Continuous Versus Repeated-Seasonal Grazing of Grass-Alfalfa Mixtures at Swift Current, Saskatchewan

J. B. CAMPBELL

Experimental Farm, Research Branch, Canada Department of Agriculture, Swift Current, Saskatchewan, Canada

This paper presents the results of a dryland grazing test conducted on grass-alfalfa mixtures at Swift Current, Sask., from 1956 through 1959. The grasses included were: crested wheatgrass, *Agropyron cristatum* (L.) Gaertn.; Russian wild ryegrass, *Elymus junceus* Fisch.; and intermediate wheatgrass, *A. intermedium* (Host.) Beauv., each in a mixture with alfalfa, *Medicago spp.* A comparison is made between continuous and repeated seasonal grazing on each of the three mixtures. It is believed that the results presented are applicable to a considerable portion of the Brown and Chestnut soils of the Northern Great Plains.

Materials and Methods

Treatments

Four duplicate treatments were established as indicated in Table 1. The site was fall cultivated in 1953, and sown to the grass-alfalfa mixtures in 12-inch spacings during May, 1954. A wheat companion crop was fall grazed during August and September. In 1955 the grass-alfalfa mixtures were cut for hay. Grazing commenced in May 1956 and continued through 1959. Rates of seeding were as follows: wheat, 30 pounds per acre; crested wheatgrass, 6 pounds per acre; intermediate wheatgrass, 10 pounds per acre; Russian wild ryegrass, 8 pounds per acre; and alfalfa, 1 pound per acre. The grass seed was secured from commercial sources. The alfalfa was a local creeping-rooted strain somewhat similar to Rambler (Heinrichs and Bolton, 1958). All fields were fenced with 32-inch hogwire, with posts at 18-foot centers. Water was piped from a central supply.

Livestock and Grazing Management

Yearling Rambouillet ewes were placed on Treatments 1, 2, 3, and 4a during early May. Continuous grazing was practiced on Treatments 1, 2, and 3 for 120 to 160 days. In the seasonally grazed paddocks the flocks were moved from 4a to 4b to 4c as the feed supply disappeared; each was grazed once a year. Stocking rates were set at approximately 250 pounds of live weight per acre at the beginning of the test; this rate is comparable to about 2¼ ewes per acre.

The test was designed to maintain the same rate of stocking from year to year, but to expect lower gains per ewe or even shorter grazing seasons during years of low forage production. These basic considerations were followed generally, although in a few instances it was necessary to reduce the stocking rate as the experiment progressed. The grazing season ended when the ewes made no gains or lost weight for two successive weekly weighings in late September or October, or when the intermediate wheatgrass was grazed to about a 5-inch stubble and the other two grasses to a 3-inch stubble; these criteria usually coincided.

Collection and Analyses of Data

Ewes were weighed weekly after being placed on pasture. Records from date of shearing only were used to analyse gain data.

Herbage was harvested from six caged and six grazed 1- x 2-yard plots per treatment every three weeks. When flocks were moved from 4a to 4b to 4c at intermediate dates, an additional clip was taken on moving day. The herbage was clipped to approximately a one-inch level with grass shears. Dry matter yield data were summarized by the Difference Method as used by Linehan and Lowe (1946) to estimate forage production and consumption. Samples were obtained on a seasonal basis for crude protein analyses.

Point-quadrat studies were undertaken in May of 1955, 1957, and 1959 following the method of Clarke, *et al.* (1942). One thousand points in each field were studied to estimate the percent ground cover.

Table 1. Treatments established

Treatment Number	Crop Mixture	Grazing Treatment	Acreage Enclosed
1	Crested wheatgrass Alfalfa	Spring through autumn	3.6
2	Intermediate wheatgrass Alfalfa	Spring through autumn	3.6
3	Russian wild ryegrass Alfalfa	Spring through autumn	3.6
4a	Crested wheatgrass Alfalfa	Spring Only	1.2
4b	Intermediate wheatgrass Alfalfa	Mid-summer Only	1.2
4c	Russian wild ryegrass Alfalfa	Autumn Only	1.2

Significance of comparison of means was estimated by the Student-Newman-Keuls multiple range test as discussed by Federer (1955).

