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Grass Hay at its Best

A. L. Moxon

G. Gastler

G. E. Staples

R. M. Jordam

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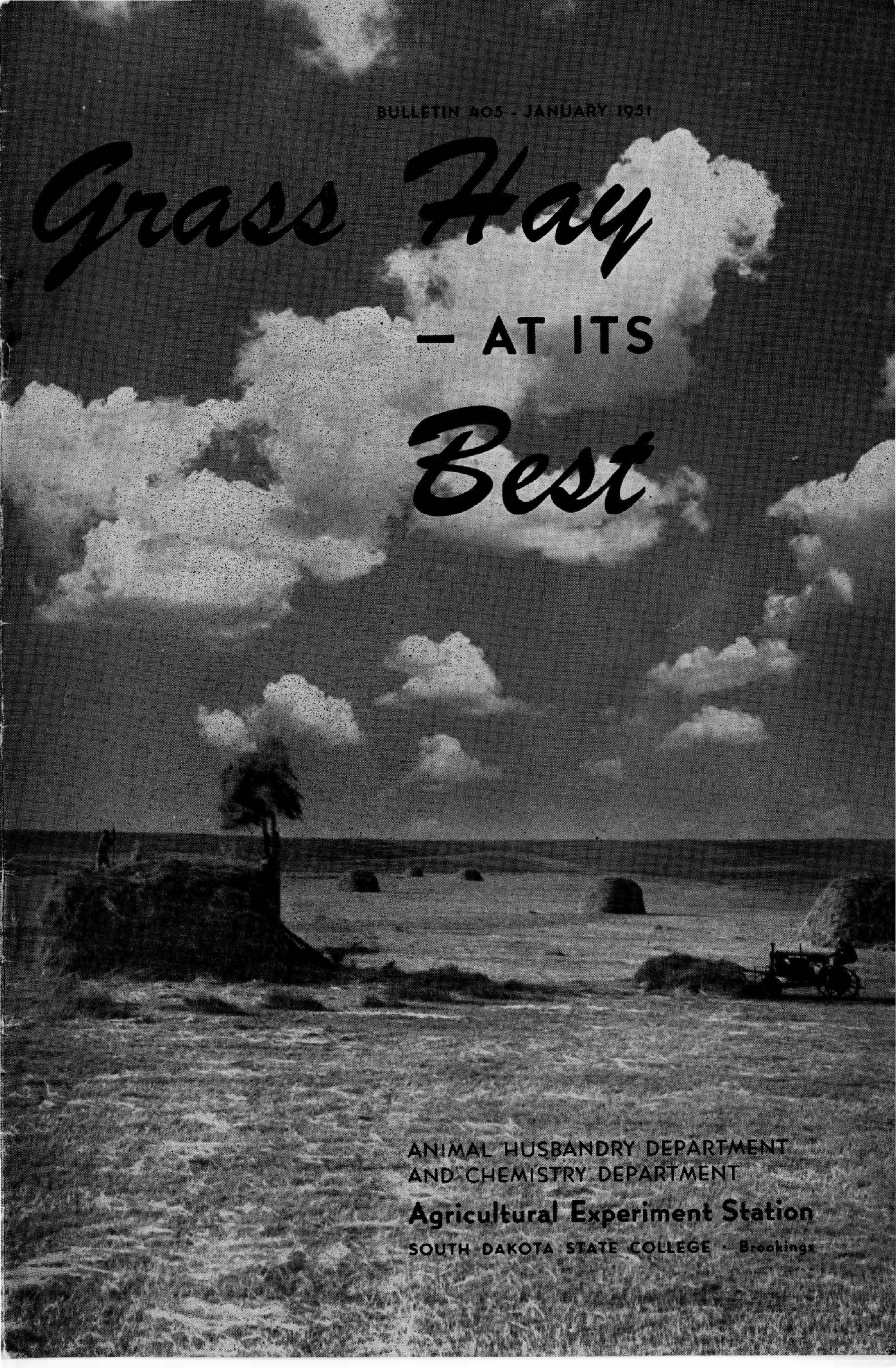
BULLETIN 405 - JANUARY 1951

Grass Hay — At Its Best



ANIMAL HUSBANDRY DEPARTMENT
AND CHEMISTRY DEPARTMENT

Agricultural Experiment Station

SOUTH DAKOTA STATE COLLEGE · Brookings

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GRASS HAY AT ITS BEST

As Shown by Chemical Analysis and Feeding Value

By A. L. Moxon, G. Gastler, G. E. Staples, R. M. Jordan[1]

"The primary food is grass. Grass feeds the ox: the ox nourishes man: man dies and goes to grass again; and so the tide of life, with everlasting repetition, in continuous circles, moves endlessly on and upward, and in more sense than one, all flesh is grass."—John James Ingalls, Kansas Magazine 1872.

Grass is the greatest single asset of the Northern Great Plains. Without it this area would be a wasteland and the flocks and herds would perish. It serves, and must continue to serve, as the basic feed for cattle and sheep which obtain 75 to 95 percent of their feed from this source.

