

RANGE SCIENCE REPORT

Agricultural Experiment Station

Cooperative Extension

No. 20

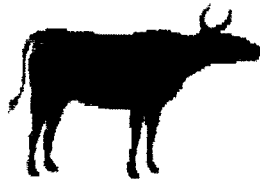
November 1988

LONG-TERM TESTING OF RANGE FORAGE IN MODOC COUNTY 1/

Burgess L. Kay 2/

Abstract

Range seeding plants were tested on the Likely Table of Modoc County from 1954 to 1988 in both small plots and pasture size seedings. Outstanding were Greenar, Amur, and Oahe intermediate wheatgrasses. Legumes have not persisted, but winter hardy alfalfas were productive for a few years if fenced. The performance of many species in small plots is discussed. Both Greenar intermediate wheatgrass and Topar pubescent wheatgrass have performed well for a long time in large pastures, and have generally suppressed cheatgrass. Big bluegrass was often the highest yielding grass, but has unsolved grazing management limitations. Brush invasion has been minimal, but will eventually be a problem.



Introduction

There are approximately five million acres of sagebrush in California. While much of this area is too rocky or steep for range seeding, there are areas that can be converted to excellent dryland pastures. Also, seeding to forage varieties may be a logical alternative for abandoned or unproductive grain farms

Following sagebrush removal, control of resident annual weeds, and minimal cultivation, it is possible to establish adapted forage varieties by carefully placing quality seed at the proper depth with a drill. Cheatgrass will naturally follow sagebrush removal, if more desirable species are not established. Cheatgrass is a relatively unreliable source of forage (Kay, 1966).

The choice of plant variety depends on seed availability and potential forage production. Suitability as a forage plant is determined by adaptability, palatability, length of growing period, and sensitivity to grazing management as well as the total amount of dry-matter produced.

This paper reports on the success of many forage plants tested in the 1954-1988 period, both in small plots and observations on long-term pastures.

Methods

These studies began in 1954, and were conducted on the "Likely Table", 2 miles NE of the town of Likely, California. At that time this relatively flat basaltic area was growing big sagebrush with an understory of cheatgrass, red-stem filaree (*Erodium cicutarium*), and Sandberg bluegrass (*Poa secunda*). Occasionally mustard (*Descurainia pinnata* or *Sisymbrium altissimum*) is important.

Total soil depth averages 10 to 20 inches, and is gravelly loam over clay, superimposed on a cemented layer on basalt bedrock. Annual precipitation averages 10 inches, with seasonal totals varying widely (Table 3). The elevation is 4,500 feet, and the growing season short and variable. Livestock use is generally is from April 15 to June 15. Deer and pronghorn antelope may use the area all year.

1/ This research was cooperative with Modoc County Farm Advisors and ranchers Warren, Rob, and Don Flournoy of Likely, California.

2/ Wildland Seeding Specialist, Department of Agronomy and Range Science, University of California, Davis 95616.

Table 1. Dry matter production of seeded perennial grasses (lb/ac).