Precipitation

Greater-than-average rainfall and satisfactory soil moisture reserves in 1954 and 1955 produced vigorous stands. However, the less-than-average precipitation from 1956 through 1959, together with reduced soil moisture reserves, were factors which reduced ground cover and yield. Specifically, the less-than-average rainfall during May and early June from 1957 through 1959, caused drought conditions which were reflected in the reduced production during 1958 and 1959. Precipitation and soil moisture reserves by years are presented in Table 2.

Results and Discussion

Point-Quadrat Studies

Results of point-quadrat analyses of ground cover for the years 1955, 1957, and 1959 are summarized in Table 3. Sampling was completed each year during early May, and thus the percentage cover of all crops was somewhat lower than when sampling was undertaken during the month of June. However, a definite trend persisted, with ground cover increasing until 1957 but showing a marked reduction by 1959.

These data indicate that intermediate wheatgrass is the least persistent of the three grasses tested. It showed some killing by the spring of 1957 and almost a 100 percent kill on Treatment 2 by May, 1959. The same trend applied to the summer-grazed stand of Treatment 4b, but the reduction was only by 60 percent between 1957 and 1959. Although the intermediate wheatgrass winter-killed, the pastures were maintained because seed of crested wheatgrass from adjacent road allowances lodged in the intermediate wheatgrass stubble, germinated, and developed into healthy plants which provided pasturage during the summer of 1959.

The replacement was on an individual plant basis, as each dead or dying intermediate wheatgrass plant acted as a host for one or more crested wheatgrass seedlings. Few crested wheatgrass plants established between the rows. Consequently, the stand retained the appearance of a sown field.

The alfalfa did not establish well with the intermediate wheatgrass. Kilcher and Heinrichs (1958) report a similar result when the seedling year is one with above-average precipitation, as was the case in the experiment being reported. It is suggested that the rapidly establishing intermediate wheatgrass is too aggressive for the slower establishing alfalfa to develop a normal stand under very favorable growth conditions. The alfalfa did not increase its stand as the intermediate wheatgrass disappeared, a condition attributed to both drought and the preference of sheep for alfalfa as indicated by Troelsen and Campbell (1959).

The reduced ground covers of crested wheatgrass and Russian wild ryegrass from 1957 to 1959 are quite normal in view of the summer droughts of 1957 and 1958. It should be emphasized that the reduced stands are the result of the smaller size of individual plants, and are caused neither by winter-killing of individual plants nor areas in a field. The basal cover of the alfalfa stands was lower also by 1959, with less reduction in the spring and autumn grazed Treatments 4a and 4c than in the continuously grazed fields of Treatments 1 and 3.

An interesting observation dealt with the effects of trampling and resting at watering and lounging sites. At these points the intermediate wheatgrass was killed completely within one year after grazing commenced. On the other hand, the crested wheatgrass, the Russian wild ryegrass, and, to a lesser extent the alfalfa, not only persisted but increased their stands; in addition, on the resting sites these crops responded to the greater available fertility which was supplied by the extra deposits of dung and urine.

Influence of Years on Production

Forage production and apparent consumption, as well as animal gains and related data, are summarized by years in Table 4. Significant differences in apparent pasture consumption, live-weight gain per ewe and per acre, and apparent consumption per pound gain, are associated with the annual pasture production.

A considerable range in forage production from year to year can be expected. This is related to the considerable variation in

Table 2. Precipitation and soil moisture reserves by months, years, and/or Periods, 1954-1959.

Precipitation and Soil Moisture for	1954	1955	1956	1957	1958	1959	Av. 37 years
	(Inches)						
May	3.37	2.58	1.24	0.13	0.57	0.76	1.55
June	3.51	1.67	3.65	1.84	0.99	4.68*	2.87
July	3.55	4.06	1.45	2.72	1.89	1.37	1.96
May to July	10.43	8.31	6.34	4.69	3.45	6.81	6.38
Annual	19.71	17.31	13.15	11.83	11.50	13.99	13.86
Soil moisture reserve—May 1st**	....	1.8	1.3	1.1	0.8	0.8	

*4.4 inches rainfall between June 26th and July 4th.

