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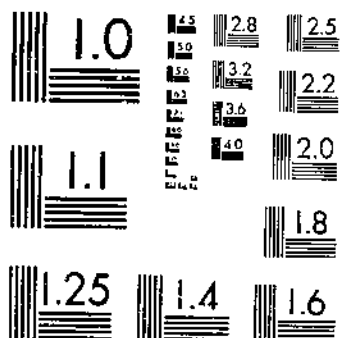
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COMPARISON OF ALFALFA AND WESTERN WHEAT GRASS HAYS FOR WINTERING

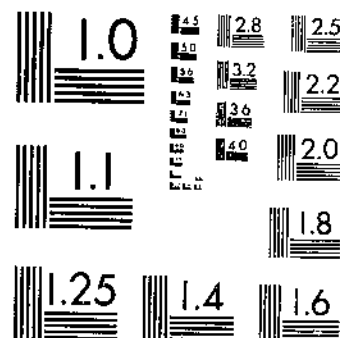
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UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

COMPARISON OF ALFALFA AND WESTERN WHEAT-
GRASS HAYS FOR WINTERING YEARLING
HEIFERS IN THE NORTHERN GREAT
PLAINS AND THEIR INFLUENCE
ON SUMMER GAINS ^{1 2}

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United States Department of Agriculture, Bureau of Animal Industry,
in cooperation with the Montana Agricultural Experiment Station

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THE AREA AND ITS PROBLEMS

The winter feeding and management of female stock used as replacements in breeding herds maintained for the production of feeder steers represent an important problem in the beef-cattle industry of the northern Great Plains.

The area includes nearly 130,000,000 acres of land in eastern Montana, northeastern Wyoming, and the western parts of North Dakota and South Dakota. The area comprises 2 percent of irrigated land, 12 of farming, 12 of farming-grazing, 13 of grazing-forage, 54 of grazing, and 7 percent of national forests. The average annual precipitation varies from 13 inches at Assiniboine in north-central Montana to 17.6 inches at Dickinson in southwestern North Dakota. At Miles City, Mont., where the experiments reported herein were conducted, the average yearly precipitation during the period was 13.4 inches. Because of the dry summers, cold winters, and successive crop failures, and the fact that there is a large proportion of grazing land and a relatively small proportion of tillable farm land, the area is best adapted for grazing by livestock. The production of winter feed for emergency as well as for regular winter use is of fundamental importance to the cattle industry as a whole.

¹ Submitted for publication April 20, 1938.
² The experiments were planned and directed by W. H. Black and J. R. Quisenberry, senior animal husbandmen, Animal Husbandry Division, Bureau of Animal Industry, and C. N. Arnett (deceased), professor of animal husbandry, Montana Agricultural Experiment Station.

In the northern Great Plains heifers usually do well until the middle or end of December, or until the arrival of prolonged subzero temperatures, but after that time large losses in weight are likely to result. The wintering of yearling heifers is often complicated by the fact that some stockmen make a practice of breeding them to calves as 2-year-olds. The movement of cattle in and out of the feed lot in order to obtain a maximum use of native range, together with the use of an adequate quantity of hay or other roughage to carry the cattle safely through the winter, constitutes a real problem on most ranches. Native range represents the area's cheapest feed, but since droughts occur without warning every ton of hay saved is always good insurance for future needs.

Roughages commonly available for wintering purposes include western wheatgrass hay, alfalfa hay, grain hay, and straw. In the past, western wheatgrass constituted the principal source of roughage for cattle of all ages. This hay was cut on upland sections during wet years and regularly on flooded creek-bottom meadows. Many of the latter have been plowed and seeded to alfalfa in recent years with considerable success, particularly when the fields were subirrigated or where irrigation water from gravity ditches was available. The yield of alfalfa hay per acre from lands of this type has been greater than that obtained from western wheatgrass, but the relative feeding value of the two hays has been more or less controversial.

SCOPE OF EXPERIMENTS

The experiments reported in this bulletin were made to determine (1) the relative values of alfalfa and western wheatgrass (bluestem) hays for wintering yearling heifers and (2) the influence of winter feeds and gains on subsequent gains on grass. These experiments extended from the winter of 1926-27 through the summer grazing season of 1929.