	First experiment								Second experiment								13-14 yr mean
	1957	1958	1959	1960	1961	1962	1963	mean	1964	1965	1966	1967	1968	1969	1970	mean	
<i>Agropyron cristatum</i> - Fairway crested wheatgrass																	
Commercial F.C. 32032	1000	170	240	410	170	640	460	350									
ALT70		260	280	400	240	780	570	420									
<i>A. carvifolium</i>									2630	1000	190	740	340	640	520	870	
<i>A. dasystachyum</i> - Thickspike wheatgrass									2110	1160	130	570	300	520	500	760	
<i>A. desertorum</i> - Standard crested wheatgrass																	
Commercial - UC purchase	980	360	360	520	280	840	620	500									
Commercial F.C. 32658	1490	430	250	370	220	750	520	420									
Nebraska 10		410	350	490	330	900	610	510									
Nordan	1550	400	280	480	280	780	580	470	3220	1400	150	1020	340	600	490	1030	750
<i>A. elongatum</i> - Tall wheatgrass																	
Alkar									1800	1120	70	610	230	400	450	670	
Commercial	1350	440	340	220	220	520	300	340									
Largo		400	350	250	230	490		340									
Nebraska 98526		360	280	200	230	590	200	310									
<i>A. inerme</i> - Whitmar beardless wheatgrass									2210	1070	140	950	340	500	370	600	
<i>A. intermedium</i> - Intermediate wheatgrass																	
A-12496									2770	1540	200	850	390	580	600	990	
Amur	1600	320	310	380	310	940	460	450	2280	1000	90	620	360	610	460	770	
Commercial	1240	380	280	320	240	690	360	380									
Tecmar Dwarf intermediate									2210	970	60	450	170	370	320	650	
Greenar	1180	520	290	300	220	640	440	400	2130	1240	170	710	350	590	570	820	
Oshe (Ree 1957-1963)		550	320	500	330	1140	680	590	2800	1880	200	940	460	780	650	1100	
<i>A. riparium</i> - Sodar streambank wheatgrass									1240	1040	80	430	210	400	230	520	
<i>A. sibiricum</i> - Siberian wheatgrass																	
Siberian 2516									2130	1160	170	730	270	560	450	780	
Siberian P-27									2740	1070	130	750	290	580	460	860	
<i>A. smithii</i> - Western wheatgrass																	
F.C. 32219		100	290	330	230	590	400	320	2170	1000	90	590	320	540	340	720	
F-727									2260	810	70	500	250	520	350	680	
F-14897																	
<i>A. spicatum</i> - Bluebunch wheatgrass P-739									2170	1160	120	640	290	310	230	700	
<i>A. subsecundum</i> - Bearded wheatgrass																	
2492									1790	660	80	310	110	180	190	470	
P-9115									2830	1240	130	920	300	580	320	900	
<i>A. trachycaulum</i> - Slender wheatgrass																	
Commercial	1110	80	140	90	140	630		180	2870	1000	100	390	210	240	250	720	
Davis slender wheatgrass T.O. 2800																	
<i>A. tricophorum</i> - Pubescent wheatgrass																	
Commercial	1170	270	330	480	260	760	650	460	2260	1400	140	830	320	480	480	840	
Luna																	
Mandan 759	1820	350	270	360	190	770	460	400									
Topar	1060	340	290	480	200	720	560	430	1320	1140	90	650	250	480	560	640	
Trigo	1490	420	300	480	230	570	600	430	1780	160	1210	430	900	830	860	660	
<i>Bromus inermis</i> - Manchur smooth brome	820	190	140	110	30												
<i>Elymus cinereus</i> - Basin wildrye									1530	1620	250	1300	340	110	350	790	
<i>E. juncoeus</i> - Vinnal Russian wildrye									1520	710	110	420	180	300	210	490	
<i>Festuca ovina</i> var. <i>chariuscula</i> - Durar hard fescue									2390	1260	200	680	540	700	680	920	
<i>Poa ampla</i> - Big bluegrass																	
Albion	1650	260	280	280	360	790	690	620	3650	1020	200	740	350	640	460	1010	
Sherman	1770	400	830	450	570	1230	650	690	2950	2020	270	910	700	800	560	1170	
<i>P. bulbosa</i> - Bulbous bluegrass									870	570			390	50	120	150	
<i>P. canbyi</i> - Canbar Canby bluegrass P-851									790		60	170	170	210	230		

Cheatgrass may germinate as early as October or as late as March, but is seldom tall enough to graze before May. In a warm-wet season, growth may start as early as February. The annual grass matures about the first week of June and is dry by the end of June.

Early experiments needed plowing to kill the sagebrush. The required heavy equipment was slow, and resulted in damage to the cultivation tools. The larger general area was cleared of sagebrush by control burning in the fall of 1957, making it possible to cultivate with available grain-farming equipment. Damage was also less because the rocks were more visible and could be avoided. Most cultivation was in the early spring in hopes of killing the already germinated cheatgrass.

Larger seedings were always with some type of planter-drill (rangeland drill or grain drill) which placed the seed in the soil at the appropriate depth. Smaller plots such as the variety trials were hand-planted in rows, but the seed was always covered with soil.

Variety trials were either 4 or 5 rows, 22 or 24 inches apart, and 16 feet long, with each forage variety replicated 3 or 4 times. Sampling usually involved clipping two of the center rows to a 2-inch height near the end of the growing season (after flower stalks were produced). Two of the trials reported here were clipped for seven years each. Observations continued for many years, recording stand survival by expressing them on a scale of 1-10, with ten being a complete row, and one being no plants left.

Larger trials vary from a few drill widths to pasture size seedings, including a 400 acre seeding of Greenar intermediate wheatgrass* seeded in 1958, and 400 acres of Topar pubescent wheatgrass seeded in 1963. These larger pastures were sampled periodically through 1988, and included point-step samples for species composition and ground cover, and a stocking method of 400 square-foot frames to measure plant distribution.