**Soil moisture reserve equivalent to inches of water on May 1st, an average date following spring run-off and prior to spring rains.

Table 3. Percentage Ground cover of grass-alfalfa mixtures by treatments and years

Crop	Ground Cover in Percentage by Treatments and Years																	
	Treatment 1			Treatment 2			Treatment 3			Treatment 4a			Treatment 4b			Treatment 4c		
	1955	1957	1959	1955	1957	1959	1955	1957	1959	1955	1957	1959	1955	1957	1959	1955	1957	1959
Crested wheatgrass	6.1	7.3	5.9			3.2*				7.1	10.5	7.5			3.7*			
Intermediate Wheatgrass—living				7.5	6.3	0.2							8.4	9.3	3.5			
Intermediate wheatgrass—dead					0.2	6.2									4.0			
Russian wild ryegrass							7.2	7.3	5.6							6.9	7.6	5.3
Alfalfa	1.8	2.2	1.3	1.6	1.0	0.4	2.0	2.1	1.1	2.0	2.4	2.1	1.5	1.3	0.4	2.1	3.1	2.1

*Invader

precipitation from year to year, and particularly during the months of May and June. Clark and Heinrichs (1957) report grass yields from 230 to over 2,000 pounds D.M. per acre in successive years, while Lawrence *et al.* (1960) show even larger differences. A report from the Range Station, Manyberries, Alberta (1949) indicates that the D.M. production from shortgrass range may be as little as one-third or as much as two and one-half times average between dry and wet years. Nevertheless, in the test being reported it was possible to maintain the sheep-days per acre at a relatively uniform level by accepting smaller carryovers than desirable and lower live-weight gains per ewe during drought years.

An anomaly in the data is the greater number of sheep-days per acre in 1958 than during 1959, although apparent consumption was greater during the latter year. This result can be explained on the basis of the rainfall pattern. During 1958 light summer rains continued through August and September and encouraged slow growth until early October. Alternately the 1959 summer rainfall was concentrated in a 10-day period between June 26th and July 5th; these rains produced a considerable growth, but with no precipitation later in the season and thus on continuing growth to supplement the July production, the supply of feed disappeared at an earlier date and the ewes had to be removed some 15 days earlier than usual. The extra forage consumed during the shorter grazing season is reflected in the higher live-weight gains during 1959.

Forage, Crude Protein and Livestock Yields by Treatments

Forage and livestock yields by treatments are summarized in Table 5. No significant differences were established between treatments on the basis of pasture production trends, apparent consumption per acre or per ewe, sheep-days per acre, apparent consumption per pound gain, or stocking rate.

Conversely, differences were established when live-weight gain data were analysed, as Treatment 3 outyielded the others on the basis of gain per ewe and gain per acre. Heinrichs

Table 4. Influence of years on forage production and livestock yields for all crops.

Year or Item	Pasture Production (lb./acre)	Apparent Pasture Consumption (lb./acre)	Apparent Pasture Consumption (lb./ewe/day)	Days Sheep-per Acre	Average Gain per Ewe (lb.)	Gain per Acre (lb.)	Apparent Consumption per pound of gain	Grazing Season (days)	Hay Production (lb./acre)
1955									3605
1956	1910	1525	3.8	402	23.9	50	29.2	166	
1957	1290	1125	3.2	370	15.9*	41*	28.1	144	
1958	750	615	1.8	358	10.8	30.5	21.5	155	
1959	900	810	2.5	293	18	42	19.1	140	
$\bar{x}$	1210	1020	2.82	356	16.8	40.8	24.5	......	
$Se_{\bar{x}}$ %	12.8	14	9	9.3	9.3	10.8	11.2	......	
P=0.05	1957>1959	1957>1959	1956>58 and 59 1957>58	1956>59		1957 and 59>1958	1956 and 57> 1958 and 59		
P=0.01	1956>57, 58 and 59 1957>1958	1956>57, 58 and 59. 1957>1958			1956>57, 58 and 59. 1957 and 59>58	1956>1958			

*Reduced gains cause by dog depredations.