Efficient range management and range livestock production include the cutting and storing of prairie hay for use during winters and in times of drought. Unfortunately, man does not always harvest or store it as well as he might. Our prairie grasses can be harvested as hay any time from late June until winter weather prevents haying operations, but the question is: when is the **best** time to cut our prairie hay? The patient nature of this valuable crop in awaiting the harvest, and the pressing work of the summer cause many stockmen to lose sight of the fact that there is a "best" time to harvest prairie hay.

Losses in valuable nutrients from prairie hay, when the opportune time for harvest is past, are not so evident to the eye as with such crops as our small grains. However, even though in outward appearance the grasses may seem to change comparatively little from July to October, important changes, which exert great influence on the feeding value, actually are taking place in the chemical composition of the hay.

With an ever increasing demand for food and the need for greater efficiency of production, it is important that the nutrients available in grass be conserved and utilized to the greatest possible extent. To accomplish this it is necessary that stockmen be provided with more complete and accurate information pertaining to the nutritive value of hay from this area. That is the purpose of this bulletin, based on investigations that have been conducted during the past eight years by the South Dakota Agricultural Experiment Station.

The first stage of the investigation was to determine the changes in chemical composition that occurred in grasses during the growing season. The later stages of the investigation included digestibility and feeding trials to determine the relationship of chemical composition to actual feeding value. In addition, yield studies were conducted to determine the relationship of time of cutting to yields.

[1]Chemist, Assistant Chemist, and Assistant Animal Husbandmen, respectively, of the South Dakota Agricultural Experiment Station.

Acknowledgment is made to Dr. L. E. Johnson, Dr. Charles Hobbs, Arnold B. Nelson, C. J. Franzke, Dr. W. E. Dinusson, E. I. Whitehead, and Dr. Frank G. Viets, Jr. for their contributions to this work.

Chemical Composition of Blue Grama and Western Wheatgrass

Although the complete nutritive value of a plant is not shown by chemical analysis, an approximate feeding value is indicated, and a study of the chemical composition of grasses cut at various growth stages can be a guide in making more efficient use of the forage grown in this state.

Causes of certain nutritional deficiency diseases have been accounted for by chemical studies of grasses cut at various stages of growth. Grass which is low in phosphorus is more likely to cause livestock dependent upon it to suffer from phosphorus deficiency disease than grass which has a high phosphorus content. Grasses which are high in crude protein and low in crude fiber have a relatively high nutritive value.

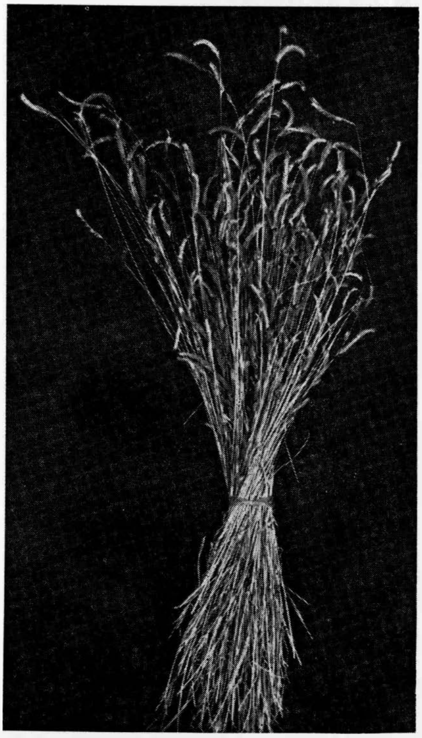
Two of the more important grasses, well-established in the state, are blue grama *(Bouteloua gracilis)* and western wheatgrass *(Agropyron smithii)*. Blue grama, a warm season grass which starts growth late in the spring, is considered to be the most valuable of the short grasses, while western wheatgrass, a cool season grass, is an outstanding mid-tall grass. According to a survey completed by the South Dakota Agricultural Experiment Station and the Soil Conservation Service in 1940, blue grama and western wheatgrass were among the five most important and most abundant grasses in the state.

Research on the chemical characteristics of the two grasses at different growth stages was done on replicated plots in 11 areas in South Dakota during the years 1942 to 1946, inclusive.

During World War II a number of ranchers in central and western South Dakota adopted the practice of leaving hay in windrows for winter feed, rather than stacking it, because of the acute labor shortage. A study of the changes in the chemical composition of hay left in windrows was made and the results are included.

Methods or Experimental Procedure

The state was divided into 11 areas based on soil types and climatic conditions as shown on the South Dakota map (Fig. 1). Location of the replicat-



Blue grama *(Bouteloua gracilis)* a short, warm-season grass, starting growth late in the spring.

ed sampling plots for each of the areas is also shown on the map. Both western wheatgrass and blue grama were available at each plot at the time the plot was located and fenced.

