

High-Altitude Studies on
Dry-Land Grasses and Clovers

DWIGHT KOONCE



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THE PRODUCTION of grasses and clovers as perennial forage crops and the establishment of permanent sod on land which has been under tillage are of major importance in Colorado.

The data in this publication present the results obtained on forage yields and stand of grasses and clovers planted on dry land at the Fort Lewis Experimental Farm for the 10-year period, 1926-35.

GENERAL CONDITIONS

The Fort Lewis Farm is located in the San Juan Basin, in the southwestern part of the state, about 5 miles south of Hesperus or 10 miles west and 4 miles south of Durango. The dry-land grass and clover plats are situated on benchland which is a part of the old flood plain of the LaPlata River. The soil is a dark loam, rather shallow, and underlaid by coarse gravel.

The experimental work is conducted by the Agronomy Section of the Colorado Experiment Station, in cooperation with the Fort Lewis School of the Colorado State College of Agriculture and Mechanic Arts.

Owing to the high altitude of 7,610 feet, the growing season at Fort Lewis is relatively short. The frost-free period, in which slight frosts are not considered, is about 110 days. The temperature is not extremely high in summer nor low in winter. The coldest months are December and January, while the warmest months are July and August. The average yearly mean temperature is about 43° F.

Precipitation

The distribution of the precipitation was rather erratic, with about 40 percent of the annual precipitation occurring in

TABLE 1.—*Monthly and annual precipitation in inches for the 15-year period, 1921-35, at Fort Lewis.*

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1921	.11	.13	1.36	.60	.64	.45	3.07	3.38	.28	1.08	.27	1.74	13.11
1922	1.07	1.31	1.38	.52	.80	.30	.88	.92	.54	.21	2.65	1.68	12.35
1923	1.32	.65	.79	.85	.63	.14	2.09	5.44	1.85	.38	.38	1.85	16.37
1924	.34	.43	4.77	2.00	.15	.00	1.85	.52	1.38	1.13	.05	1.79	14.41
1925	.14	T	1.13	.41	.76	2.05	3.87	3.22	3.44	2.95	.32	1.03	19.32
1926	.40	.39	.54	3.58	2.87	.14	2.14	.76	2.17	.85	.60	1.54	15.98
1927	.15	4.29	1.31	.53	.60	3.05	1.85	3.31	6.26	.81	1.15	1.60	24.91
1928	.51	1.70	1.53	.37	1.26	.02	2.12	1.51	.63	2.97	2.89	1.14	16.65
1929	1.24	1.74	.95	1.21	.68	.00	4.13	3.91	3.34	1.19	.20	.18	18.77
1930	2.61	.74	1.15	1.31	.89	.35	2.76	3.08	.50	.32	1.91	T	15.62
1931	.15	2.45	1.03	1.82	.50	2.03	3.20	1.14	2.22	2.09	3.64	2.35	22.62
1932	.74	3.23	.98	1.22	.84	.83	2.97	4.05	1.30	1.56	T	1.81	19.53
1933	1.66	1.32	.60	1.88	.72	.66	1.82	1.98	2.51	1.21	.82	1.40	16.58
1934	.19	2.03	.08	.81	1.16	.25	1.63	1.75	1.50	.31	1.74	1.24	12.69
1935	2.11	2.31	3.25	1.48	3.49	T	1.16	2.38	2.57	1.69	1.12	.67	22.23
Average													
15 years	.85	1.51	1.39	1.24	1.07	.68	2.37	2.49	2.03	1.25	1.18	1.33	17.41
1926-35													
10 years	.98	2.02	1.14	1.42	1.30	.73	2.38	2.39	2.30	1.30	1.41	1.19	18.56

the months of July, August, and September. The highest precipitation occurred in July and August, while the lowest occurred in May and June. The winter precipitation, especially the February snows, provided a good soil moisture content for early spring growth.

Table 1 contains the precipitation data for the 15-year period, 1921-35. The highest annual precipitation was 24.91 inches in 1927, and the lowest was 12.69 inches in 1934. The 15-year average annual precipitation was 17.41 inches. The average annual precipitation for the 10-year period of the test (1926-35) was 18.56 inches.

PLANTINGS

Although the plats were mostly planted to mixtures, some were planted to individual grasses and clovers. The varieties used and the rate of planting in pounds per acre are given in table 2.

