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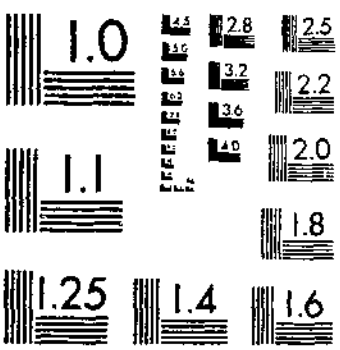
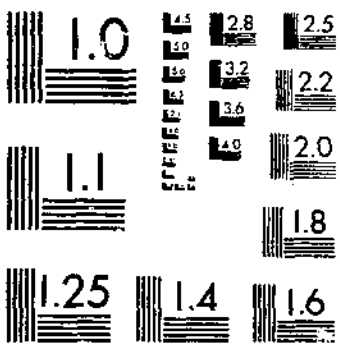


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



MICROCOPY RESOLUTION TEST CHART
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Improved Spring Pastures, Cow-Calf Production, and Stocking Rate Carryover in the Northern Great Plains

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Improved Spring Pastures, Cow-Calf Production, and Stocking Rate Carryover in the Northern Great Plains[1]

By W. R. HOUSTON [2] and J. J. URICK, *range scientist*, Plant Science Research Division, and *research animal husbandman*, Animal Science Research Division, respectively, Agricultural Research Service

SUMMARY

A grazing study was conducted for 5 years in eastern Montana, comparing seeded pastures of crested wheatgrass-alfalfa and Russian wildrye-alfalfa with native range as spring pastures for Hereford breeding cows and calves. The spring grazing period was about 6 weeks in duration, from late April to early June. Carryover effects on both cows and calves from a previous grazing intensity study on native range pastures grazed during summer and fall were also measured.

For the period 1964-68, the two seeded grass-alfalfa mixtures produced more forage with higher crude protein and with increased carrying capacity compared with that produced on the native range spring pasture. The native range spring pasture lost desirable plant composition and plant vigor from the spring grazing, whereas the seeded pastures were essentially unaffected.

The seeded spring pastures were ready for grazing 10 days to 5 weeks earlier in the spring than the native range spring pasture, but were not grazed earlier in this study. Cows and calves from the seeded spring pastures had higher weights and gains during spring, summer, and fall than those from the native range spring pasture. Calf crop weaned and cow pregnancy—both measures of fertility—were higher from the seeded spring pastures than from the native range spring pasture. The annual value of the increased animal productivity from the seeded spring pastures was about five times the increased annual costs.

For most characteristics—forage production, protein content, carrying capacity, cow weights and gains between early spring and fall, cow condition in winter, calf crop weaned, and cow pregnancy—the Russian wildrye-alfalfa pastures were slightly to substantially superior to the crested wheatgrass-alfalfa. For other characteristics—summer herbage regrowth or recovery from spring grazing with its potential for fall grazing, spring cow gains, and summer and fall calf weights—the crested wheatgrass-alfalfa pastures were superior. Overall, the two seeded spring pasture mixtures were about equally effective.

Previous heavy grazing on the native range pastures grazed during summer and fall reduced summer and fall calf weights, whereas previous light grazing increased calf weights and gains. However, cow weights and gains were not affected. It appeared that calves were more sensitive than cows to carryover effects from previous heavy and light grazing intensities.

[1] Cooperative investigation of Plant Science Research Division and Animal Science Research Division, Agricultural Research Service, U.S. Department of Agriculture, and Montana Agricultural Experiment Station at U.S. Range Livestock Experiment Station, Miles City, Mont.

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INTRODUCTION

The use of cool-season, introduced-grass pastures in the northern plains to provide more and earlier grazing than native range alone has long been recognized (*18, 22, 31,* and *32*).[3] These studies, as well as those of Campbell (*4*) and Woolfolk (*34*), have pointed out the adaptation and value of crested wheatgrass (*Agropyron desertorum* (Fisch. ex Link) Schult.) for spring and early summer grazing in the region. They showed that the early grazing combined with the use of native range later in the season resulted in substantially increased grazing capacity and usually increased animal gains. More recent research by Lodge (*12*) has confirmed these earlier findings.

Other studies comparing growth and yield of crested wheatgrass in mixtures and under different cultural practices were those of Clark and Heinrichs (*6*), Rogler, Lorenz, and Schaaf (*21*), Whitman, Petersen, and Conlon (*29, 30*), and Worzella and others (*35*).

Grazing studies by Barnes and Nelson (*1*), Campbell (*5*), Lang and Landers (*11*), Rauzi, Lang, and Barnes (*16*), Rogler and Lorenz (*19*), and Whitman and others (*28*) have shown that crested wheatgrass-alfalfa (various cultivars of *Medicago sativa* L.) mixtures increased forage and beef production as compared with that of crested wheatgrass alone.

There is increasing evidence that Russian wildrye (*Elymus junceus* Fisch.) is comparable with crested wheatgrass in the northern plains. Russian wildrye also provides early growth and more forage and beef production than the native range (*5, 21, 23*).

A recent report by Lodge (*13*) summarizes and compares the research with spring pastures in the northern plains. In this report, he points out the widespread adaptability of the practice.

Nearly all the grazing studies of these species have either used young, nonbreeding animals or did not include study of long-term carryover effects of grazing improved spring pastures on breeding animals (*8, 24*).

The objectives of the research reported here were to:

- Compare adaptability and productivity of crested wheatgrass-alfalfa and Russian wildrye-alfalfa (cv. Rambler) mixtures with native range spring pasture and with each other as spring pastures grazed in combination with native range.
- Compare summer regrowth or recovery from spring grazing of the seeded mixtures for potential late-summer and fall grazing.
- Study the accumulative effects of the combination treatments on productivity and management of breeding cows over several years, 1964-68.
- Determine the carryover effects, if any, from previous years of heavy, moderate, and light stocking on the native range pastures grazed in this study during summer and fall.

EXPERIMENTAL AREAS

The seeded spring pastures were located 3 miles west of Miles City, Mont., near the Yellowstone River. The native range spring pasture and native range pastures grazed during summer, fall, and winter were located 6 to 7 miles south of the city.

The four seeded pastures (duplicated pastures of each mixture) were each of 11.5 acres arranged in a line. Topography was smooth, averaging less than 2-percent slope. Stock water was available on the fence line between each pair of pastures.

The major soil types of the seeded pastures were Havre silty clay, Havre loam, and Havre saline silt loam on the west pair of pastures, and these types plus Lohmiller silty clay loam on the east pair.[4]

[3] Italic numbers in parentheses refer to Literature Cited, p. 20.

[4] PARKER, JOHN. SOIL DESCRIPTIONS AND MAPPING UNITS OF EXPERIMENTAL RANGES. U.S. RANGE LIVESTOCK EXPERIMENT STATION, MILES CITY, MONT. U.S. Soil Conserv. Serv. Rpt., 47 pp. 1964. [Correspondence to Station Director.]