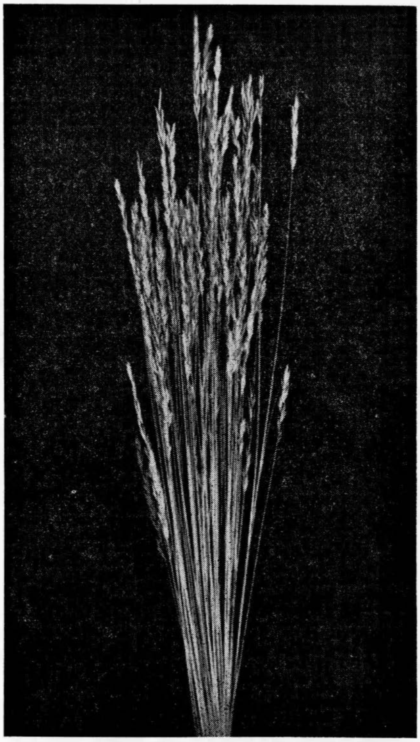
Samples of the two species of grasses were collected at various intervals during the season, the time of sampling being determined by the stage of growth of the plant. In 1942, when the experiment was started, each grass was sampled at the seed-ripe stage. In 1943 and 1944, western wheatgrass was sampled at three different growth stages (shooting, seed-ripe, and over-mature). Two samples of blue grama (seed-ripe and over-mature) were taken in 1943, and three, (shooting, seed-ripe, and over-mature) in 1944. Samples of both grasses were taken in 1945 and 1946 from several of the areas.

After cutting, the samples were weighed, air-dried, ground, and analyzed. Standard methods of chemical analysis[2] were used to determine crude fat, crude protein, ash, crude fiber, nitrogen-free extract, phosphorus, calcium, manganese, iron and carotene. For purposes of comparison, all the analyses of the grasses given here are calculated to a dry-hay basis with a moisture content of 12 percent.

Results and Discussion

Protein. The crude protein content showed a very definite seasonal decline, both species of grasses showing marked decreases as they matured. This situation was found to be true for every year. Livestock need supplementary protein feeds when the mature grass fails to provide enough protein to meet their requirements. Growing cattle need more protein than mature animals, and many of the protein values for the mature grasses of both species show a deficiency of protein. Considerably more protein for feed from either western wheatgrass or blue grama grass is obtained from the first cutting or shooting stage.

[2]Methods used were those of the Association of Official Agricultural Chemists.



Western wheatgrass *(Agropyron smithii)* a mid-tall, cool season grass, one of the abundant grasses.

Ether Extract. The ether extract, or crude fat content, was found to be variable for both species of grasses. The crude fat content of blue grama was about half that of western wheat-

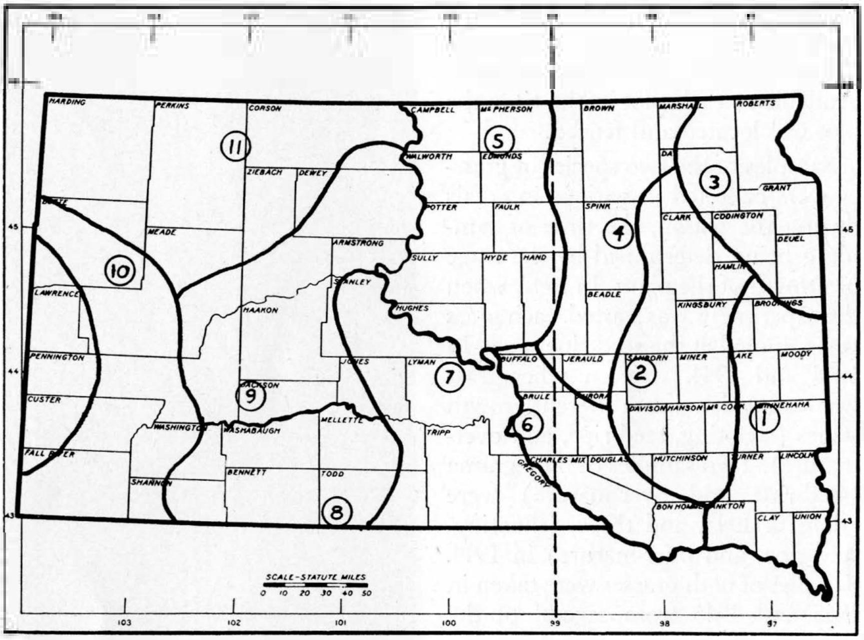


Fig. 1. Location of Grass Plots in South Dakota.

1. **MINNEHAHA COUNTY—4 miles north, one-half mile east of Humboldt.**
2. **SANBORN COUNTY—9 miles east of Woonsocket.**
3. **DAY COUNTY—1 mile west, one-half mile north of Webster.**
4. **SPINK COUNTY—9 miles south, three-fourths mile west of Redfield.**
5. **McPHERSON COUNTY — Eureka substation.**
6. **BRULE COUNTY—2 miles northeast, 1½ miles east of Chamberlain.**
7. **LYMAN COUNTY—Reed Ranch.**
8. **TODD COUNTY—Tom Arnold's Ranch.**
9. **JACKSON COUNTY—Cottonwood substation.**
10. **BUTTE COUNTY—Newell Federal Station**
11. **PERKINS COUNTY—18 miles south, 1¼ miles east of Lemmon.**

grass. Either species will add little fat to the diet, but a large amount of fat is not essential for range animals; other constituents, for example carbohydrates, can readily be changed to fat in the animal's body.