Results and Discussion

Nursery trials:

Perennial grasses, especially wheatgrasses, were the most consistently successful as illustrated by the results of the nurseries established in 1956 and 1963 (Table 1.). Highest yielding, but only available for the second test, was Oahe intermediate wheatgrass. Also consistently good in both tests were Greenar and Amur intermediate wheatgrasses, and Nordan crested wheatgrass. Similarly productive, but more rhizomatous and inclined to be "sod bound" are the pubescent wheatgrasses Topar, Luna, and Trigo.

* See table 1 for scientific names of forage species.

Big bluegrass was the highest yielding of the perennial grasses, including both varieties tested (Sherman and Albion). However, this species can be difficult to establish because of its very small seed. More important, it has a reputation of being very difficult to manage in that the cows will pull it out. We confirmed this reputation by deferring grazing on part of a stand for several years. Planted in 1963, the cows showed no inclination to damage the grass when grazed in 1964-1967. The fence was removed after grazing in 1967. The following year the cows pulled up most of the plants in both areas, generally spitting them out rather than eating them.

Persistence over long periods of time, including a variety of rainfall and grazing conditions, is important. Many of the plants in the 1963 nursery are still present in excellent numbers (Table 2). All of the wheatgrasses mentioned above as being productive are still among the best survivors. Also surviving well is Whitmar beardless wheatgrass, but would not be a good forage choice at this location because it appears to be completely unpalatable. Western wheatgrasses are also surviving well, but appear unproductive and sod-bound. Strongly rhizomatous species are well adapted to this site and conditions. They have filled most of the voids left by less adapted species. Because they were grazed, identification not reliable, but -they are probably pubescent wheatgrasses.

Table 2. Survival index in 1988 of perennial grasses from a nursery planted in 1963 and grazed since 1970.*

Beardless wheatgrass, Whitmar	10
Bluebunch wheatgrass, P-739	9
Crested wheatgrass, Nordan	10
Intermediate wheatgrass, Amur	10
" " Greenar	7
" " Oahe	9
" " Tegmar	10
Pubescent wheatgrass, Topar	10
" " Trigo	10
" " Luna	10
Siberian wheatgrass, 2516	6
" " P-27	10
Slender wheatgrass, commercial	1
Streambank wheatgrass, Sodar	8
Tall wheatgrass, Alkar	1
Thickspike wheatgrass	6
Western wheatgrass, P-727	10
" " 14897	6
Big bluegrass, Sherman	1
" " Albion	1
Hard fescue, Durar	8
Russian wild rye, Vinall	8

* Index (1=none, 10=excellent)

Table 3. Inches precipitation (US Forest Service, about 20 miles NNW of experiment site).

Year	J	A	S	O	N	D	J	F	M	A	M	J	Total
1957-58			.95	2.40	2.40	1.73	1.85	2.36	1.34	.43	1.02	2.72	17.20
58-59	.83	.39	.75	.87	.83	1.06	1.10	1.81	.16	.28	1.73	.35	10.16
59-60	.67	.63	.66	.35		.67	1.73	3.23	1.69	.98	1.14		11.75
60-61	.35	.04	.20	.16	3.39	.51	.08	1.65	1.30	.16	.83	.35	9.02
61-62		.71	.21	.83	.67	1.69	1.10	1.26	1.50	.24	2.48		10.69
62-63		.31	.11	6.14	1.18	.87	.59	1.65	1.18	2.72	1.42	.94	17.11
63-64	.04	.55	.56	1.22	1.30	.63	1.89	.20	.59	.39	2.36	3.07	12.80
64-65	.20	.12	.24	.43		4.13	1.85	.16	.20	1.73	1.61	2.32	12.99
65-66	.35	2.99	.01	.16	1.89	1.46	1.14	.59	.55	.67	.79	.43	11.03
66-67	.63		.59	.12	2.76	1.46	3.03	.12	.91	1.57	1.02	.87	13.08
67-68	.24	.08	.11	.24	.87	1.50	1.85	1.38	.59	.20	1.46	.43	8.95
68-69		1.97		.39	2.17	.94	4.21	.91	.51	1.10	.28	3.35	15.83
69-70	.08			1.77	.67	2.83	3.62	.59	1.46	.83	.63	2.60	15.08
70-71			.17	.63	3.15	3.31	.24	.20	3.31	.91	2.95	1.54	16.41
71-72	.39		1.70	.71	1.34	.87	1.50	2.48	.91	.98	.63	.24	11.75
72-73	.04	.16	1.42	.87	2.87	1.02	1.46	.55	.55	1.57	.67		11.18
73-74			.65	.59	1.89	1.22	1.69	.83	1.69	.47			9.03
74-75	.71			.31	.63	1.54	.59	2.44	1.22	1.42	.12	.79	9.77
75-76	.16	.51	.04	.35	.59	.39	.35	1.38	1.10	.16	.20	.47	5.70
76-77	.43	.98	1.14		.16		1.02	.47	.47	.08	2.56	1.34	8.65
77-78	.20	.31		.16	.94	1.73	.67	.87	1.42	2.95	.43	.04	9.72
78-79	.08	.28				.55	.67	.87	1.34	1.54	1.34	.51	7.18
79-80	.20	.12		1.95	2.04	.70	3.65	1.82	1.27	.75	.85	.59	13.94
80-81	.40	.08	.41	.86	.14	1.10	.92	1.05	1.10	.79	1.90	.93	9.68
81-82	.02		.66	1.51	3.10	2.10	.80	1.13	1.59	.45	.82	1.69	13.87
82-83	.26	.35	.47	1.84	1.55	1.44	.61	1.46	2.86	1.63	1.95	.23	14.65
83-84		.86	.71	1.06	3.03	4.17	.19	1.11	1.23	1.00	.68	1.71	15.75
84-85	.02	.85	.31	1.46	2.80	.46	.52	.87	.78	.34	.96	.30	9.67
85-86	.05	.04	2.12	.15	2.49	.25	.98	5.08	2.36	2.13	1.47	.57	17.69
86-87	.61		1.62	.33	.50	.64	.89	.68	1.15	1.09	.79	.72	9.02
87-88	1.27			.09	.91	1.87	1.65	.25	1.08	2.57	1.07	.44	11.20
Mean	.27	.40	.51	.90	1.49	1.38	1.37	1.27	1.21	1.04	1.17	.95	11.95