The native range pastures grazed during summer, fall, and winter were used in previously reported grazing intensity studies (*10, 17*). In the present study, the six larger native range pastures previously grazed in winter were grazed in summer to provide more summer grazing capacity. The six pastures previously grazed in summer were grazed in winter. None of these range pastures were grazed from midsummer of 1961 until spring of 1963 because of the effects of severe drought in 1961.

A good-condition, native range pasture of 173 acres was used as the native range spring pasture for comparison with the seeded spring pastures.

Soils of the native range pastures varied. The soil types included Havre silty loams, Pennel-Bainville complex of weakly developed loams over sandstone or silty shale, Arvada-Larb and Ferdig-Laurel complexes of solidized-solonetz and solanchak loams and clays, Marias silty clay, and a Midway-Bainville complex of litholol clay loams and shale outcrops.[5]

The native range pastures ranged in size from 110 to 227 acres on the summer grazed area and from 97 to 189 acres on the winter grazed area. The number of animal units carried per pasture was varied in proportion to pasture sizes to provide uniform stocking. At each unit the range pastures were pie shaped, radiating out from a central well.

Topography at the summer grazed area varied from level to shale outcroppings and clay buttes with up to 70-percent slopes. Topography at the winter grazed area was relatively level.

Native vegetation was typical of the drier southwestern part of the northern Great Plains. Although part of the mixed prairie (*27*), this area has more shortgrasses and fewer midgrasses than the more humid Dakotas.

The principal forage species, which make up about two-thirds of the plant cover, were threadleaf sedge (*Carex filifolia* Nutt.); the shortgrasses, blue grama (*Bouteloua gracilis* (H.B.K.) Lag. ex Steud.) and buffalograss (*Buchloe dactyloides* (Nutt.) Engelm.); and the midgrasses, western wheatgrass (*Agropyron smithii* Rydb.), needle-and-thread grass (*Stipa comata* Trin. & Rupr.), and green needlegrass (*S. viridula* Trin.). Secondary grasses were Sandberg bluegrass (*Poa secunda* Presl.), sand dropseed (*Sporobolus cryptandrus* (Torr.) A. Gray), alkali sacaton (*Sporobolus airoides* (Torr.), Torr.), tumblegrass (*Schedonnardus paniculatus* (Nutt.) Trel.), needleleaf sedge (*Carex eleocharis* L. H. Bailey), desert saltgrass (*Distichlis stricta* (Torr.) Rybd.), false buffalograss (*Munroa squarrosa* (Nutt.) Torr.), and red threeawn (*Aristida longiseta* Steud.).

The main shrub species were fringed sagewort (*Artemisia frigida* Willd.), big sagebrush (*A. tridentata* Nutt.), silver sagebrush (*A. cana* Pursh), western snowberry (*Symphoricarpos occidentalis* Hook.), plains prickly-pear (*Opuntia polyacantha* Haw.), and, on only the summer grazed area, black greasewood (*Sarcobatus vermiculatus* Hook.) Torr.).

The most common forbs were textile onion (*Allium textile* Nels. and Macbr.), Hood's phlox (*Phlox hoodii* Rich.), and scarlet globemallow (*Sphaeralcea coccinea* (Pursh) Rydb.).

CLIMATE AND WEATHER

The climate of the northern plains region is semiarid with cold winters and hot summers. Precipitation is concentrated in the spring and early summer. Fall weather is often warm and frequently dry. The growing season averages about 130 days near Miles City, Mont. (*26*). Long-term average annual precipitation near Miles City is slightly less than 13 inches (table 1). Nearly 70 percent of this occurs during the growing season.

On the average, drought has occurred at about 5-year intervals in the area and severe drought at about 10- to 12-year intervals. Pre-

[5] See footnote 4.

TABLE 1.—*Monthly precipitation and annual totals, 1963-68, and long-term mean, 1877-1968. Recorded at Headquarters, U.S. Range Livestock Experiment Station, Miles City, Mont.*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual total[1]
	Inches												
1963	0.8	0.6	0.3	2.4	1.6	3.7	1.5	0.9	2.0	0.0	0.2	0.3	14.4
1964	.7	.3	.8	1.2	1.0	3.1	0.5	2.4	.1	.2	1.1	.6	12.0
1965	.8	.4	.7	2.2	1.2	2.8	3.9	.4	1.8	.0	.3	.5	15.1
1966	.6	.5	.7	.6	1.1	2.7	1.6	.5	.6	.4	.8	.4	10.4
1967	.4	.6	1.4	2.2	1.9	4.6	.9	.0	2.4	.5	.4	1.2	16.6
1968	.5	.6	.6	.5	1.5	4.4	.7	3.9	.3	.5	.6	1.2	15.3
Mean—1877-1968	.6	.4	.8	1.1	2.0	2.7	1.5	1.1	1.0	.8	.5	.5	12.9

[1] Because of rounding, annual totals are not exact totals for some years.

cipitation was 10 to 20 percent below the long-term average in 1964. Significant early spring droughts occurred twice, in both 1966 and 1968, during the study period of 1964-68. Drought effects on vegetation and livestock were most obvious in 1966. Precipitation was above average in 1965 and 1967. Early spring moisture was particularly favorable in both of these years.

For a period of nearly 60 days from mid-July to mid-September of 1967, precipitation was nearly nonexistent. This affected both cow and calf gains and regrowth of seeded pastures during the period.

EXPERIMENTAL PROCEDURES

The seeded pastures were seeded in the fall of 1961 at 6 pounds per acre of mixed grass and alfalfa seed. The grass seed comprised 5.1 pounds per acre of the mixture and alfalfa seed 0.9 pounds per acre. Certified Standard crested wheatgrass, commercial Russian wildrye, and certified alfalfa cv. Rambler seed were used. Weeds were mowed in 1962 and 1963, and the pastures first grazed in the spring of 1964.

Herbage production was measured in both early June and mid-August on the seeded spring pastures and in early June on the native range spring pasture. Production from eight, 4- by 4-foot, caged and ungrazed areas and production from similar grazed areas were determined in each seeded spring pasture and from 12 ungrazed and 12 grazed sample areas in the native range spring pasture each year. The major components of these herbage samples were analyzed for crude protein and all components were combined for phosphorous analysis.

Plant counts of the seeded grass and alfalfa on the seeded spring pastures were made in mid-June each year.

The experimental animals, good-quality Herefords, were turned into the seeded spring pastures and native range spring pasture at an average date of April 23. Grazing continued for 4 to 7 weeks, depending upon the amount of forage. The animals were then moved to the summer grazed native range pastures.

The experimental animals were grazed on the summer native range pastures from early June through late October. In late October calves were weaned and scored for feeder

grade, all cows were examined for pregnancy, nonpregnant cows were culled, pregnant replacement females were added, and all cows were moved to the winter use range pastures.