Crude Fiber. The highest crude fiber values usually were found in the third cutting, or over-mature growth stages, of both species of grasses. Grass with high crude fiber content usually is associated with low digestibility. Therefore, there may be a wide difference in feeding value between the shooting and over-mature stages of both species of grasses.

Nitrogen-free Extract. The nitrogen-free extract contents of the grasses represent roughly the more digestible carbohydrates of the plants, although large portions of it may not be utilized by the animal. Nitrogen-free extract content was found to be variable for western wheatgrass, while that of blue grama showed a slight increase as the grass matured.

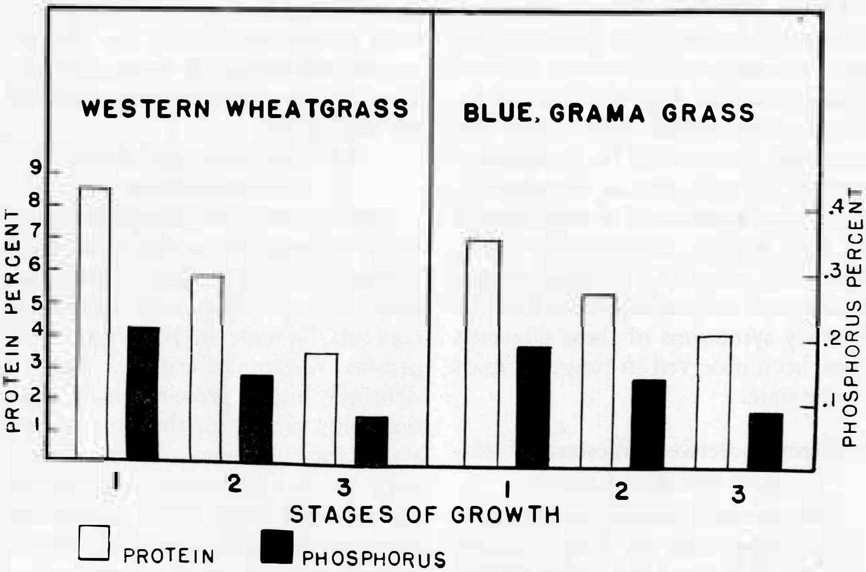


Fig. 2. Average protein and phosphorus content of western wheatgrass and blue grama cut at different growth stages during 1942 to 1946. Stages of Growth: 1. Shooting. 2. Seed-ripe. 3. Mature.

Phosphorus. Phosphorus presents the same picture as protein, with the seasonal trend for phosphorus content being downward. The average phosphorus contents of the two grasses are remarkably similar (Fig. 2) for the time of cutting. A phosphorus content of .13 percent is considered to be the deficiency borderline value for maintenance of mature beef cattle. Nearly all values obtained show that the phosphorus content has dropped below this borderline value by the third cutting, or the over-mature growth stage. For some of the plots, the phosphorus content already is below the borderline value at the time of the second cutting, or seed-ripe stage.

Both calcium and phosphorus are important minerals for livestock, but in South Dakota phosphorus is more likely to be the mineral deficient in the more mature grasses. Inadequate amounts of phosphorus can result in deficiency diseases. For cattle dependent on the mature stage of growth of the grasses as pasture or hay, bonemeal or other suitable supplemental sources of phosphorus should be supplied. All tables show that a low phosphorus content in both species of grasses is associated with a low protein content.

Calcium. A deficiency of either calcium or phosphorus in the diet will cause poor skeletal growth and deficiency symptoms in animals. The calcium contents of both species of grasses at all stages of growth probably are sufficient to meet the needs of range animals. Both species of grasses showed little seasonal changes in calcium content as they matured.

Other Minerals. Recent work on mineral deficiencies in livestock has shown that the individual mineral constituents of the ash should be given more consideration than the total ash content. The manganese content of each species increased as the grasses matured. The iron content of each species showed wide variation. The values for manganese and iron appear to be adequate and no deficiency symptoms of these elements have been observed in range animals in the state.

Differences Between Western Wheatgrass and Blue Grama

The average chemical composition of the two grasses cut at three different growth stages from 1942 to 1946 is given in Table 1. Some differences in composition of the two species for the 5-year period were found: the outstanding difference being the ether extract, or crude fat value, which in western wheatgrass was almost twice that of blue grama for each of the three stages of growth. The crude fiber content of western wheatgrass was slightly higher than that of blue grama. The ash content and some of the constituents of ash such as calcium, manganese and iron were, in general, slightly higher in blue grama than in western wheatgrass. The nitrogen-free extract of western wheatgrass was below the value obtained for blue grama.