Table 4. Yield of range legumes, planted 1963. Species were harvested only as long as stand was significant.

Species	Pounds per acre (oven dry)						
	1964	1965	1966	1967	1968	1969	1970
Hairy canary clover (<i>Dorycnium hirsutum</i>)							1970
Cicer milkvetch (<i>Astragalus cicer</i>) Cicar	1600	1140		290	40		
Ladak alfalfa (<i>Medicago sativa</i>)	3800	2040	480	1420	590	1350	1260
Rambler alfalfa (<i>M. sativa</i>)	3030	2380	250	1420	660	1380	1590
Spanish alfalfa (<i>M. sativa</i>) TO 2678	2890	2140	420	1120	700	900	1140
Sainfoin (<i>Onobrychis sativa</i>) TO 2718	1880	620	200	480	90		
Sainfoin (<i>O. chorassanica</i>) P-11592 SCN-847	1930	810	200	740	120		

Table 5. Survival and distribution of species in seeded pastures.

Species	Percent*																	
	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1977	1980	1985	1988
1958 Greenar seeding																		
Greenar	73		82		68	76	85	83	90	93	92	94	92	97	96	97		97
Alfalfa	39		18		7		1	1	T	1	1	1	1	2				
1963 Topar seeding																		
Topar						42	72	78	89	89	94	96	99		100	100	99	99
Alfalfa						16	15	5	6	4	3	5	6		2	1		

* Percent of the 400 1.0 sq. ft. quadrats sampled which had one or more plants present. T = Less than 0.5%.

Table 6. Ground cover of seeded and resident species in the 1963 Topar seeding, and an unseeded area.

Species	Ground cover (percent)																	
	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1977	1980	1985	1988	
Greenar wheatgrass		1	1	11	4	9	3	6	8	6	12	6	5	11	8	5	16	
Poa secunda and Stipa sp.			T	T	T		T	T	T	T	1	T	T		1	5	2	
Alfalfa								T	T	T				T				
Cheatgrass		25	5	17	38	24	4		3	2	1	3	3	T	2	T	1	
Other				T	T				1		T			T	T			
Total ground cover		26	6	28	43	32	7	6	12	8	13	9	8	12	16	6	19	
Topar pubescent wheatgrass					T	2	1	3	4	7	6	7	14	8	16	3	7	
Poa secunda and Stipa sp.								T			T			T	1	T	T	
Alfalfa					T		T	T	T	T				T	T			
Cheatgrass					12	29	6	T	1	T	T	T	1	T	10	T	1	
Other					T			T	1		T	T	T	T	T			
Total ground cover					12	31	7	3	6	7	6	7	15	8	27	3	8	
Unseeded pasture (burned only)																		
Poa, Stipa, and Sitanion	T				T	T	T	1	T	2	2	1	8		3		1	
Cheatgrass	5			20	31	42	7	T	3	4	3	4	14		2		T	
Red-stem filaree	2								T		T	T	T					
Mustard	T			4		T		T	T		T	1						
Other	T			7		2	1	1	2	T	2	1	4				T	
Sagebrush												T	T	2			T	
Total ground cover	7			31	31	44	8	1	4	7	7	7	26		5		2	