During the winters of 1963-64 and 1964-65, the experimental cows were separated into six groups proportional in size to the acreage of assigned winter pastures. Sufficient hay was fed during winter to maintain animals in thrifty condition in each pasture. During the other winters of the study, all animals were retained in one group and rotated through the winter pastures in response to the feed supply in the individual pastures as well as to the presence of adequate shelter from winter storms.

The supplemental feeding during winter consisted of fair-quality, 1- or 2-year-old native grass or crested wheatgrass hay fed in minimum amounts required for maintenance.

Salt was provided free choice throughout the study.

Calves were born on the winter use ranges. They were weighed and identified at birth (fig. 1). Male calves were castrated and all calves were branded in early June.

Approximately one-half (24 to 28) of the cows and calves were assigned to the seeded spring pastures and were initially divided into four groups of 4 to 7 cows of uniform weight and age, each with their calves. They were moved to the individual seeded spring pastures when adequate forage was present in the native range spring pasture. At the same time, the other half of the cows and their calves were placed on a good-condition native range spring pasture of 173 acres for the spring grazing period.

PN–2395

FIGURE 1.—Calves weighed and identified at birth.

At the end of spring grazing, all cows and calves from the seeded and native range spring pastures were moved to the summer pastures and redivided into six groups proportional in size to the areas of the six native range summer pastures. Each of the six groups included animals from each of the seeded spring pastures and the native range spring pasture.

The assignments of animals to individual spring pastures and to individual summer range pastures were essentially permanent. The assignments of a few animals were changed as more information became available on carrying capacity of the individual spring and summer use pastures.

Cows found nonpregnant in the fall were replaced by pregnant animals of comparable quality and breeding from the station herd. Cows were also replaced in the spring if the calf was aborted or died at birth or shortly after.

Cows were bred on the summer range to six Hereford bulls of approximately equal performance and breeding each year. The bulls were rotated weekly among the six summer range pastures during the 45-day breeding season that began on June 15 each year.

The cattle were weighed at 28-day intervals throughout the year and at each time they moved between pastures. They were denied water overnight for each of the weighings.

Cow condition or flesh was determined at the end of winter the last 3 years of the study.

Most vegetation data were analyzed by analysis of variance and calf crop was tested by Chi-square. Animal weights and gains were analyzed by the least-squares method described by Harvey (*9*). Differences between pasture treatments were tested by Duncan's multiple-range test (*7*).

RESULTS

Vegetation Studies

Forage yield and utilization

The seeded spring pastures of crested wheatgrass-alfalfa and Russian wildrye-alfalfa yielded on the average 3.4 to 4.8 times as much perennial herbage per acre as did the native range spring pasture (table 2). The lowest advantage of the seeded pastures over the native range pasture was in 1964, the first year of the study and a year of subnormal precipitation. The greatest advantage percentagewise was in 1966, a year of significant drought. The greatest advantage in pounds of forage was in 1967, a year of above-average precipitation.

The 20-percent-below normal precipitation in 1966 resulted in a 45-percent reduction in forage yield on the native spring pasture from 1965, whereas yield on the seeded pastures was essentially unchanged (fig. 2). Favorable subsurface moisture from the nearby Yellowstone River may account in part for the increased yield and lesser effects of drought on the seeded pastures.

PN-2896

FIGURE 2.—Cows and calves on Russian wildrye-alfalfa pasture in foreground 4 days after entering in 1966, showing plant growth remaining from the previous year. Crested wheatgrass-alfalfa pasture in background.

TABLE 2.—*Yield (air-dry, harvested at ground level) of ungrazed major herbage components on seeded spring pastures of crested wheatgrass-alfalfa and Russian wildrye-alfalfa and on native range spring pasture in early June at end of spring grazing period, 1964-68*

Year	Mean yield per acre on indicated pastures									
	Seeded grass on—		Alfalfa on—		Total perennial herbage[1] on—			Annuals and forbs on—		
	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa	Native range[2]	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa	Native range	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa
	Pounds									
1964	360	600	50	150	410	410	740	40	5	10
1965	1,340	2,190	610	450	610	1,950	2,650	30	40	30
1966	920	1,480	760	1,730	340	1,680	3,210	50	610	490
1967	1,910	1,640	640	1,860	670	2,550	3,500	410	440	40
1968	1,180	910	630	910	450	1,810	1,820	270	60	20
Mean	1,140	1,360	540	1,020	500	1,680	2,380	160	230	120

[1] Because of rounding, totals of perennial herbage are not exact totals for some years.
[2] Includes all perennial grasses.

TABLE 3.—*Utilization of major herbage components on seeded spring pastures of crested wheatgrass-alfalfa and Russian wildrye-alfalfa and on native range spring pasture in early June at end of spring grazing period, 1964-68*

Year	Mean utilization on indicated pastures									
	Seeded grass on—		Alfalfa on—		Total perennial herbage on—			Annuals and forbs on—		
	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa	Native range[1]	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa	Native range	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa
	Percent									
1964	50	76	85	71	39	55	75	0	0	0
1965	77	69	96	94	62	83	74	0	0	44
1966	69	69	84	96	44	76	83	6	67	95
1967	66	48	68	92	42	67	72	54	74	64
1968	71	45	65	37	34	69	41	56	51	92
Mean	67	61	80	78	44	70	69	23	38	59

[1] Includes all perennial grasses.

Yield of perennial herbage on the crested wheatgrass-alfalfa pastures averaged 1,680 pounds per acre. This is over 40 percent higher than that reported by Whitman and others (*28*) in western North Dakota for the same mixture with slightly higher average precipitation.

Yield of perennial herbage on the Russian wildrye-alfalfa pastures averaged 42 percent higher during the study than that on the crested wheatgrass-alfalfa pastures. The alfalfa component averaged approximately 90 percent higher and the grass component 20 percent higher.

Average yield of annual and forb species was higher during the study on the crested wheatgrass-alfalfa pastures than on either the Russian wildrye-alfalfa pastures or the native range spring pasture. The yield of annuals and forbs reached its peak on the seeded pastures during the drought year of 1966. However, the yield reached its peak on the native range pasture during the following year. The decline in yield of annuals and forbs following the drought was most rapid on the Russian wildrye-alfalfa pastures.

Utilization of perennial herbage, measured in early June at the end of the spring grazing period, averaged about 70 percent on the seeded spring pastures as compared with 44 percent on the native range pasture (table 3). This higher utilization, combined with much higher yield, resulted in substantially increased grazing capacity for the seeded spring pastures.

Utilization of the alfalfa component was about equal on the two seeded pasture mixtures. However, variations in use from year to year were greater on the Russian wildrye-alfalfa pastures than on the crested wheatgrass-alfalfa pastures. Utilization of alfalfa was much higher in 1967 on the Russian wildrye-alfalfa pastures and utilization of the seeded grass much lower.