The grasses planted were: Brome (*Bromus inermis* Leyss.), Canada bluegrass (*Poa compressa* L.), crested wheat (*Agropyron cristatum* L., Beauv.) grazier ryegrass (a selection from slender wheat), Kentucky bluegrass (*Poa pratensis* L.), meadow fescue (*Festuca elatior* L.), orchard (*Dactylis glomerata* L.), perennial ryegrass (*Lolium perenne* L.), red top (*Agrostis alba* L.), slender wheat (*Agropyron pauciflorum* Schwein., Hitchc.), tall oat (*Arrhenatherum elatius* L., Mert. and Koch.), and timothy (*Phleum pratense* L.).

The clovers planted were: Red clover (*Trifolium pratense* L.), alsike (*T. hybridum* L.), white Dutch clover (*T. repens* L.), yellow sweetclover (*Melilotus officinalis* Lam.), and white sweetclover (*M. alba* Desr.).

Five plantings on plats each containing one-fortieth of an acre were made on the following dates: Spring of 1923, spring of 1924, fall of 1924, spring of 1925, and fall of 1925. Only one planting of each grass, clover, or mixture was made on each date. The spring plantings were made the last part of April or the first part of May. The fall plantings were made in October, late enough that the seed did not germinate until spring. The seedbed was prepared on fall-plowed land by disking and harrowing. The seed was broadcast and harrowed in.

Harvesting

The plats were cut with a mowing machine and raked with a hay rake, care being taken to keep the forage on each plat separate. This method of harvesting favored the taller grasses,

TABLE 2.—*Dry-land forage yields in pounds per acre for the 10-year period, 1926-35, at the Fort Lewis Experimental Farm.*

No.	Seeding mixture: species and rate of seeding in pounds per acre	Air-dry matter in pounds per acre									
		1926	1927	1928	1929	1930	1931	1932	1933	1935	Average
1	Slender wheat 8, brome 8, yellow sweetclover 4.....	1552	1048	952	32	2	520	1552	824	824	731
2	S. wheat 8, M. fescue 4, y. s. clover 4.....	1680	1616	1208	88	40	448	1168	616	136	700
3	Brome 12, M. fescue 8, y. s. clover 4.....	1624	1256	1056	48	7	512	1464	744	992	770
4	Brome 15, orchard 15, M. fescue 10, timothy 6, y. s. clover 4	1396	1344	848	68	4	424	1520	536	944	688
5	Brome 10, orchard 6, M. fescue 5, perennial rye 5, red clover 4	464	736	188	16	4	496	1056	352	720	403
6	Brome 10, orchard 6, M. fescue 5, redtop 5, red clover 4..	376	904	164	16	2	304	864	328	704	366
7	Brome 10, orchard 6, tall oat 6, alsike 2, red clover 4...	368	848	276	20	10	488	1040	372	728	415
8	Ky. blue 5, orchard 6, tall oat 6, redtop 5, red clover 4..	312	776	220	16	10	144	752	128	272	263
9	Can. blue 5, orchard 6, redtop 5, red clover 4, white Dutch clover 1	600	640	160	100	5	220	1020	280	440	347
10	Brome 8, orchard 8, M. fescue 6, timothy 4, yellow sweet clover 4	1227	1053	600	13	23	427	1320	533	587	578
11	Brome 10, orchard 5, tall oat 5, redtop 5, red clover 3...	648	720	212	12	2	352	904	320	624	379
12	Brome 10, orchard 5, tall oat 5, redtop 5, perennial rye 5	464	768	88	16	4	384	840	312	528	340
13	Timothy 8, redtop 8, red clover 4, alsike 4, white Dutch clover 3	788	744	200	56	0	232	648	412	200	328
14	S. wheat 8, orchard 5, tall oat 5, redtop 5, yellow sweet clover 3	1792	1440	976	148	12	416	1328	656	416	718
15	Slender wheat 10	720	360	88	4	0	48	256	152	0	163
16	Orchard 30	232	656	116	60	0	168	888	248	328	270
17	Tall oat 40	570	1195	340	110	45	410	1100	410	400	458
18	Meadow fescue 15	488	836	112	32	2	96	616	264	40	249
19	Brome 15	600	896	184	28	8	344	888	416	792	416
20	Yellow sweet clover 15	1510	1300	780	140	0	150	240	350	0	447
21	White sweet clover 15	2150	1420	960	130						466
22	Crested wheat 3	0	0	20	0	0	800	1560	640	760	378
23	Crested wheat 15	0	160	80	20	0	680	1240	520	560	326
25	Grazier rye 15				0	0	80	420	360	0	123

While the year 1934 was omitted from the table, it was used in calculating the averages. All yields are the averages of 5 plats, excepting 9 and 25 which were in duplicate, 10 which was in triplicate, and 22 and 23 which were single plats.

and especially the yellow and white sweetclovers, as very little of this forage was missed by the rake, while much of the leafy material of the shorter grasses was missed. The plats were harvested about the middle of July when haying equipment was available. The harvesting probably could have been done the last of June or the first of July without any decrease in yields. Additional yields could have been obtained by harvesting the late growth which was grazed in the fall, usually by cattle.