Table 5. Response of crops and livestock by treatments (1956-1959)

Treatment	Average Pasture Production (lb./acre)	Apparent Pasture Consumption (lb./acre)	Apparent Forage Consumption (lb./ewe/day)	Sheep-Days Per Acre	Gain Per Ewe (lb.)	Gain per Acre	Apparent Consumption per pound of Gain	Stocking Rate Pounds of Live weight per acre	Hay Yield 1955 (lb./acre)
1	1160	1000	2.78	358	14.3	35	26.25	259	3615
2	1120	880	2.72	325	14.2	36	24.25	237	3585
3	1210	1090	3.02	361	24.4*	50*	21	260	3760
4	1350	1105	2.79	373	14.5	42.25	26.5	294	3465
$\bar{x}$	1210	1020	2.82	354	16.8	40.8	24.5	262	....
$Se_{\bar{x}}$ %	9.0	10	6.3	6.6	6.6	7.7	7.9	9.4	....
P=0.05	N.S.	N.S.	N.S.	N.S.		3>1, and 2	N.S.	N.S.	
P=0.01					3>1, 2, and 4				

*Reduced gains by dog depredations.

and Lawrence (1958) suggest a reason for the greater gains on the Russian wild ryegrass-alfalfa pasture; their data show that the grass has a relatively high crude protein content, and a good balance of protein, carbohydrate, and mineral throughout the entire grazing period. Troelsen and Campbell (1959) rated Russian wild ryegrass higher in nutritive value than crested wheatgrass and intermediate wheatgrass after comparing the three species in a feeding and digestibility trial.

When Russian wild ryegrass-alfalfa is harvested for hay, the mixture usually yields less than crested wheatgrass-alfalfa. Although there is no significant difference in the pasture yields of these crops, as reported in Table 5, a slightly higher production of Russian wild ryegrass-alfalfa is indicated. This agrees with the reports of Thaine (1954) and Heinrichs and Lawrence (1958), who show that Russian wild ryegrass yields more than crested wheatgrass when clipped to simulate grazing. In part, the increased pasture yield may be due to the closer clipping when simulated grazing or actual grazing is practiced, but Thaine (1954) shows a significantly greater yield for Russian wild ryegrass when it is clipped three to five times per season than when one or two clippings are taken. The higher pasture yield of this species has not been recognized as one of its important characteristics, and should be exploited when its desirable qualities are being reported.

Crude protein contents of the four treatments during three years for spring, summer, and autumn are summarized in Table 6. The length of each season for all treatments has been set arbitrarily by the dates of changing pasture on Treatment 4, and is indicated on the gain line for Treatment 4 in Figure 1. The data presented show that the crude protein content of the Russian wild ryegrass-alfalfa mixture is significantly higher than for the other treatments. This factor, together with the slightly higher daily intake of the mixture, is credited with the significantly