Utilization of the grass component averaged somewhat lower on the Russian wildrye pastures. Utilization of both the grass and alfalfa components was substantially lower on the Russian wildrye-alfalfa pastures in 1968, the last year of the study, although carrying capacity (that is, stocking rate) was substantially higher, as compared with

TABLE 4.—*Stocking rates on seeded spring pastures of crested wheatgrass-alfalfa and Russian wildrye-alfalfa and on native range spring pasture during late April to early June, 1964-68 (includes only use by mature cows)*

Year	Stocking rate on indicated pastures						
	Native range	Crested wheatgrass–alfalfa			Russian wildrye–alfalfa		
		Pasture 1	Pasture 2	Mean	Pasture 1	Pasture 2	Mean
	Acres per cow per month						
1964	4.4	1.7	1.6	1.6	1.9	1.5	1.7
1965	3.1	1.4	1.2	1.3	1.4	1.2	1.3
1966	[1]4.4	1.4	1.2	1.3	1.3	1.0	1.0
1967	5.5	1.3	1.3	1.3	1.3	1.3	1.3
1968	4.1	1.8	1.8	1.8	1.6	1.3	1.5
Mean	4.3	1.5	1.4	1.5	1.5	1.3	1.4

[1] Because of spring drought and limited native forage yield in 1966, cattle were placed on other native range during spring for 10 days.

that of the crested wheatgrass-alfalfa pastures (table 4).

When cattle entered the seeded spring pastures, the grasses averaged 4 to 8 inches in height and the alfalfa about 1 inch. Grazing was concentrated on the grasses until the amount available become limited before the alfalfa was noticeably grazed. During the latter part of the spring grazing periods, utilization of the alfalfa was much greater than that of the seeded grasses. This pattern was particularly evident on the Russian wildrye-alfalfa pastures in 1967 (fig. 3). However, in 1968 the opposite occurred, and utilization of alfalfa was less than that of the Russian wildrye. In 1968, yield of both perennial components on the Rusian wildrye-alfalfa pastures decreased sharply from yield in previous years.

Stocking rates

The seeded spring pastures showed a clear advantage in permissible stocking rates or carrying capacity over the native range spring pasture during the study (table 4). This advantage is due to the combination of both higher yield and higher utilization on the seeded spring pastures. The low carrying capacity in 1964 was due to the combination of low spring precipitation and low forage yields that year, and probably also to the young age of the seeded stands, which had

PN-2397

FIGURE 3.—Cow and calves on Russian wildrye-alfalfa pasture in early May 1967. Old growth of alfalfa is still evident.

not yet reached full production. The stocking in 1966, a drought year, was too high. Some reduced animal productivity resulted in that year from the heavier-than-average grazing on the seeded spring pasture treatments.

The average carrying capacity of 1.4 to 1.5 aces per mature cow per month on the seeded pastures in this present study is lower stocking than the 0.9 acres per mature animal per month (calculating yearling steers at 0.6 of mature animal) on crested wheatgrass-alfalfa pastures shown by Whitman and others (*28*) in western North Dakota. In the present study, we observed that stocking the seeded pastures at rates heavier than about 1.3 to 1.4 acres with normal precipitation reduced productivity, gains, and fertility of cows. Whitman and others (*28*) used yearling steers and did not measure carryover effects.

Summer regrowth

Between early June and mid-August the regrowth or recovery of the grazed stubble (herbage remaining after grazing) of the crested wheatgrass-alfalfa pastures was much greater than that of the Russian wildrye-alfalfa (table 5). This fact is important when late summer and fall grazing is considered in addition to spring grazing.

TABLE 5.—*Regrowth of grazed stubble of major herbage components on seeded spring pastures between early June and mid-August, 1964-68*

Year and spring pasture	Mean regrowth of grazed stubble of—			
	Seeded grass	Alfalfa	Total perennial herbage	Annuals and forbs
	Percent			
1964:				
Crested wheatgrass-alfalfa	251	2,488	346	833
Russian wildrye-alfalfa	136	33	113	486
1965:				
Crested wheatgrass-alfalfa	93	7,519	669	2,382
Russian wildrye-alfalfa	62	6,742	309	1,805
1966:				
Crested wheatgrass-alfalfa	–35	326	70	209
Russian wildrye-alfalfa	0	987	129	100
1967:				
Crested wheatgrass-alfalfa	68	178	95	249
Russian wildrye-alfalfa	3	100	17	–62
1968:				
Crested wheatgrass-alfalfa	164	415	267	275
Russian wildrye-alfalfa	36	39	37	560
Mean:				
Crested wheatgrass-alfalfa	108	2,185	289	790
Russian wildrye-alfalfa	47	1,580	121	568

During the study, yields of crested wheatgrass stubble grazed during spring increased an average of 108 percent between June and mid-August, whereas yield of Russian wildrye also grazed during spring increased an average of only 47 percent. The yields of alfalfa, total perennial herbage, and annuals and forbs similarly increased at a higher rate between June and mid-August on the crested wheatgrass-alfalfa pastures than on the Russian wildrye-alfalfa pastures. Only in 1966, the year of severe drought, did the grass and alfalfa components of the Russian wildrye-alfalfa pastures increase more or decrease less between June and mid-August than those same components on the crested wheatgrass-alfalfa pastures. In 1967, during recovery from drought, the yield of annual and forb species increased about 250 percent between June and mid-August on the crested wheatgrass-alfalfa pastures but decreased about 60 percent on the Russian wildrye-alfalfa pastures.

The yields of ungrazed herbage on sample plots similarly increased at higher rates between June and mid-August on the crested wheatgrass-alfalfa pastures than on the Russian wildrye-alfalfa pastures.

The abundant regrowth of alfalfa during the summer, as high as 7,500 percent in 1965, may be due in part to its ability to draw on subsoil moisture from the nearby Yellowstone River.

Protein content

The average crude protein content of ungrazed crested wheatgrass and Russian wild-

TABLE 6.—*Crude protein content (N × 6.25) of ungrazed herbage and regrowth of grazed stubble of major herbage components on spring pastures in early June and in mid-August, 1964-68* [1]

Herbage class and year	Mean protein content on indicated pastures							
	Seeded grass on—			Alfalfa on—		Total perennial herbage on—		
	Native range[2]	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa	Native range	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa
	Percent							
EARLY JUNE								
Ungrazed herbage in—								
1964	12.8a	13.8a	11.7a	19.4a	20.0a	12.1 b	14.6a	13.6ab
1965	12.1a	12.1a	11.8a	15.5a	16.4a	12.0a	13.8a	12.6a
1966	11.3a	10.4a	11.2a	15.7a	16.2a	9.6 b	12.6a	13.8a
1967	11.0a	11.2a	11.4a	14.9a	16.4a	12.4a	12.0a	13.9a
1968	10.4 b	13.0a	13.6a	20.2a	19.4a	10.1 b	15.8a	16.8a
Mean	11.5a	12.1a	11.9a	17.1a	17.7a	11.2 b	13.8a	14.1a
MID-AUGUST								
Ungrazed herbage—5-year mean.	—	8.0a	9.2a	12.5a	12.3a	—	9.6a	9.9a
Regrowth of grazed stubble—5-year mean.	—	9.4a	10.6a	13.0a	13.0a	—	11.3a	11.5a

[1] Means in the same year-row or for the same 5-year mean for the same herbage component when followed by the same letter or letters are not significantly different at the 5-percent level.