Stands

Counts of plants were made each year (1925-35) on permanent square-yard quadrats.

Estimated coverages of plants were made each year (1932-35) on four representative square-meter quadrats on each plat. The quadrat was divided into 100 squares, and the coverage was determined by the area the plant covered and was not limited to the root zone. The data on stands are presented in table 3. The annual plant counts are the averages from five plats. The annual plant cover was determined from 20 square-meter quadrats.

Comparison of Spring and Fall Plantings

Spring and fall plantings were made in 1924 and 1925. Of these the highest yields were produced by the fall-of-1924 plantings, the lowest by the fall-of-1925 plantings, and about the same yields by the two spring plantings. While the difference in yields was probably owing to seedbed and moisture conditions



Figure 1.—Number of plants in permanent square-yard quadrats, 1925-35; 1, brome; 2, crested wheat; 3, orchard; 4, tall oat; 5, meadow fescue; 6, slender wheat; 7, yellow sweetclover.

TABLE 3.—*Plant counts and percentage cover on dry-land plats at the Fort Lewis Experimental Farm.*

No.	Species	Plant counts on permanent square-yard quadrats												Percentage cover on square-meter quadrats*				
		1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	Av.	1932	1933	1934	1935	Av.
1	Slender wheat 8	5	7	8	7	7	9	4	1				4.4	1				
	Brome 8	1	3	5	5	11	11	13	16	19	13	25	11.1	30	50	36	42	40
	Y. sweet clover 4	1	3	5	8	4	2	2	15	3	1		4.0	20	1	1		6
2	Slender wheat 8	4	5	5	5	6	11	7	3	2	2		4.5	5	2			2
	Meadow fescue 4		1	1	1	3	2	1	1				0.8	1	1			
	Y. sweet clover 4	1	4	12	12	7	8	4	17	2	2		6.3	16				4
3	Brome 12	3	6	9	7	12	14	16	21	26	20	28	14.7	44	57	39	49	47
	Meadow fescue 8	1	2	3	3	3	2						1.3	1				
	Y. sweet clover 4	3	4	12	9	3	1	1	14	1	1		4.5	14	1			4
4	Brome 15	3	7	7	6	8	11	13	17	19	12	17	11.0	32	44	20	31	32
	Orchard 15	2	4	7	5	4	5	6	6	6	4	3	4.6	10	6	6	4	7
	Meadow fescue 10		3	1	1	1	1						0.6					
	Timothy 6	1	1	2	2	3	1	1					1.0					
	Y. sweet clover 4	6	4	6	7	3	1		6				3.0	2				
5	Brome 10	3	7	6	8	10	13	14	17	20	15	14	11.5	26	35	20	23	26
	Orchard 6	3	3	4	3	3	6	4	5	4	3	4	3.8	9	5	6	6	6
	Meadow fescue 5		1	2	3	2	1						0.8					
	Perennial rye 5	1	2										0.3					
	Red clover 4	1	1	4	3	4	1						1.3					
6	Brome 10	3	8	7	6	10	13	14	17	21	14	13	11.5	24	29	17	25	24
	Orchard 6	1	3	2	3	1	2	2	4	4	2	4	2.5	8	4	5	5	6
	Meadow fescue 5		3	1	1	2	1						0.7					
	Redtop 5	1	1	1	4	3	1	1					1.1					
	Red clover 4	1	3	4	5	3	1						1.5					
7	Brome 10	1	5	4	7	8	10	13	16	17	12	16	9.9	25	35	23	27	28
	Orchard 6	2	2	3	2	2	3	3	4	3	2	3	2.6	9	4	5	5	6
	Tall oat 6	1	1	1	1	3	1	1	2	1	1		1.2	1				
	Alsike 2			1	1								0.2					
	Red clover 4			1	1								0.2					

TABLE 3.—*Plant counts and percentage cover on dry-land plats at the Fort Lewis Experimental Farm.*
—Continued.