The work was conducted at the United States Range Livestock Experiment Station, formerly the Fort Keogh Military Reservation, located at Miles City, Mont., near the center of the northern Great Plains. The station comprises 56,300 acres, 46,915 of which are in a triangle between the junction of the Tongue and Yellowstone Rivers and 9,385 acres on the north side of the Yellowstone River. Approximately 650 acres are devoted to the production of irrigated alfalfa, 700 acres to the production of dry-land crops, and the remainder is utilized as winter and summer range for cattle, sheep and horses.

EXPERIMENTAL PROCEDURE

HEIFERS USED AND METHODS OF HANDLING

The heifers used in these experiments were purebred Herefords raised at the station. They were born on the range between April 10 and June 1 each year. Part of the animals used in experiment 1 were wintered, as calves, on alfalfa hay and the remainder, also as calves, on alfalfa hay and corn silage. Heifers in experiments 2 and 3 were used, as calves, in an experiment to determine the effect, on winter gains and feed costs and on subsequent gains on grass, of feeding alfalfa hay alone and in combination with cottonseed cake and corn

silage. The results of the last two experiments with the calves have been published.³

The heifers were carried in a single group on fall range each year until the arrival of severe cold weather and were then moved to headquarters, weighed, divided into two groups, and fed either alfalfa or western wheatgrass hay. In dividing the heifers into the two experimental groups, care was observed to obtain uniformity of weight as well as uniformity of previous winter treatment. Group 1 received a full feed of alfalfa hay, and group 2 a full feed of western wheatgrass hay each morning from a weighed load stored in the end of the bunker. Daily hay weighings were not made.

The initial and final weights of the heifers for the winter-feeding period were the average of 3 consecutive days' weights taken at the beginning and close of the feeding period. The winter-feeding experiments were begun with the afternoon feeding on the second day of weighing. Weights were taken between 10 and 11:30 a. m. Intermediate weights were taken at the close of each 28-day period through the feeding season. A single weighing at the end of the summer-range season marked the close of the experiment.

During the winter season the heifers were quartered in corrals, each having a long open shed facing south and east. Hay was fed in pole bunkers, parallel to and approximately 100 feet in front of the sheds. Salt and water were available at all times. Water for both groups was supplied from a central concrete tank supplied by a flowing well and located at the partition fence. Tank heaters were used during extremely cold weather to insure a regular supply of water.

WINTER FEEDS USED

The alfalfa and western wheatgrass hays used in these feeding experiments were produced under irrigation on the station farm. There was considerable variation in the quality of the two types of hay fed in a single year, as well as in each kind fed from year to year. The two hays, on the whole, were more nearly comparable in the last experiment than in the two previous ones, both hays fed in 1929 being of poor quality. The wheatgrass hay used in the first 2 years was of excellent quality, being superior to the alfalfa hay used during the same experiments.

The alfalfa hay varied considerably throughout the experiments in quantity of foreign material, such as stubble rakings, which ranged from 10 to 40 percent. Its quality was also impaired because of bleaching and a high percentage of stems to leaves.

The wheatgrass hay likewise contained from 10 to 40 percent of foreign material in the 3 years, but the foreign material consisted largely of sweetclover and sunflowers, which did not impair the quality of this hay so much as did the stubble and foxtail barley (*Hordeum jubatum* L.) in the alfalfa hay.

Table 1 shows the average chemical analyses of the winter feeds used.

³ BLACK, W. H., QUEENBERRY, J. R., and BAKER, A. L. EFFECT OF DIFFERENT METHODS OF WINTERING BEEF CALVES, IN THE NORTHERN GREAT PLAINS, ON WINTER GAINS AND FEED COSTS AND ON SUBSEQUENT SUMMER GAINS. U. S. Dept. Agr. Tech. Bull. 529, 11 pp., illus. 1930.