[2] Western wheatgrass only.

rye on the seeded spring pastures and western wheatgrass on the native range spring pasture in early June did not differ for the 5-year study period (table 6). However, in 1968, the last year of the study, protein content of the western wheatgrass dropped below that of the seeded grasses. Protein content of crested wheatgrass was slightly higher than that of Russian wildrye during the first 2 years of the study. During the last 3 years, when the stands had reached their optimum density, the opposite was true. The same relationships were true for protein content of total perennial herbage on these seeded pastures.

Protein content of alfalfa from the two seeded pastures was nearly the same throughout the study.

Protein content of total perennial herbage was significantly lower on the native range spring pasture than on the seeded pastures in 3 of the 5 years of study. This low protein content was due primarily to lower protein in the perennial grasses other than western wheatgrass.

Protein content of most herbage components was lowest in 1966, the year of severe drought.

The combination of higher protein content and higher dry-matter yields on the seeded pastures indicates nutrient production approximately 350 to nearly 600 percent higher for these pastures than for the native range pasture.

By mid-August, the protein content of ungrazed herbage from the seeded pastures had decreased 2.7 to 4.1 percentage points for the seeded grasses and 4.6 to 5.4 percentage points for alfalfa (table 6). However, the average protein content of all herbage components was still similar for the two seeded pastures.

In mid-August, the protein content of regrowth of grazed stubble was slightly higher than that of ungrazed herbage for all herbage components. Protein content of regrowth of total perennial herbage was higher on the Russian wildrye-alfalfa pastures than on the crested wheatgrass-alfalfa pastures for 4 of the 5 years of the study.

Phosphorous content

The phosphorous content of total herbage in mid-June did not differ significantly between any of the spring pastures. Phosphorous contents of ungrazed herbage averaged 0.19 to 0.21 percent over the study. Phosphorous contents were at lower levels in 1966 (0.15 to 0.17 percent), the drought year, than in 1965 and 1968 (0.19 to 0.24 percent), years of higher precipitation.

Average phosphorous content of the ungrazed herbage in early June was higher on the crested wheatgrass-alfalfa (0.26 percent) and Russian wildrye-alfalfa spring pastures (0.24 percent) than on the native range spring pasture (0.20 percent).

In mid-August, phosphorous content of total herbage averaged 0.13 to 0.14 percent, with a range of from 0.12 to 0.16 percent on both ungrazed herbage and regrowth of the grazed stubble on the seeded spring pastures. Only slight differences were found between years, and no differences were found between the two seeded pastures.

Plant density

Total number of plants per unit of area (plant density), including seedlings, was substantially greater on the crested wheatgrass-alfalfa pastures than on the Russian wildrye-alfalfa pastures during the study (table 7). The average number of grass plants on the crested wheatgrass pastures was about twice that on the Russian wildrye pastures, and the average number of alfalfa plants on the crested wheatgrass pastures was about two-thirds that on the Russian wildrye.

The 5-year mean for the proportion of seedling plants to total plants was as follows:

	Percent of total plants
Grass seedlings on—	
Crested wheatgrass-alfalfa pastures	28
Russian wildrye-alfalfa pastures	16
Alfalfa seedlings on—	
Crested wheatgrass-alfalfa pastures	29
Russian wildrye-alfalfa pastures	30

TABLE 7.—*Plant density on seeded spring pastures in mid-June, 1964-68*

Year	Mean plant density on indicated pastures			
	Seeded grass on—		Alfalfa on—	
	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa
	Number of plants per square foot			
1964	10.4	5.6	0.3	0.4
1965	8.6	3.5	0.6	1.6
1966	5.2	3.0	0.5	0.7
1967	7.2	3.3	6.4	7.5
1968	7.3	3.4	2.3	4.0
Mean	7.7	3.8	2.0	2.9

Although the proportion of seedling grass plants to total grass plants was higher on the crested wheatgrass pastures than on the Russian wildrye pastures, the proportions of seedling alfalfa plants were about equal on the two seeded pastures in 3 of the 5 years of the study. The number of seedlings of both seeded grasses and alfalfa was small in both 1965 and 1966. A rapid increase in total numbers of both seeded grass and alfalfa plants was observed between 1966 and 1967. These increases may have been due to good fall establishment in 1966.

The greater number of alfalfa plants present with the Russian wildrye than with the crested wheatgrass may have contributed to the higher grass yields in most years on these pastures through nitrogen stimulation. However, the lack of difference in average protein content between the two grass species would indicate that this stimulus was probably small.

Range condition

Range condition rating of the native range spring pasture, based on 100 percent for complete dominance by climax species (*25*), declined steadily during this study. The average range condition rating of this pasture decreased from 62 percent in 1963, to 60 percent in 1965, to 53 percent in 1967. The range condition ratings fluctuated only slightly on the summer grazed native range pastures during this period. Range condition ratings on these summer grazed pastures decreased from an average of 60 percent in 1963 to 58 percent in 1965, but then increased to 60 percent again in 1967.

On these bases, grazing native range between mid-April and early June was deleterious to composition of desirable forage species, but grazing between early June and late October had little effect on the composition.

Grazing between late April and early June had no deleterious effects on forage production, plant vigor, number of alfalfa plants, or weed invasion of the seeded pastures. Stocking rates and utilization on the seeded pastures in this study were lower and forage yields higher than those shown by Whitman and others (*23*).

Animal Studies

Cow weights and gains

Weights and gains of breeding cows were influenced throughout the year by grazing the different spring pastures only during spring (table 8). Gains during the 45-day breeding

season were higher for those cows from the seeded spring pastures than for those from the native range spring pasture. This resulted in higher weights of cows from seeded pastures from early August to late October.

Gains during spring grazing were highest on the crested wheatgrass-alfalfa pastures, but these high gains appeared to depress subsequent gains and late winter weight. Summer gains and weights were higher and weight loss lower for cows from the Russian wildrye-alfalfa spring pastures than for those from the crested wheatgrass-alfalfa pastures.

At no time during the study were adverse effects observed from grazing alfalfa during spring. Neither bloat nor spoiled udders were observed.

Weights of cows in late October 1966 were lowest for any year because of drought and limited forage in the growing season in 1966. Winter weight losses were highest in the winters of 1964-65 (–64 pounds) and 1965-66 (–115 pounds), reflecting severe winter weather. Gains on spring pastures were significantly higher in 1964, the first year of treatment. The reason for this is unknown.