Effect of Time of Cutting on Composition

Crude protein and phosphorus contents decrease from the first stage through the third, while at the same time the crude fiber and manganese contents increase in both species of grasses. Western wheatgrass shows a definitely higher protein content than does blue grama for the first growth stage; the differences for the second stage are less noticeable; and for the third growth stage, crude protein has decreased until there is less in western wheatgrass than in blue grama (See Table 1).

The over-mature stages of both grasses show a phosphorus content of less than half that present in the first or shooting stage of growth.

Average percentages of crude protein and phosphorus in the two species at different stages of growth are shown by the bar graph in Fig. 2. Protein and phosphorus are two dietary constituents which have been found most likely to be deficient in the over-mature stage of these grasses.

Table 1. The Average Chemical Composition (Percent) of Western Wheatgrass and Blue Grama Cut at Different Stages from 1942 to 1946. 12 Percent Moisture Basis.

	Ash	Crude Protein	Crude Fiber	Ether Extract	Nitrogen Free Extract	Cal-cium	Phos-phorus	Manganese*	Iron*
Western Wheatgrass									
Shooting	7.59	8.56	29.18	2.57	40.11	.29	.21	5.67	254.28
Seed-ripe	7.46	5.86	29.62	3.01	42.06	.32	.14	9.82	98.15
Mature	8.16	3.46	32.29	2.71	41.39	.29	.08	13.64	221.93
Blue Grama									
Shooting	8.11	7.03	28.99	1.35	42.51	.37	.19	8.16	113.6
Seed-ripe	8.34	5.40	29.06	1.6	43.61	.37	.14	12.90	218.17
Mature	9.31	4.17	29.31	1.42	43.79	.32	.09	16.86	354.39

*parts per million

Area Differences. Differences between areas in chemical composition of the two species are shown in Appendix Table 1 for the year, 1944. The crude protein content of western wheatgrass at the shooting stage ranged from a high of 10.26 percent in one area (Area 2) to a low of 5.50 percent in another area (Area 8). A high crude protein value of 8.53 percent (Area 1) and a low of 4.99 percent (Area 8) were found in blue grama at the same growth stage. Both low crude protein values were found in the same area.

Phosphorus content for the shooting stage of western wheatgrass ranged from .24 percent (Area 2) to .15 percent (Area 8). The area showing the highest total crude protein content of both grasses at the shooting stages (Area 2) also showed the highest total phosphorus content. A similar relationship is held in the area showing the lowest total crude protein (Area 8). Variations in chemical composition found among the 11 areas may be due to a number of factors such as fertility of the soil, elevation. and seasonal climatic conditions.

Variations Within Individual Areas. Comparison of values within three areas (Appendix Table 2) shows the variation in the chemical composition of the same species in the same area. Values for three of the areas sampled in 1946 are typical. The widest differences are in the crude protein, ash, and manganese values for western wheatgrass, and ash and manganese for blue grama in Area 7.

Annual Differences. Five-year values for the seed-ripe stage of both species in two of the areas sampled are shown in Table 2. These values are examples of the difference found from year to year at the same stage of growth. Wide differences are noticed among the mineral content values (calcium, phosphorus, manganese, and iron). Seasonal climatic variations may cause differences in the composition of a given species of grass from one year to another.

Table 2. Composition (Percent) of Western Wheatgrass and Blue Grama Cut at the Seed-ripe Stage in Areas 6 and 9 from 1942 to 1946. 12 Percent Moisture basis.

Date	Location Area No.	Ash	Crude Protein	Crude Fiber	Ether Extract	N-Free Extract	Calcium	Phos-phorus	Manganese*	Iron*
				Western Wheatgrass						
8/4/42	6	5.31	4.55	31.56	2.83	43.75	.42	.10	13.75	
8/4/43	6	6.46	6.43	32.23	2.81	40.07	.22	.15	10.26	103.23
9/6/44	6	5.76	4.94	32.31	2.14	42.85	.16	.13	5.82	44.81
9/6/45	6	6.38	5.10	32.49	1.94	42.08	.22	.14	13.25	73.68
8/26/46	6	6.21	6.29	30.34	3.22	42.11	.21	.12	22.55	
7/29/42	9	8.98	5.61	27.33	3.25	42.83	.43	.14	4.70	
8/14/43	9	8.27	5.74	30.17	3.85	39.97	.40	.17	1.55	238.90
9/1/44	9	7.26	4.22	29.46	3.34	43.72	.32	.11	2.91	40.15
9/1/45	9	7.79	3.77	31.14	2.62	42.67	.30	.09	6.06	79.37
9/6/46	9	8.69	3.95	30.80	2.34	42.31	.24	.08	8.40	
				Blue Grama						
8/4/42	6	6.75	4.20	31.29	1.82	43.94	.56	.09	16.20	
8/3/43	6	7.39	5.58	29.56	1.96	43.51	.30	.15	16.15	401.21
9/6/44	6	9.14	5.08	29.68	1.07	43.03	.30	.12	8.96	64.07
9/6/45	6	9.05	5.16	28.47	1.43	43.89	.31	.13	13.77	393.22
8/26/46	6	7.91	5.12	29.37	1.05	44.55	.33	.13	20.68	
8/10/42	9	10.03	5.81	26.72	1.97	43.47	.48	.15	19.39	
8/14/43	9	8.57	5.82	27.61	2.23	43.77	.30	.20	10.22	520.13
9/1/44	9	9.98	4.41	26.32	1.51	45.78	.38	.13	9.80	147.64
9/1/45	9	8.17	3.85	28.90	1.46	45.62	.44	.13	7.99	142.39
9/9/46	9	10.64	4.55	27.67	1.24	43.90	.38	.13	9.21	