TABLE 1.—Average chemical analyses of winter feeds used, 1927-29

Feed	Water	Ash	Protein	Crude fiber	Nitrogen-free extract	Fat
	Percent	Percent	Percent	Percent	Percent	Percent
Alfalfa hay.....	4.65	7.30	13.50	38.10	35.99	1.42
Wheatgrass hay.....	3.91	8.12	6.69	40.36	39.22	3.54

SUMMER RANGE

Two-year-old heifers were placed in the different breeding groups about July 1 of each year, for a 6- to 7-week breeding season. The general practice was to graze the heifers and dry cows together, on a range apart from the cows with calves, from the close of the breeding season until the close of the summer-grazing season. The rate of stocking on summer range varied from year to year with the numbers of available cattle, but in general all ranges were understocked and grazing conditions, insofar as available feed was concerned, were satisfactory. Grazing conditions were favorable in all years but were better in 1927 and 1929 than in 1928. A charge of 1 cent per head per day was made for grazing during the three experiments.

WEATHER CONDITIONS DURING THE EXPERIMENTS

Table 2 shows the average temperatures and precipitation at Miles City during the winter-feeding and summer-grazing experiments.

TABLE 2.—Meteorological data¹ during the winter-feeding and summer-grazing experiments at Miles City, Mont.

WINTER-FEEDING EXPERIMENTS

Month	Average temperature			Total precipitation		
	1927	1928	1929	1927	1928	1929
	°F.	°F.	°F.	Inches	Inches	Inches
January.....	16.2	20.6	3.0	0.61	0.44	0.90
February.....	20.7	24.1	8.8	.22	.38	.38
March.....	35.2	38.0	36.7	.23	.54	1.72
Average or total.....	24.0	27.6	16.2	1.06	1.36	3.00

SUMMER-GRAZING EXPERIMENTS

April.....	44.4	43.0	44.7	2.37	0.43	0.70
May.....	52.0	62.2	53.3	4.74	.47	2.23
June.....	64.0	60.7	64.4	1.72	2.83	2.94
July.....	71.6	71.8	76.0	1.32	4.78	.70
August.....	68.7	68.8	75.8	2.54	.14	.28
September.....	58.4	58.4	55.4	1.80	.34	1.86
October.....	50.9	49.4	50.2	.33	1.34	1.05
Average or total.....	58.6	58.8	60.0	14.82	10.33	9.76

¹ Data obtained from the station of the U. S. Weather Bureau at Miles City.

RESULTS OF EXPERIMENTS

EXPERIMENT I

On January 5, 1927, the heifers were brought to the feed lot at headquarters, weighed, and divided into two uniform groups. Winter feeding was then begun, one group receiving alfalfa hay and the other

western wheatgrass hay. The winter-feeding period was terminated on April 12, at the end of a 97-day feeding period, and the heifers were placed on spring range. They were placed with the breeding herds on June 22, bulls were turned out on June 30 and July 1 and were removed on August 20. The summer-range season was terminated on October 28, at the close of a 199-day period.

The results of the first winter-feeding and summer-grazing season (table 3) show that heifers in group 2, fed 19.5 pounds of wheatgrass hay per day, produced greater winter gains, slightly smaller summer gains, and greater total gains than heifers wintered on 20.3 pounds of alfalfa hay per day. There was no significant difference between the two groups in the total feed and range cost per head for the entire experiment. However, there was a slight saving in favor of the use of wheatgrass hay, which may be attributable to the better quality of this feed.

The difference in feed and range cost for similar gains, with prices of hay the same, does not show any significant advantage of wheatgrass hay over alfalfa hay in this experiment.

TABLE 3.—Summary of experiment 1, January 5 to October 28, 1927

Item	Group 1, fed 20.3 pounds of alfalfa hay per day	Group 2, fed 19.5 pounds of wheat- grass hay per day
Heifers in lot.....	number.....	number.....
Averages for winter period (Jan. 5 to Apr. 12).....	days.....	days.....
Initial weight per heifer.....	pounds.....	pounds.....
Gain per heifer.....	do.....	do.....
Hay consumed per heifer.....	do.....	do.....
Salt consumed per heifer.....	do.....	do.....
Feed cost per heifer ¹	dollars.....	dollars.....
Averages for summer-range period (Apr. 12 to Oct. 28).....	days.....	days.....
Final weight per heifer.....	pounds.....	pounds.....
Gain per heifer.....	do.....	do.....
Range cost per heifer.....	dollars.....	dollars.....
Averages for winter and summer periods.....	days.....	days.....
Gain per heifer.....	pounds.....	pounds.....
Daily gain per heifer.....	do.....	do.....
Feed and range cost.....	dollars.....	dollars.....