Gains of cows during the breeding season (summer) of 1967 were the highest of any year during the study, and late summer weight losses also were the highest. June precipitation during 1967 was 70 percent above the long-term average. This was followed by a near-2-month period from mid-July to mid-September of almost no rainfall. Gains of cows and calves were exceptionally high during June and early July and good until after a 3-day rainstorm in mid-September. The cows and their calves then began to search out the

TABLE 8.—*Average weights and gains of breeding cows during the year by spring pasture assignments on seeded spring pastures and on native range spring pasture and by years, 1964-68 (includes only cows that weaned calves)*[1] [2]

Spring pasture assignment or year	Cows	Fall weight[3] (Nov. 1)	Winter gain[3]	Late winter weight[3] (Mar. 19)	Gain on spring pasture[4]	Pre-breeding weight (June 14)	Summer gain	End-of-breeding weight (Aug. 8)	Fall gain	Weight at weaning (Oct. 27)
	Number	*Pounds*								
Native range	134	1,096a	– 12a	1,084a	56 b	1,034a	74 b	1,108 b	– 8a	1,100 b
Crested wheatgrass-alfalfa	61	1,075a	– 30a	1,045 b	103a	1,026a	91a	1,117 b	–12a	1,104 b
Russian wildrye-alfalfa	60	1,110a	– 16a	1,094a	70 b	1,049a	100a	1,149a	– 4a	1,145a
1964	52	1,137a	39 b	1,175a	110a	1,125a	54 c	1,179a	–31 c	1,148a
1965	51	1,137a	– 64 c	1,073 b	55 b	993 c	105 b	1,098 b	67a	1,165a
1966	51	1,125a	–115 d	1,009 c	66 b	997 c	53 c	1,051 c	6 b	1,056 b
1967	51	1,000 c	70a	1,069 b	74 b	1,015 bc	140a	1,155a	–75 d	1,080 b
1968	50	1,069 b	25 b	1,095 b	75 b	1,046 b	97 b	1,143a	–15 c	1,128a

[1] Dates for indicated weights are average date, 1964-68.

[2] Means in the same column for comparisons of spring pastures or comparisons of years when followed by the same letter or letters are not significantly different at the 5-percent level.

[3] Fall weights of the previous year, winter gains, and late winter weights shown by spring pasture assignments include 4 years' data, 1965-68, and indicate the average effects of grazing during the preceding years (1963-67) on assigned spring pastures.

[4] Cow gains on spring pastures apply only to cows that calved before entering spring pastures.

short, green, regrowth herbage and their weights dropped sharply. The cows and their calves gained well on dry forage, but lost weight rapidly when their diet shifted to the sparse green forage with its limited dry-matter production and high water content.

Cow condition

Late winter condition or flesh of the cows during the last 3 years of the study was significantly improved by previous grazing on the Russian wildrye-alfalfa spring pastures compared with previous grazing on the crested wheatgrass-alfalfa (table 9). The condition scores were correlated to some extent with late winter weights.

Cow condition was low in March 1966, no doubt a result of severe winter weather and consequent high weight losses (fig. 4). Cow condition was improved during the following years of the study.

Calf weights and gains

The spring pasture treatments had no effects on either birth dates or birth weights of calves (table 10). The gains of the early calves (the 80 percent of calves that were born before entering spring pastures and thus received the full effects of the spring grazing treatments) on spring pastures and their prebreeding and end-of-breeding weights were all significantly higher for the seeded spring pastures than for the native range. The advantage of the seeded pastures over the native range spring pasture for these calves averaged 10 to 20 pounds from the end of spring grazing through weaning. These weights and gains were higher for calves from the crested wheatgrass-alfalfa spring pastures than for those from the Russian wildrye-alfalfa pastures.

When weight and summer gains of all calves were considered, which includes the late calves born on the spring pastures, only the prebreeding weights from the seeded spring pastures increased significantly. For all calves, the weaning weights averaged 427 pounds for the native range, 436 pounds for crested wheatgrass-alfalfa, and 435 pounds for the Russian wildrye-alfalfa spring pastures. These differences in weaning weights, as well as those shown in table 10, were not significant. Weights and gains of all calves during the spring grazing period could not be compared because approximately 20 percent of the calves were born after the cows entered the spring pastures.

Feeder grades of calves at weaning (weaning scores), a measurement of conformation

PN-2398

FIGURE 4.—Cows on good-condition winter range in February 1966 following a snow storm.

TABLE 9.—*Average condition score in late winter (average date—March 19) of cows grazing during previous year (1965-67) on seeded spring pastures and on native range spring pasture, 1966-68* [1]

Spring pasture or year	Condition score [2]
	Percent
Native range	58ab
Crested wheatgrass-alfalfa	57 b
Russian wildrye-alfalfa	64a
1966	55 b
1967	64a
1968	60ab

[1] Means in the column for the comparisons of spring pastures or the comparisons of years when followed by the same letter or letters are not significantly different at the 5-percent level.

[2] Based on condition of a hypothetical, young, fat, nonpregnant cow as 100 percent.

TABLE 10.—*Average birth dates, weights and gains during spring, summer, and fall, and weaning scores of calves by spring pasture assignments of dams on seeded spring pastures and on native range spring pasture and by years, 1964-68 (all weights and weaning scores corrected to steer basis and weights also corrected for age of dam. Includes only calves born before dams entered spring pastures)* [1] [2]

Spring pasture assignment of dam or year	Calves	Birth date[3]	Birth weight[3]	Gain on spring pasture[4]	Pre-breeding weight (June 14)	Summer gain	End-of-breeding weight (Aug. 8)	Fall gain	Weaning weight (Oct. 27)	Weaning score[5]
	Number	*Days*				*Pounds*				
Native range	106	98a	80a	76 b	196 b	107a	303 b	130a	433a	5.0a
Crested wheatgrass-alfalfa.	45	97a	82a	92a	216a	110a	326a	127a	453a	4.5a
Russian wildrye-alfalfa.	52	96a	79a	86a	207a	106a	313ab	128a	441a	4.6a
1964	43	91 b	76 b	81ab	211a	104ab	316ab	129a	445ab	5.8a
1965	44	99a	77 b	81ab	179 b	116a	295 b	130a	425 b	5.3ab
1966	39	99a	80ab	88ab	212a	93 b	305ab	129a	434ab	3.9 c
1967	42	94ab	83a	79 b	205a	114a	319ab	105 b	424 b	4.5 bc
1968	35	99a	85a	90a	221a	102 b	322a	140a	462a	4.4 c

[1] Dates for indicated weights are average date, 1964-68.

[2] Means in the same column for comparisons of spring pastures or comparisons of years when followed by the same letter or letters are not significantly different at the 5-percent level.

[3] Birth dates are in number of days since preceding December 31. Birth dates and birth weights shown by spring pasture assignments of dams include 4 years' data, 1965-68, and indicate average effects of dam's grazing during the preceding years (1964-67) on assigned spring pastures.

[4] Gains on spring pastures are calculated from average daily gains multiplied by 42-day average spring grazing period.

[5] Weaning scores are on a scale of 4.0, 5.0, and 6.0 for high-, medium-, and low-choice feeder grades, respectively.

and condition, were not influenced by the spring grazing treatments.