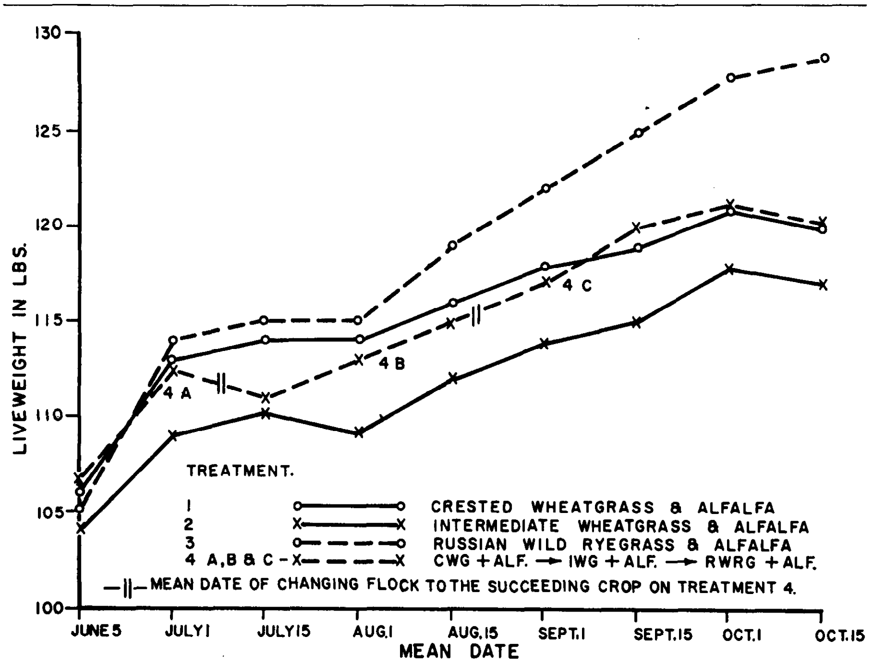

FIGURE 1. Average weight of 70 yearling ewes by treatment and dates, from date following shearing to the end of grazing season (1956 to 1959 inclusive).

Table 6. Crude protein in percentage by seasons and treatments

Treatment & Statistic	Spring Mean[1]	Summer Mean	Autumn Mean	Mean of 3 seasons for 1956, 7, 8
		(Percent)		
1	12.98	10.42	8.10	10.5
2	11.45	8.30	7.65	9.13
3	14.00	12.80	11.65	12.82
4	11.32	6.98	9.88	9.4
$\bar{x}$	12.44	9.62	9.3	
$Se_{\bar{x}}$ %	5.69	7.36	7.61	
P=0.05	3>2, and 4	1>2 3>1		
P=0.01		1>4 3>2, and 4	3>1, and 2	

[1]Each mean yield represents the analyses of three samples, one at the beginning, one at the middle, and a third at the end of each grazing period.

greater gain per ewe and per acre.

Losses from dog depredations occurred during mid-August, 1957, on both replicates of Treatment 3. Four ewes were killed and both flocks worried. The worried animals did not settle after this incident; they did not graze in a normal manner, were easily excited, and made no gains from mid-August to early October. Conversely, unmolested ewes on Treatment 4c, which was producing the same mixture, increased their mean live-weight by seven pounds. No allowance was made for the loss of the ewes nor for the expected gain during this period. This disturbance reduced the ewe gain and the live-weight gain per acre for the Russian wild ryegrass-alfalfa mixture. Nevertheless the mixture was still outstanding.

Treatment 4 produced rather inconclusive results. Although forage production, apparent consumption, grazing capacity, and sheep-days per acre were higher than for the other treatments, live-weight gain per ewe was no greater than for Treatments 1 and 2, and much less per ewe and per acre than for Treatment 3.

The data presented in Table 5 indicate that Treatment 4 had a slightly higher carrying capacity in terms of sheep-days per acre and rate of stocking than Treatments 1, 2, and 3. Both criteria were particularly high during the first two years of the test when forage production was above average. However, under dry conditions as in 1958 and 1959, these same measurements indicated a lower grazing capacity for Treatment 4 than for Treatments 1 and 3. This result is associated with the rate of autumn growth in relation to the acreage available. The slow growth on the small fields (1.2 acres) after the pasture reserve disappeared produced little more than enough feed to maintain the flocks. On fields three times the size, particularly Treatment 3, the slow autumn growth plus the disappearing reserve provided a supply sufficient for live-weight increases as well as maintenance.

Forage and livestock production results for Treatment 4 are summarized in Table 7. Forage production on Treatments 4a and 4c followed expectations; when harvested for hay. However, the forage yield on Treatment 4b was less than expected during all years; this is attributed to the rather poor catch of alfalfa, and to the loss of the grass during 1958.