¹ Of 21 heifers in the original group, 5 calved and were removed.

² Of 21 heifers in the original group, 4 calved and were removed.

³ At the following prices per ton: Alfalfa hay and wheatgrass hay, \$8; salt, \$24. Range use estimated at 1 cent per head per day.

EXPERIMENT 2

On January 10, 1928, the heifers were brought to headquarters, weighed, and divided into two uniform groups. Wintering on alfalfa and wheatgrass hays was then begun. Winter feeding was terminated on April 3 at the end of 84 days, and the heifers were placed on spring range. They were turned with breeding herds on June 22. The bulls were turned out on July 2 and 3 and were removed between August 13 and 18. The summer-range season was terminated on October 19, at the end of a 199-day period.

The results of the second winter-feeding and summer-grazing season (table 4) show that heifers in group 2, fed 19.5 pounds of wheatgrass hay per day, produced slightly greater winter gains, slightly lower summer gains, and slightly lower total winter and summer gains than heifers in group 1, winter-fed a ration of 22.8 pounds of alfalfa hay. The total feed and range cost per head for the entire

experiment was \$1.11 greater for heifers wintered on alfalfa hay. The wheatgrass hay fed during this trial, as during the initial trial, was considered to be slightly superior to the alfalfa hay on a market-grade basis.

TABLE 4.—*Summary of experiment 2, January 10 to October 19, 1928*

Item	Group 1, fed 22.8 pounds of alfalfa hay per day	Group 2, fed 19.5 pounds of wheat- grass hay per day
Heifers in lot.....	number.....	115.....
Averages for winter period (Jan. 10 to Apr. 4).....	days.....	84.....
Initial weight per heifer.....	pounds.....	685.....
Gain per heifer.....	do.....	46.....
Hay consumed per heifer.....	do.....	1,917.....
Salt consumed per heifer.....	do.....	4.....
Feed cost per heifer ¹	dollars.....	7.67.....
Averages for summer-range period (Apr. 3 to Oct. 19).....	days.....	199.....
Final weight per heifer.....	pounds.....	977.....
Gain in weight per heifer.....	do.....	238.....
Range cost per heifer.....	dollars.....	1.99.....
Averages for winter and summer periods.....	days.....	283.....
Gain per heifer.....	pounds.....	282.....
Daily gain per heifer.....	do.....	1.00.....
Feed and range cost.....	dollars.....	9.60.....

¹ Of 18 head in the original group, 3 calved and were removed.

² Of 18 head in the original group, 2 died accidentally and 1 calved.

³ See footnote 3, table 3.

Heifers in group 1, fed alfalfa hay, consumed on the average 3.3 pounds more per head per day than the heifers in group 2 fed wheatgrass hay. The higher consumption of alfalfa hay was responsible for the increased feed costs for the heifers fed this hay. There was no significant difference in final weights or gains between the two groups of heifers in the second trial, but as significantly less hay was required by the heifers fed wheatgrass, and as their gains per head were essentially the same, there was a material advantage in favor of the use of wheatgrass hay.

EXPERIMENT 3

On January 23, 1929, the heifers were brought to headquarters, weighed, and divided into two uniform groups. Winter feeding of alfalfa and wheatgrass hays was then begun. The winter-feeding season was terminated on April 2, at the end of 69 days, and the heifers were then placed on spring range with yearling steers and heifers. They were added to the breeding herds on June 26, bulls were turned out on July 2 and 3 and were removed between August 13 and 18. The summer-range season was terminated on October 22, at the end of a 203-day period.

The results of the third winter-feeding and summer-grazing period (table 5) show that heifers fed 24.8 pounds of alfalfa hay per day produced significantly greater winter gains and slightly lower summer gains than a similar group of heifers fed 21.2 pounds of wheatgrass hay per day. However, the total gains were essentially the same for both groups. The heifers in group 1 consumed on the average 3.6 pounds more hay per head per day at an added winter feed cost of \$1 per head, which also represented the difference in the total feed and range

cost per head. As already stated, the wheatgrass hay fed during this trial was inferior in quality to wheatgrass hay fed during previous trials but was nearly comparable in quality to alfalfa hay fed during this third experiment.