*parts per million

Stage of Cutting and Yields Per Acre

It is a common belief that what the hay loses in quality is made up in quantity by letting the grass become more mature before cutting. Studies on yields in connection with the feeding and digestion trials have produced results contrary to this belief. Table 3 shows averages for early-, medium-, and late-cut hays in producing pounds of dry matter per acre during 1948 and 1949 at three locations. These yields of dry matter were obtained at the Cottonwood, Eureka, and Highmore stations.

Table 3. Pounds of Dry Matter Per Acre From Prairie Grass Cut at Early, Medium, and Late Stages (3-Station Average)

	Early lbs.	Medium lbs.	Late lbs.
1948	1149.6	1024.6	970.7
1949	1376.[illegible]	899.2	743.3

Since the early-cut hays on the average produce more dry matter per acre than the more mature hays, and since the data to be reported show that digestible nutrients are higher in the less mature hays the advantage of the less mature hays is evident. The early-cut hay on the average produced the most nutrients per ton and the largest tonnage per acre, with medium-cut hay following in second place, and late-cut hay running a poor third, particularly when production is considered from the viewpoint of digestible nutrients and animal gains. The gains produced by the late hay would very likely have compared even less favorably with the other hays had hay been fed alone, rather than including supplement along with the hay. The lower tonnage of the more mature hays is attributed to the loss of seeds and falling of some leaves as the stage of maturity advances. Further, there is usually more fiber in late hay, and it is lower in palatability, thereby increasing the amount of hay that is wasted by the livestock.

The 1948 yield of protein from Highmore and Eureka hays showed that early-cut hay produced an average of 49.9 pounds more protein per acre than did late-cut hay for these two stations. Stated in terms of tons, the early-cut hay contained an average of 70 pounds more protein per ton than did late-cut hay. To bring the protein content of a ton of late-cut hay up to that of a ton of early-cut hay would require more than 150 pounds of 40 percent protein supplement.

Experiments at the Station at Brookings have shown that when pregnant ewes were fed rations containing equal amounts of total digestible nutrients but various levels of protein, the ewes receiving the largest amount of protein made the largest gain. This example and other similar work strongly indicate that protein is the limiting factor in most rations. Late-cut hay fed either to sheep or cattle would require the addition of about twice as much protein supplement to provide a desirable level of protein than would be necessary if the early-cut hay were used.

Changes in Chemical Composition of Hay Mowed in July and Left in Windrows for Winter Feed

As mentioned previously, during World War II a number of ranchers in central and western South Dakota adopted the practice of leaving hay in windrows for winter feed, rather than stacking it, because of the acute labor shortage. They observed that hay left in the windrows gave excellent results, and that the labor costs were as low as 20 cents per ton.

In 1944 an investigation of changes in composition of hay left in windrows was started in Area 7. (Fig. 1.) Samples of hay were taken from windrows at the time of mowing and at intervals throughout the fall and