Calf weights and gains were also influenced by years and weather. The earliest average date of birth of calves and lowest birth weights were in 1964, the first year of the study. The cows were younger and smaller at the beginning of the study and were bred in 1963, before the different spring grazing treatments were initiated. The highest birth weights with a late date of birth were in 1968, the last year of the study. The highest gains on spring pastures and the highest prebreeding, end-of-breeding, and weaning weights of calves also were observed in 1968.

As with cow weights and gains, and no doubt for the same reason, calf gains were high during the breeding season of 1967; but because of the shift in diet from dry forage to young, growing forage, the late summer gains were lower than in any other year.

Calf crop weaned

The calf crop at weaning time or fertility of breeding cows, based on the proportion of cows in the breeding herd the previous year

TABLE 11.—*Calf crop weaned (1965-68) by cows grazing during previous years (1963-67) on assigned spring pastures of seeded spring pastures and of native range spring 68* [1]

Year	Calf crop weaned and mean fall pregnancy on indicated pastures			
	Native range	Seeded pastures (mean)	Crested wheatgrass-alfalfa	Russian wildrye-alfalfa
	Percent			
1965	84.6	89.3	92.9	85.7
1966	81.8	92.8	85.7	100.0
1967	79.3	90.4	90.0	90.9
1968	81.5	90.4	90.9	90.0
Mean	81.7a	90.8a	89.9a	91.6a
Fall pregnancy—5-year mean.	89.4	94.5	93.6	95.4

[1] Row means followed by the same letter are not significantly different at the 5-percent level.

that weaned calves the current fall, was substantially higher for the two seeded spring pastures than for the native range spring pasture (table 11). These differences approached significance ($P \simeq 0.06$) and averaged 8 to 10 percentage points. The mean difference in calf crop between the crested wheatgrass-alfalfa and Russian wildrye-alfalfa spring pasture treatments was less than 2 percentage points.

Differences in fall pregnancy, determined at weaning time each year, averaged 4 to 6 percentage points between the native range and the seeded spring pasture treatments.

Summer pastures and carryover effects of previous grazing intensity treatments

The native range pastures grazed during summer and fall had been previously used in grazing intensity studies (*10, 17*). The various grazing treatments on the summer pastures for those studies—heavy, moderate, and light grazing intensities—had several distinct effects on cow and calf weights and gains in the present study (tables 12 and 13).

One of the two previously heavily grazed pastures (pasture T) produced the heaviest cow weights, usually with the most rapidly gaining cows (table 12). The plant cover on this pasture had the highest proportion of grasses of any of the summer pastures, although all were grazed at a moderate intensity on the basis of relative carrying capacity.

One of the two previously moderately grazed pastures (pasture S) produced the lowest weights and gains of cows. This pasture had the highest proportion of unproductive soils, shale outcroppings, and clay buttes, with the highest cover of shrubs of any pasture on the summer range.

One of the two previously heavily grazed pastures (pasture Q) produced the lowest birth weights of calves, latest birth dates, and lowest calf weights and gains during the summer (table 13). The previously moderately stocked pasture S produced the next lowest calf weights. The previously lightly grazed pasture V (fig. 5) produced the highest weights and gains of calves during this study.

The interactions of these previous summer pasture grazing intensity treatments with the present spring pasture treatments or with years were negligible.

PN-2899

FIGURE 5.—Cow and calves on good-condition, previously lightly grazed, summer range pasture V. Note rough topography compared with that in figure 4.

TABLE 12.—*Average weights and gains of breeding cows during the year by summer pasture assignments on previously heavily, moderately, and lightly grazed pastures, 1964-68 (includes only cows that weaned calves)*[1] [2]

Summer pasture assignment	Grazing intensity	Fall weight (Nov. 1)	Winter gain	Late winter weight (Mar. 19)	Gain on spring pasture[3]	Pre-breeding weight (June 14)	Summer gain	End-of-breeding weight (Aug. 8)	Fall gain	Weight at weaning (Oct. 27)
		Pounds								
Q	Heavy	1,103a	–11ab	1,092ab	81ab	1,056a	95ab	1,151a	–37 c	1,114ab
R	Moderate	1,095ab	7a	1,102ab	84a	1,055a	95ab	1,150a	–15 b	1,134ab
S	do	1,051 b	– 6a	1,045 b	61 b	991 b	87 bc	1,078 b	–15 b	1,063 c
T	Heavy	1,123a	– 5a	1,118a	83ab	1,048a	110a	1,158a	– 6ab	1,152a
U	Light	1,094ab	–11ab	1,083ab	76ab	1,041a	74 c	1,115ab	10a	1,125ab
V	do	1,094ab	–28 b	1,065 b	72ab	1,019ab	80 bc	1,100 b	6a	1,106 b

[1] Dates for indicated weights are average dates, 1964-68.

[2] Means in the same column when followed by the same letter or letters are not significantly different at the 5-percent level.

[3] Cow gains on spring pastures apply only to cows that calved before entering spring pastures.

TABLE 13.—*Average birth dates, weights and gains during spring, summer, and fall, and weaning scores of calves by summer pasture assignments of dams on previously heavily, moderately, and lightly grazed pastures, 1964-68 (all weights and weaning scores corrected to steer basis and weights also corrected for age of dam)* [1] [2]

Summer pasture assignment	Grazing intensity	Birth date[3]	Birth weight	Gain on spring pasture[4]	Pre-breeding weight (June 14)	Summer gain	End-of-breeding weight (Aug. 8)	Fall gain	Weaning (Oct. 27)	Weaning score[5]
		Days	*Pounds*							
Q	Heavy	99a	79a	84a	197a	100a	297a	114 c	411 b	4.7a
R	Moderate	95a	80a	81a	207a	110a	317a	127ab	444a	4.9a
S	do	98a	80a	85a	207a	104a	310a	122 bc	432 b	5.0a
T	Heavy	96a	79a	84a	208a	105a	313a	131ab	444a	4.7a
U	Light	94a	83a	81a	206a	110a	316a	131ab	448a	5.0a
V	do	98a	80a	89a	209a	106a	315a	135a	449a	4.8a

[1] Dates for indicated weights are average date, 1964-68.

[2] Means in the same column when followed by the same letter or letters are not significantly different at the 5-percent level.

[3] Birth dates are in number of days since preceding December 31.

[4] Gains on spring pastures are calculated from average daily gains multiplied by 42-day average spring grazing period.

[5] Weaning scores are on a scale of 4.0, 5.0, and 6.0 for high-, medium-, and low-choice feeder grades, respectively.

Carryover effects of the previously heavily, moderately, and lightly grazed pastures on weights and gains of cows were not evident during the study. However, the carryover effects on fall weights and gains of calves were still significant after 2 years of nonuse of the pastures, including 1 year of severe drought (1961) and a following year of considerably above-normal moisture (1962). Grazing during the summer of 1963, a year of preparation before initiating spring pasture treatments, was similar on all pastures.