TABLE 5.—Summary of experiment 3, January 23 to October 22, 1929

Item	Group 1, fed 24.8 pounds of alfalfa hay per day	Group 2, fed 21.2 pounds of wheatgrass hay per day
Heifers in lot.....number.....	23	122
Averages for winter period (Jan. 23 to Apr. 2).....days.....	69	69
Initial weight per heifer.....pounds.....	668	675
Gain per heifer.....do.....	41	19
Hay consumed per heifer.....do.....	1,712	1,461
Salt consumed per heifer.....do.....	1.06	1.00
Feed cost per heifer ¹dollars.....	0.87	0.87
Averages for summer-range period (Apr. 2 to Oct. 22).....days.....	203	203
Final weight per heifer.....pounds.....	1,000	1,003
Gain per heifer.....do.....	291	300
Range cost per heifer ¹dollars.....	2.03	2.03
Averages for winter and summer periods.....days.....	272	272
Gain per heifer.....pounds.....	332	323
Daily gain per heifer.....do.....	1.22	1.21
Feed and range cost ¹dollars.....	8.40	7.90

¹ Of 23 head in the original group, 1 calved and was removed.

² See footnote 3, table 3.

AVERAGE RESULTS OF THE THREE EXPERIMENTS

The results of the three experiments are summarized in table 6, which shows that groups of yearling heifers, one of which was wintered an average ration of 22.7 pounds of alfalfa hay, and the other, 20 pounds of western wheatgrass, or bluestem, hay for 82 days, made essentially the same winter and summer gains. Approximately 12 percent more alfalfa hay than of western wheatgrass hay was required for the same gains. As a result of the difference in hay consumption, the winter feed cost per heifer of the group receiving alfalfa hay was \$0.80 higher than of the group receiving western wheatgrass hay.

TABLE 6.—Summary of the three experiments

Item	Group 1, fed an average of 22.7 pounds of alfalfa hay per day	Group 2, fed an average of 20 pounds of wheatgrass hay per day
Heifers in lot.....number.....	54	54
Averages for winter period.....days.....	82	82
Initial weight per heifer.....pounds.....	684	685
Gain per heifer.....do.....	33	40
Hay consumed per heifer.....do.....	1,846	1,645
Salt consumed per heifer.....do.....	1.4	1.4
Feed cost per heifer ¹dollars.....	7.40	6.60
Averages for summer-range period.....days.....	201	201
Final weight per heifer.....pounds.....	1,003	1,005
Gain per heifer.....do.....	281	280
Range cost per heifer ¹dollars.....	2.01	2.01
Averages for winter and summer periods.....days.....	283	283
Gain per heifer.....pounds.....	319	320
Daily gain per heifer.....do.....	1.13	1.13
Feed and range cost ¹dollars.....	9.41	8.61

¹ See footnote 3, table 3.

SUMMARY AND CONCLUSIONS

Experiments were carried on with purebred Hereford yearling heifers through three winter and three summer grazing seasons to determine (1) the relative value of alfalfa and western wheatgrass, or bluestem, hay and (2) the influences of winter feeds and gains on subsequent gains on summer range. These experiments were conducted from the winter of 1927 through the summer grazing season of 1929 at the United States Range Livestock Experiment Station at Miles City, Mont.

The alfalfa hay fed during the experiments was considered to be approximately equal in market grade to the western wheatgrass hay in 1929 and inferior to the wheatgrass hay in 1927 and 1928. Most of the alfalfa hay was stemmy and bleached and contained a considerable quantity of foxtail barley (*Hordeum jubatum* L.) common to irrigated sections, but all of it was considered to be satisfactory for winter feeding yearling heifers.

The results show that approximately 12 percent more alfalfa hay than of western wheatgrass hay of the qualities used was required for the production of similar winter gains. These gains were followed by similar summer gains, regardless of the kind of hay fed. The wheatgrass hay valued at the same rate per ton as alfalfa hay was therefore slightly less expensive from the standpoint of winter feed cost.

END