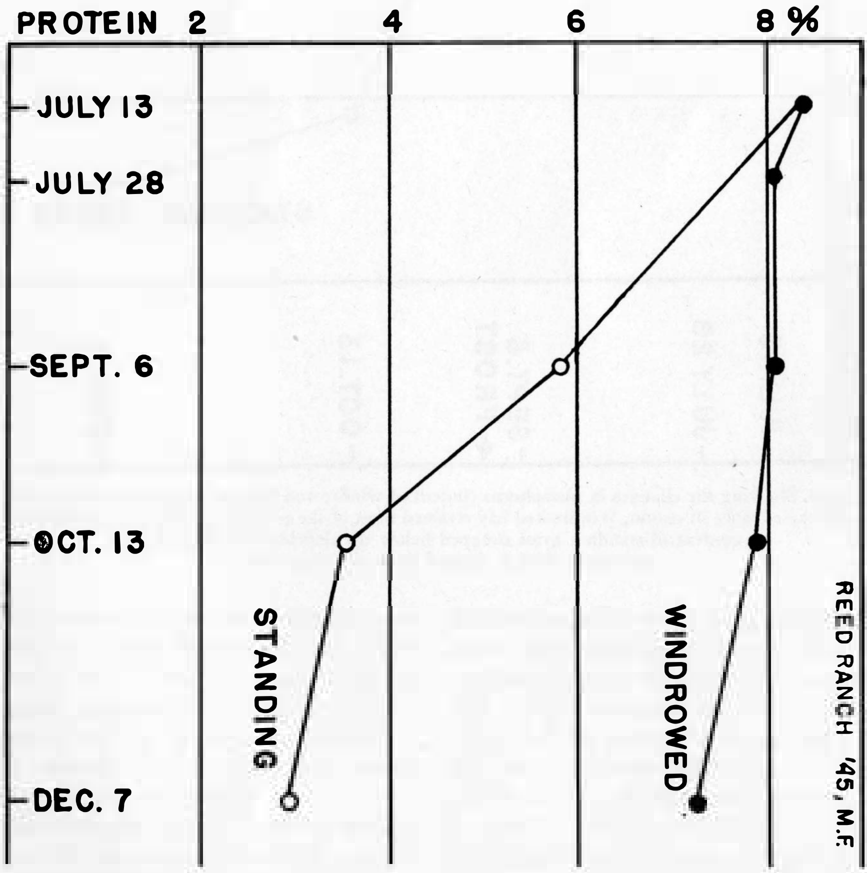


Fig. 3. Showing the changes in protein content of windrowed hay and adjacent standing grass with the advance in season. Windrowed hay showed very little change while standing grass dropped to 3 percent by December 7.

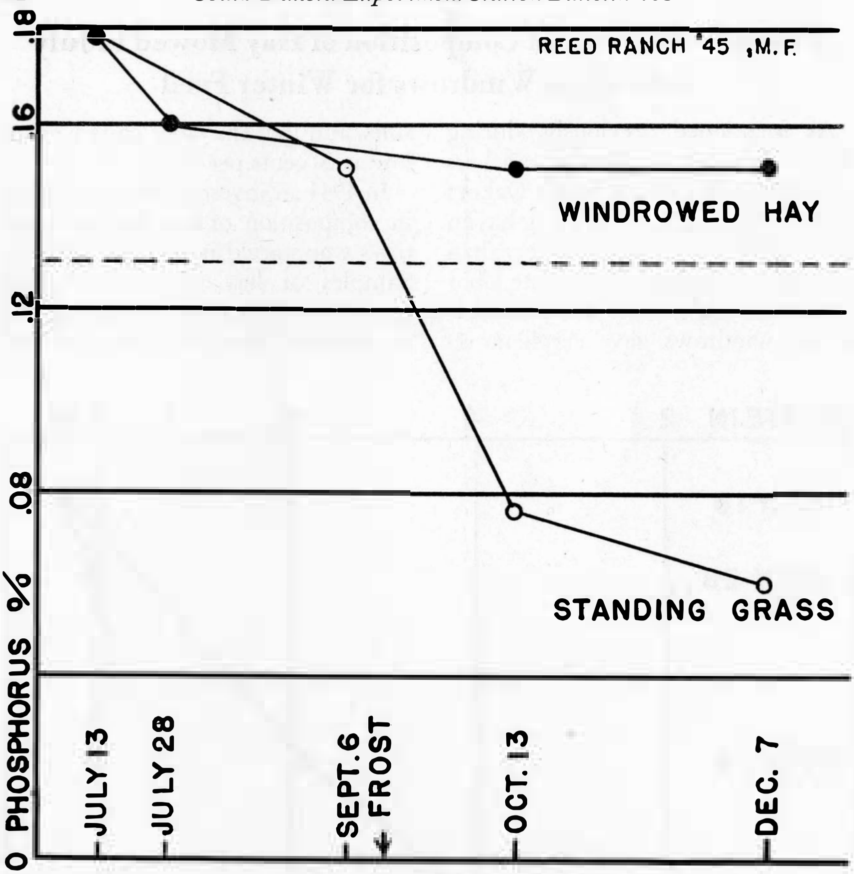


Fig. 4. Showing the changes in phosphorus content of windrowed hay and adjacent standing grass with the advance in season. Windrowed hay retained most of the phosphorus while the phosphorus content of standing grass dropped below the deficiency borderline for mature beef battle (dotted line) after September 6.

winter for three years. Samples of adjacent standing grasses also were taken at each date for comparison. Typical results shown in Figs. 3, 4, 5.

The protein content of the windrowed hay remained at about the same level through the period of July 13 to Dec. 7. The protein content of the standing grass fell to 3 percent by Dec. 7. Thus, the protein content of the windrowed hay remained at a level which is adequate for wintering mature beef cows under range conditions, but the protein content of the standing grass by Dec. 7 was below this required level for mature cattle.

