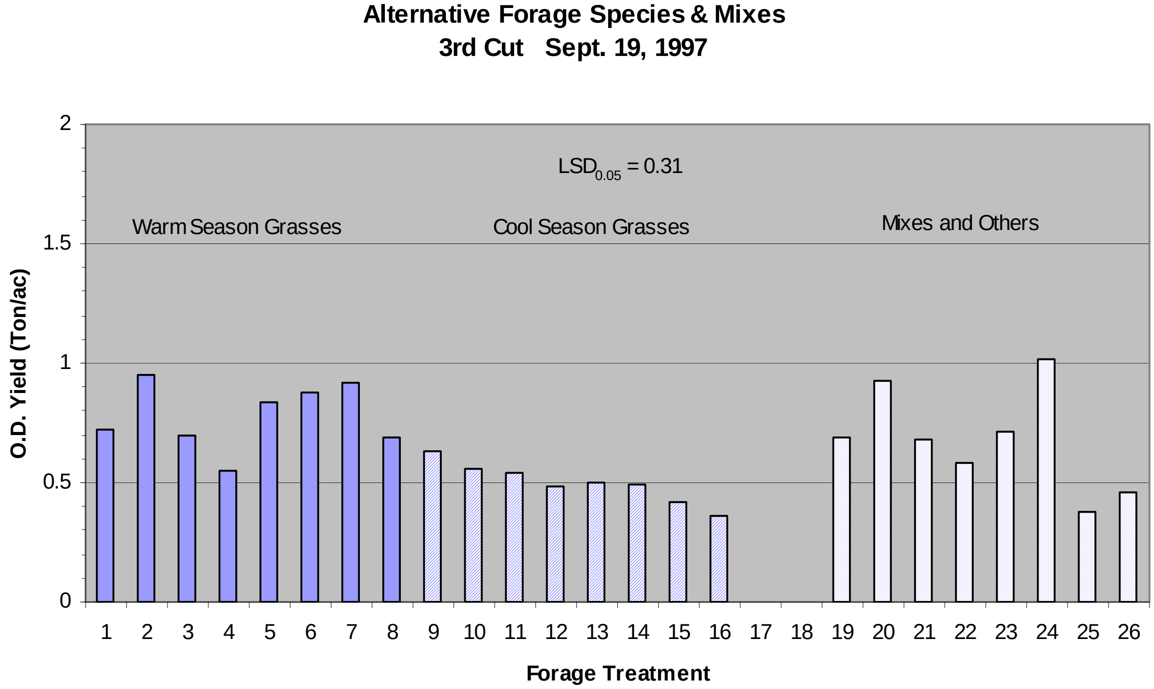


Fig. 6. Alternative Forages Yield, 3rd Cutting and Annual Total, 1997. Southern Oregon Research and Extension Center, Medford, OR.



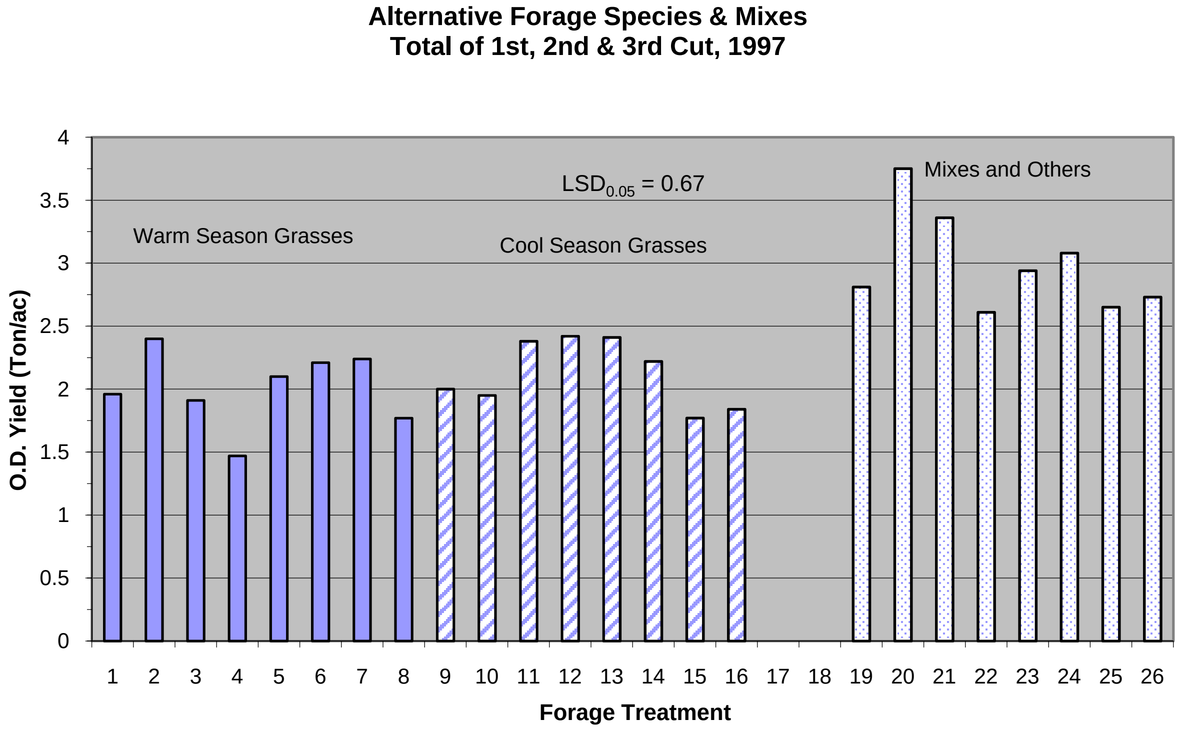


Fig. 7. Alternative Forages, 1994, 1995, & 1997, Annual Yield Totals. Southern Oregon Research and Extension Center, Medford, OR.