Costs and returns

Gross return from the different spring pastures may be evaluated by calculating the pounds of calf weaned per breeding cow and assigning a sale price. The pounds of calf produced per cow are obtained by multiplying average weaning weight by percent calf crop for each group of animals. For this study average pounds of calf produced per cow (including all calves with weights corrected to steer basis) may be calculated as follows:

Spring pastures	*Average pounds of calf produced per cow*
Native range	427 pounds × 0.817=349 pounds
Crested wheatgrass-alfalfa.	436 pounds × 0.899=392 pounds
Russian wildrye-alfalfa.	435 pounds × 0.916=398 pounds

These data show an average increase of 43 pounds of calf produced per cow or 12 percent for the crested wheatgrass-alfalfa spring pastures, and 49 pounds or 14 percent for the Russian wildrye-alfalfa, as compared with the production for the native range spring pasture.

At a selling price of 30 cents per pound for steer calves at weaning, the annual gross returns per cow in the breeding herd were $12.90 and $14.70 more for the two seeded spring pasture treatments than for the native range spring pasture treatment. In 1967, Nielsen (*15*, table 6) approximated an average annual seeding cost of $1.20 per acre, adjusted for 20-percent stand failures and including both initial and maintenance costs of fencing, water development, and nonuse. These costs probably have not changed materially since 1967. At this annual seeding cost and at spring pasture stocking rates of 2.25 acres of seeded spring pastures per cow for 6 weeks, the average annual costs of seeded pastures per cow would total about $2.70. Thus, the annual additional gross return per cow from the seeded spring pastures would be approximately 5 times the annual additional costs.

These data on costs and returns may be easily recalculated for different proportions of sex of calves, different selling prices, and different seeding and management costs. For example, weaning weights of heifer calves are about 5 percent lower than those of steer calves (*3*), and heifer calves sell for a lower price.

DISCUSSION AND CONCLUSIONS

The seeded spring pasture mixtures produced more forage of higher quality with substantially increased grazing capacity during the study than the native range spring pasture used for comparison. The seeded pastures also tolerated much higher utilization levels without deleterious effects on plant density or on plant composition and vigor.

The Russian wildrye-alfalfa spring pastures produced more forage of slightly higher quality and with higher grazing capacity than the crested wheatgrass-alfalfa pastures. This was also shown by Rogler and Lorenz (*20*) when they compared pure grass pastures of both species in central North Dakota.

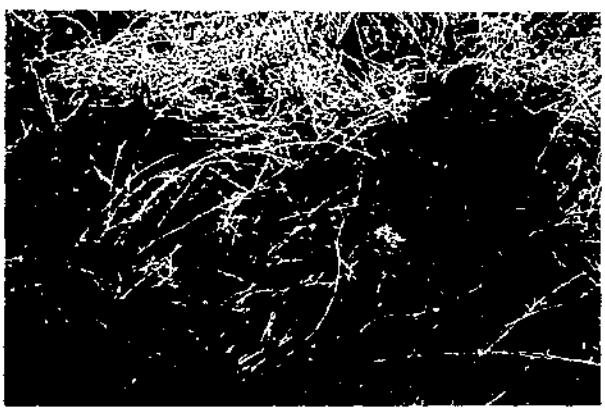
Another advantage of the seeded pastures could be fall grazing of the summer regrowth. During the study, an additional 2 to 4 weeks of fall grazing during September and October could have been provided. We do not know the effects of fall grazing of alfalfa regrowth on the date of beginning grazing the next spring or on the amount of spring grazing.

The seeded pastures were ready to graze

from 10 days to 5 weeks earlier than the native spring pasture, although management limitations did not permit earlier use of these pastures during this study (fig. 6). The maximum, 5-week advantage in date of readiness for grazing occurred in 1966, a year of early spring drought when the earlier grazing would be particularly valuable. Without emergency use of other native range for 10 days in 1966, the native range spring pasture would have been very heavily grazed that year with, no doubt, reduced animal gains and possibly even reduced fertility.

With adequate protection from spring storms, the seeded spring pastures could be used as calving pastures. This would mean beginning grazing about March 20, one full month earlier than during this study. Concentrating the cattle on smaller pastures would permit more intensive care of the cows during calving and of the newborn calves and would reduce labor costs. It may also reduce costs of supplemental feeding during early spring. However, the earlier spring grazing may require a pasture rotational grazing scheme in order to avoid reduced long-term productivity and carrying capacity of the spring pastures.

The seeded spring pastures produced higher spring, summer, and fall gains and weights of cows and higher spring and early summer gains and weights of calves than the native spring pasture. The higher calf crops and cow fertility obtained from the seeded spring pasture treatments are of particular economic importance. These results corroborate in part the findings of Bellows (*2*) and Wiltbank and others (*33*). Both studies indicated that the nutritional level of cows after calving has a marked effect on their subsequent reproductive performance.



PN-2400

FIGURE 6.—New growth of crested wheatgrass in mid-April 1967 before grazing. Note old stems of alfalfa from regrowth during summer of 1966.

The 10- to 20-pound weight advantage of calves from the seeded spring pastures in mid-June was statistically significant, and the same weight advantage continued through the summer and fall. However, the difference in weights was now significant only in early August and then for only that 80 percent of the calves that were born before entering spring pastures. If the experimental cattle assigned to the seeded spring pasture treatments had entered those pastures earlier, which was feasible, or continued there longer, or both, possibly the late summer and fall weights of calves may also have differed significantly.

The summer recovery of grazed plants, plant density of the seeded grass, gains of cows on seeded pasture, and calf weights during summer and fall were higher for the crested wheatgrass-alfalfa spring pastures than for the Russian wildrye-alfalfa. However, cow weights throughout the study, cow condition in early winter, cow gains in early summer, calf crop weaned, and economic returns were slightly to significantly higher for the Russian wildrye-alfalfa pastures.

The crested wheatgrass-alfalfa pastures may have better stimulated milk flow in the cows during spring grazing and this stimulation carried over during the summer and fall, with consequent increased gains and weights of calves. This stimulation of milk flow was at the expense of cow weights and also results in poorer condition of cows during the following winter.

Considering all characteristics of the two pasture mixtures, there seems little practical basis for choosing one mixture over the other as spring pasture for breeding cows.

The carryover effects of a previously heavily grazed pasture on decreasing calf weights

and gains during summer and the effects of a previously lightly grazed pasture on increasing calf weights and gains were a surprise. Though one pasture had been heavily grazed and the other lightly grazed for 29 years, range condition ratings in 1958 were not materially different for either pasture in relation to the other summer grazed pastures (*10*) (fig. 4). Range condition ratings in 1961, 1963, 1965, and 1967 showed little or no differences between any of the pastures. These ratings showed similar increases in range condition ratings over the years for all pastures since 1958.

Why the carryover effects of previous grazing intensities should influence calf weights and gains more than those of cows is not clear. Apparently calf responses are more sensitive indicators of forage production or range condition than either cow responses or species composition indices. McIlvain and Shoop (*14*) also observed this phenomenon. They attributed it to the effects of quality of the cow's diet on milk production and milk nutrient content.

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