Legume survival has not been good at this site. Establishment is also unpredictable because planting, which should be after danger of frost is past, may not receive adequate rainfall for effective germination. However, if successfully established, some legumes may yield very well in fenced plots for a few years (Table 4). Surviving longest and most productive were winter-hardy alfalfas such as Ladak and Rambler. There were no legumes surviving in 1988. They probably disappeared soon after the fence was removed in 1971. A few alfalfa plants continue to survive in the pasture size seedings.

Many other forage varieties were tested, but only the most successful are shown in the tables. Among those which established in one or more trials but did not yield well or survive long are Manchar smooth brome (Bromus inermis), tall oatgrass (Arrhenatherum elatius), Orchardgrasses (Dactylis glomerata) Wilton rose clover (Trifolium hirtum), and Nomad alfalfa (Medicago sativa).

The native rhizomatous grass creeping wild rye (Elymus triticoides) has survived well. Rhizomes of 15 accessions were transplanted from the old SCS Plant Materials Center in Pleasanton California in 1963. They were from a variety of climatic locations in California, including Southern California and the San Joaquin Valley, and all survived. This strongly rhizomatous species is not an important forage plant, but would be excellent for erosion control if seed were available. Unfortunately the plant rarely produces viable seed.

Pasture-size trials:

After the brush was control burned, Warren Flournoy was anxious to improve the range by seeding. Based on small plot testing to that date (1958) two grasses were outstanding: Greenar intermediate wheatgrass and Topar pubescent wheatgrass. The first indication that these grasses were special was their ability to out compete the cheatgrass. Of all the varieties tested to that date, only these two excluded cheatgrass from between the rows. Yields were also attractive, with Greenar being the best. With some hesitation we suggested planting Greenar, even though intermediate wheatgrass at that time was only recommended for rainfall areas above 15 inches (Cornelius and Talbot, 1955).

Topar pubescent wheatgrass was planted in an adjacent 400 acre pasture in 1963. Both pasture have survived well and have very little cheatgrass or brush (Figure 1). There is some rabbitbrush (Chrysothamnus sp.) in the sandy area of the north end of the pastures, and sagebrush appears to be invading from the rim rock on the south. Voids created by using a soil-active herbicide in a fertilizer plot have been filled by sagebrush (Kay, 1988).

Samples near the center of the fields in 1985 suggest the Greenar field has 27 sagebrush, 8 gray rabbitbrush (C. nauseosus), and 1 green rabbitbrush (C. viscidiflorus) plants per acre. They average 14, 16, and 12 inches high respectively. The Topar field has 14 sagebrush and 2 gray rabbitbrush, averaging 13 and 15 inches. Long-term samples show the wheatgrasses are surviving equally well, and are not threatened by brush invasion (Table 5). Someday it may be desirable to spray with 2,4-D to limit the brush invasion, but this is probably many years away.

Cheatgrass is a minor component of either the Greenar or Topar fields. There was a lot more cheatgrass in the first few years of both pastures, but only minimal amounts since the dry year of 1966 when ground cover of cheatgrass was very low even in the unseeded area (Table 6).

Native perennial grasses appear to have increased in all three pastures, possibly due to favorable management. The areas are usually grazed from early or mid-spring to early summer, removing the cows while there is still some soil moisture to allow regrowth. Most of the blanks in the Greenar field, the site of inactive rodent colonies, now contain a population of Poa secunda.

Depth and rate of seeding of Greenar intermediate wheatgrass were investigated in 1958. Seeding at depths of 0, 0.5, 1.5 and 3.5 inches, resulted in 16, 34, 29, and 26 seedlings per 50 ft of row (LSD.05=7), suggesting 0.5 inches is a good depth. Rates of seeding tested were 2.8, 3.9, 6.2, 7.9, and 13.8 lb/acre, and resulted in 55, 67, 101, 164, and 244 seedlings per 50 ft of row (LSD.05=32), suggesting the more seed the better within the limits of the pocketbook. The Greenar pasture was seeded at 8 lb/acre.

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