No.	Species	Plant counts on permanent square-yard quadrats												Percentage cover on square-meter quadrats*				
		1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	Av.	1932	1933	1934	1935	Av.
8	Kentucky blue 5												Many	60	54	58	31	51
	Orchard 6	1	3	4	3	3	3	3	4	2	2	3	2.8	7	5	6	5	6
	Tall oat 6	1	1	4	2	2	2	2	2	1	1		1.6	2				
	Redtop 5		2	4	8	8	4						2.4					
	Red clover 4				1								0.1					
9	Can. blue 5												Many	32	35	36	29	33
	Orchard 6	2	1	1	3	2	4	4	6	3	4	5	3.2	13	8	10	10	10
	Tall oat 6		2	1	4	3	3	3	3	1	1	1	2.0	3	1	1		1
	Red clover 4																	
	Redtop 5		2	8	8	6							2.1					
	White Dutch clover 1																	
10	Brome 8	4	5	5	6	8	10	12	13	13	7	14	8.8	19	21	20	22	21
	Orchard 8	1	5	5	4	4	5	5	6	6	9	5	5.0	7	4	7	3	5
	Meadow fescue 6	1	5	3	1	1	1				1		1.2					
	Timothy 4	1	2	2	2	3	1	1		1			1.2	5	1			1
	Y. sweet clover 4		5	2	7	4	3		10				2.8	1	1			
11	Brome 10		7	7	5	8	10	11	14	11	7	13	8.4	25	31	21	20	24
	Orchard 5	1	2	2	4	3	3	3	4	4	3	3	2.9	11	5	6	7	7
	Tall oat 5		1	1	1	1	1	1	1				0.6					
	Redtop 5		1	1	1	4	1						0.7					
	Red clover 3			1	1								0.2					
	White Dutch clover 1		2		1	2							0.4					
12	Brome 10	4	6	5	5	10	9	11	13	11	8	7	8.1	23	30	20	21	24
	Orchard 5	3	4	5	4	3	3	4	5	5	3	5	4.0	7	4	5	5	5
	Tall oat 5		1	1	1	1	1	1	1				0.6					
	Redtop 5		1	2	3	3	2						1.0					
	Perennial rye 5	2	3	1	1								0.6					

(Continued)

TABLE 3.—*Plant counts and percentage cover on dry-land plats at the Fort Lewis Experimental Farm.*
—Continued.

No.	Species	Plant counts on permanent square-yard quadrats												Percentage cover on square-meter quadrats*				
		1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	Av.	1932	1933	1934	1935	Av.
13	Timothy 8	1	2	5	3	3	4	4	5	3	2		2.9	15	6	4		6
	Redtop 8	1	3	2	6	6	3	2	1				2.2					
	Red clover 4	1	2	6	5	5	2						1.9					
	Alsike 4			4	4	1	1						0.9					
	White Dutch clover 3	1	3	1	2	3	1						1.0					
14	Slender wheat 8	2	4	5	4	4	7	5	1				2.9	1				
	Orchard 5	1	2	2	2	3	4	3	3	2	1	3	2.4	11	6	2	2	5
	Tall oat 5			2	1	2	2	2	2	1	1	2	1.4	3	2	1	2	2
	Redtop 5			1	5	6	2						1.3					
	Y. sweet clover 3	5	13	21	5	5	5	13	21	1			8.1	10				3
15	Slender wheat 10	6	17	12	14	10	16	11	5	1			8.3	6	1			2
16	Orchard 30	9	27	16	15	11	11	10	11	12	6	7	12.3	21	18	15	16	18
17	Tall oat 40	4	8	10	10	11	12	11	12	7	5	4	8.5	15	8	9	8	10
18	Meadow fescue 15	5	11	11	18	16	14	7	6	3	2	1	8.5	9	4	2	1	4
19	Brome 15	4	15	17	14	15	18	19	23	23	17	24	17.2	53	51	32	37	43
20	Y. sweet clover 15	16	25	28	31	6	5	4	3				10.7	5				1
21	W. sweet clover 15	15	17	20	10	2							5.8					
22	C. wheat 3			18	23	23	20	20	25	17	21	22	18.9	18	16	18	22	18
23	C. wheat 15			40	40	40	43	46	42	28	30	22	33.1	24	26	28	28	26
25	Grazier rye 15				29	28	26	15	2				9.1	10	2			3

*Average of estimations on four representative square-meter quadrats on each plat.

rather than time of planting, the average yields indicate that fall planting may be better. When only the plantings for the fall of 1924 and spring of 1925, which emerged the same spring, are compared, the yields indicate that late fall planting is preferable.