Although the forage yield of Treatment 4b was less than expected, the stand had a relatively high carrying capacity as indicated by the sheep-days per acre reported in Table 7. Troelsen and Campbell (1959) suggest a reason for its relatively high grazing capacity, as they show that intermediate wheatgrass is less acceptable to sheep than either crested wheatgrass or Russian wild ryegrass. The data presented in Tables 5 and 7 suggest that the intermediate wheatgrass-alfalfa mixture was the least acceptable of those tested when apparent consumption per ewe-day was the unit of measurement.

Figure 1 presents the mean weight of the ewes by semimonthly intervals. The first weight is that on the day following shearing. Other than the greater gains recorded by Treatment 3, the interesting point presented is the slow rate of ewe gain during July and early Au-

Table 7. Forage and livestock production on treatment 4 from 1956 through 1959

Treatment	Forage Production (lb./acre)	Apparent Consumption (lb./ac.)	Apparent Consumption (lb./ewe/day)	Live-weight Gain (lb./acre)	Apparent Consumption lb. forage per lb. of gain	Sheep Days per Acre
4a	1560	1325	3.0	55	24.1	400
4b	1340	1060	2.05	32	33.1	398
4c	1145	940	2.2	40	23.5	322
$\bar{x}$	1350	1105	......	42.25	......	......
$Se_{\bar{x}}$ %	9.2	8.1	......	9.3	......	......
P=0.05	4a>4c	4a>4c	......	4a>4b and 4c	......	......

gust on all treatments. This characteristic of yearling ewes was noted during all years of this test as well as during previous trials.

Summary and Conclusion

Southwestern Saskatchewan is a naturally low rainfall region. In addition, the period from 1956 to 1959 was one of less-than-average precipitation. Nevertheless, this paper reports the relatively satisfactory grazing capacity of environmentally adapted grasses and legumes during those dry years.

A Russian wild ryegrass-alfalfa sward grazed from early May through mid-October was outstanding in stand maintenance and live-weight gains per ewe and per acre. Equal in stand maintenance and grazing capacity, but significantly lower in live-weight gain per ewe and per acre, was a continuously grazed crested wheatgrass-alfalfa pasture. Both mixtures are recommended for dryland pasture on the basis of this test, which confirms recommendations based on simulated grazing experiments reported by Kilcher *et al.* (1956).

The intermediate wheatgrass-alfalfa pasture produced well during the first two years. However, winter-killing of the grass after three years of grazing reduced the productivity of the sward. Although the loss of the grass is attributed to winter-killing, undoubtedly the grazing treatment predisposed its disappearance. Therefore, the mixture cannot be recommended for pasture of more than three years' duration.

One fault of the repeated season treatment showed up strongly during the drought years of 1958 and 1959. With very little autumn precipitation to promote new grass growth, the grass reserve created by the practice disappeared quickly from the restricted acreage. Although plant growth was no greater on the continuously grazed pasture, the large acreage provided a sufficient supply to maintain the flock till later dates in October.

The creeping-rooted strain of alfalfa used in this test maintained its stand in the spring grazed paddocks and persisted strongly in the autumn pastured fields, but decreased on the continuously and summer grazed pastures. No bloat was experienced on any treatment.

The conclusions deduced from this test are as follows: (1) that Russian wild ryegrass, crested wheatgrass, and the creeping-rooted strain of alfalfa included in the mixtures are suitable pasture crops for Southwestern Saskatchewan and presumably would be useful in adjacent districts within the Northern Great Plains; (2) that intermediate wheatgrass cannot be recommended for long-term pastures; and (3) a repeated seasonal pasture employing the crops listed in Treatment 4 cannot be recommended over continuous pasturing of Russian wild ryegrass-alfalfa or crested wheatgrass-alfalfa pastures.

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NOTICE TO THE SCHOOLS

Not all schools contributed to the list of theses compiled by Floyd E. Kinsinger and Richard E. Eckert, Jr. and published in No. 1, Volume 14 of the Journal. Some additional material, recently received, will be published in subsequent numbers of Volume 14. Hereafter, an annual list of theses will be published in the January Journal. Lists not received for this annual publication cannot be handled at a later day. Send your material to Kinsinger or Eckert.