About 40 percent of the annual precipitation occurs in the months of July, August, and September. This fact suggests that July planting on clean, fallowed land might be the better practice.

YIELD AND STAND

Table 2 presents the data on plantings, rate of seeding in pounds per acre, and annual and average yields of air-dry forage in pounds per acre for the 10-year period (1926-35). The data on stands are given in table 3.

In order to limit the quantity of data presented, the results from like plantings, made at different dates, were averaged annually and are comparable.

The failure of some plats to produce forage in certain years accounted for the low yields recorded. Only one cutting was made each year, and the later growth was grazed in September.

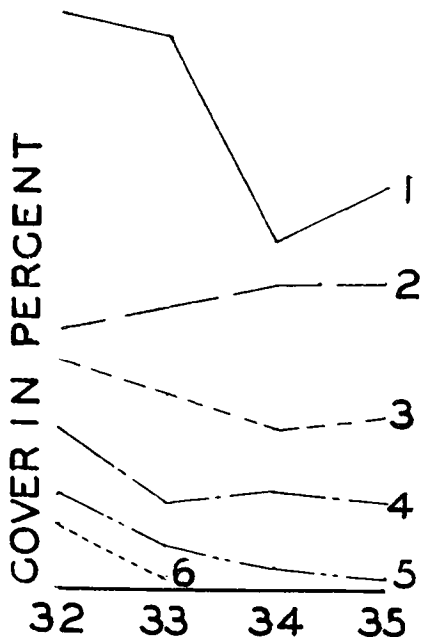


Figure 2. — Estimated cover percentages, 1932-35; 1, brome; 2, crested wheat; 3, orchard; 4, tall oat; 5, meadow fescue; 6, slender wheat.

The amount of forage depended largely upon the moisture stored in the soil from the fall and winter precipitation and upon the amount and distribution of the spring precipitation. This is substantiated by the yields obtained in 1926, 1927, and 1932, years of favorable precipitation. The low yields in 1929 were caused by grazing late in May, in 1930 by low winter precipitation and grazing, and in 1934 by the severe drought.

Mixtures

All the high-yielding plats contained yellow sweetclover.

Good yields of forage were obtained from plats 1, 3, and 4,

which contained yellow sweetclover and brome. Most of the forage produced the first part of the test was from the clover and the last part of the test from brome. This is shown by the plant counts and cover estimations of these plats and also by the results obtained on straight plantings of yellow sweetclover and brome.

Good yields were also obtained from plats 2 and 14, which contained yellow sweetclover and slender wheat. On plat 2 about two-thirds of the forage was produced during the first part of the test by the clover and a few good yields of slender wheat. Much of the forage produced in the last part of the test was from volunteer grasses. Similar conditions prevailed for plat 14, except that the later yields were the result of tall oat and orchard.

The yields of forage were about the same from plats 5 and 6, containing brome, orchard, and red clover; plats 7 and 11, containing brome, orchard, tall oat, and red clover; plat 12, containing brome, orchard, and tall oat; and plat 19, containing brome. None of the mixtures exceeded straight brome in average yield. The data on plant counts and cover estimations show that practically all the forage on the above-mentioned mixtures was produced by brome and orchard, especially during the latter part of the test.



Figure 3.—Plat 19, brome, photographed in July 1933; a very good stand of pure brome.



Figure 4.—Plat 16, orchard, photographed in July 1933; a fair stand of pure orchard but not as good a cover as on plat 19.

Grasses

The annual stands and cover of straight plantings of grasses and yellow sweetclover are shown graphically in figure 1.

Tall oat grass matures early, reseeds to some extent, and yields rather consistently but is primarily a hay grass. When planted alone, tall oat produced the highest average yield, and the stand and cover were consistent. However, in mixtures tall oat did not withstand competition and was practically eliminated by 1933.

Brome grass produces a good leafy, palatable forage, spreads by underground rootstalks, forms a sod, and is drought-resistant. The drought resistance is clearly demonstrated by the good cover and forage yield produced in 1935 after the severe drought of 1934. Whether planted alone or in mixtures, brome persisted and increased as shown by the annual yields, the plant counts, and cover estimations, and at the end of the test was the predominant grass.

Orchard grass is a well-known bunch grass, produces a good leafy forage, and grows both early and late in the season. While the results were not as favorable as those from brome, orchard was fairly consistent in stand and yield, survived the drought of 1934, and withstood competition in the mixtures, as shown by its occurrence throughout the test.

Meadow fescue is a perennial bunch grass but is not as bunchy as orchard or tall oat. When planted alone, the average yield of meadow fescue compared favorably with that of orchard. The data show that meadow fescue did not become established as soon as brome, is short-lived, and is unable to compete satisfactorily in mixtures. Very few plants persisted after 1930.

Crested wheat is a hardy, drought-resistant, perennial bunch grass native to the cold, dry plains of Russia and Siberia. As this grass was not planted in any mixtures, data on its behavior under competition are lacking. When planted alone, the plant counts and annual yields indicate that it may take several years for crested wheat to become established. However, the stand and survival were good at the end of the test. While apparently crested wheat is adapted, neither the cover nor the yield was as good as that of brome after the drought of 1934.

Slender wheatgrass is a short-lived, native, perennial bunch grass. The data show that slender wheat became established early, and the yields for the first few years were good. However, it did not persist when planted either alone or in mixtures.

Timothy is a hay grass widely used in the more humid regions. The conditions of this test were too dry for the production of timothy, and the results obtained were unfavorable.



Figure 5.—Plat 12, brome, orchard, tall oat, red top, and perennial rye; photographed in July 1933. Note the predominance of brome; a few plants of orchard are noticeable.



Figure 6.—Plat 22, crested wheatgrass, photographed in July 1933; a good stand of pure crested wheat.

Kentucky bluegrass spreads by creeping stems and grows rapidly under favorable moisture conditions. It thrives almost as well as grasses native to the region and causes considerable trouble by sodding alfalfa fields. This grass produced a good cover which persisted, but only a small amount of forage.

Canada bluegrass is a hardy perennial, similar in its habits to Kentucky bluegrass, but easily distinguishable by its blue color. This grass produced a good cover that persisted, but very little forage.

Redtop is a vigorous grower, is adapted to a wide range of conditions, and forms a good turf where moisture conditions are favorable. While redtop has considerable drought resistance and was conspicuous in certain years, it produced very little forage.

Perennial ryegrass was almost a complete failure. The few plants which became established persisted for only a few years.

Grazier ryegrass is a selection from slender wheat made in Canada. Plantings of this grass made in 1927 produced good stands but low yields.

Clovers

Yellow sweetclover is a biennial which depends upon seed production for its continued occurrence. Reseeding did occur in

the tests as shown by the plant counts. However, the amount of forage gradually decreased, and very little was produced after 1932. Of the clovers tested, the best results were obtained from yellow sweetclover. However, it was not as prevalent in mixtures containing brome as in other mixtures. This was owing probably to the competitive effects of brome.

White sweetclover is also a biennial which usually produces more forage than yellow sweet, but due to coarser stems the quality is inferior. As long as white sweetclover persisted, the forage yields were higher than those of yellow sweetclover on straight plantings. However, as very little reseeding occurred, the white sweetclover had practically disappeared by 1928.

The plant counts of red clover, which was planted in several of the mixtures, show that only a few plants became established, and these did not persist for long. Although some excellent stands were obtained from straight plantings, red clover did not prove drought-resistant and was practically eliminated the first dry year.

The conditions were too dry for alsike and white Dutch clover, both of which were complete failures.

CONCLUSIONS AND SUGGESTIONS

Clean seed of good germination, a firm seedbed, and favorable moisture conditions are more essential than rate or date of planting in establishing a good stand of grasses and clovers. Where possible, drilling is preferable to broadcasting of seed.

Yields of dry-land forage at Fort Lewis were largely dependent upon moisture stored from winter snows and spring precipitation.

Of the grasses tested, brome, orchard, and crested wheat were the most promising.

Brome increased in stand and forage throughout the test and was the predominant grass at the end.

Orchard was consistent in stand and forage yield throughout the test but did not yield as high as brome.

Crested wheat grass, which was not planted in any mixtures, produced good yields from straight plantings after it became established.

Yellow sweetclover was the most promising clover tested. Although it did not persist throughout the test, it produced good yields the first few years.

From results obtained from the tests, the following mixture is suggested for planting on dry land under conditions similar to those at Fort Lewis: Brome, 10 pounds; orchard, 8 pounds; crested wheat, 8 pounds; yellow sweetclover, 4 pounds.