Phosphorus content of the windrowed hay showed little change. It was low to start with for young, growing cattle, but was above the deficiency borderline value of .13 percent for mature beef cattle. The phosphorus content of the standing grass went below the .13 percent level some-

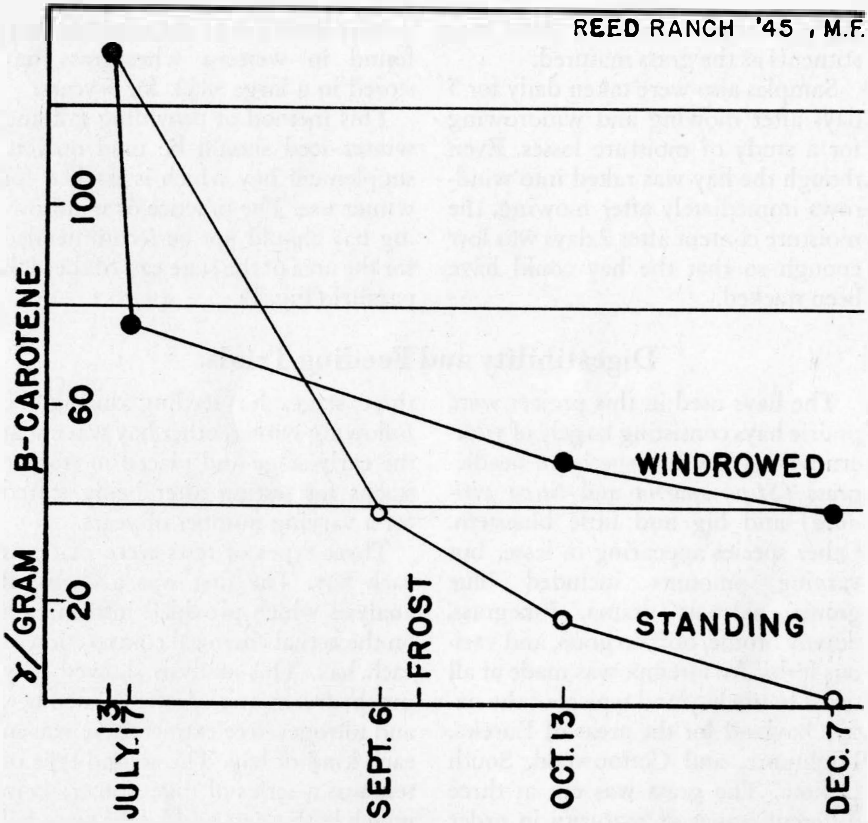


Fig. 5. Showing the changes in carotene content of windrowed hay and adjacent standing grass with the advance in season. Both showed great losses of carotene, but the windrowed hay retained over one-fourth of the original carotene when the standing grass had lost practically all of its carotene. Carotene is the plant form of vitamin A and is important for proper nutrition of cattle. These tests of windrowed hay were made at the Reed ranch in Lyman county. Similar results have been obtained with windrowed hay at other locations in Lyman, Haakon and Jackson counties, Areas 7 and 9 (Fig. 1, page 6).

time after early September and dropped to the low level of .06 percent by Dec. 7.

Carotene content (plant form of vitamin A activity) of the windrowed hay dropped quite rapidly in the first few weeks after mowing, but remained at a satisfactory level for range cattle even in the Dec. 7 sample. Hay on the outside of the windrows was weathered and became almost black by October. Some of this outside black hay was removed carefully and analyzed. It contained only a trace of carotene, but the protein content was only .5 percent lower than hay in the center of the windrow.

No definite change in either the crude fiber or nitrogen-free extract was observed in the windrowed hay, but in the standing grass there was a

slight increase in each of these constituents as the grass matured.

Samples also were taken daily for 5 days after mowing and windrowing for a study of moisture losses. Even though the hay was raked into windrows immediately after mowing, the moisture content after 2 days was low enough so that the hay could have been stacked.

Very little loss of carotene has been found in western wheatgrass hay stored in a large stack for 5 years.

This method of providing fall and winter feed should be used only to supplement hay which is stacked for winter use. The practice of windrowing hay should not be recommended for the area of the state east of the 99th parallel (Fig. 1).

Digestibility and Feeding Trials

The hays used in this project were prairie hays consisting largely of western wheatgrass, two species of needlegrass *(Stipa spartia* and *Stipa viridula)* and big and little bluestem. Other species appearing in lesser but varying amounts included blue grama, sideoats grama, Junegrass, downy brome, buffalo grass, and various forbs. An attempt was made at all times to use hayland typical of the native hayland for the areas of Eureka, Highmore, and Cottonwood, South Dakota. The grass was cut at three different stages of maturity in order to determine the effect of maturity on the chemical composition and nutritive value.

The first or early-cut hay was harvested about the middle of July when the dominant grasses in the particular area were in the shooting stage, that is, when the grass "shoots" up the seed stalk and begins to head. The second or "seed ripe" stage was harvested about the middle of August and has been called medium-cut hay. The third, over-mature or "seed falling" stage, usually was cut during the time from September 20 to the first week in October and has been called late-cut hay. In addition to the hay cut at the three stages for feeding during the following winter, other hay was cut at the early stage and placed in storage stacks for testing after being stored for a varying number of years.

Three types of tests were made of each hay. The first was a chemical analysis which provided information on the actual chemical composition of each hay. This analysis showed how much dry matter, protein, fat, fiber, and nitrogen-free extract there was in each kind of hay. The second type of test was a series of digestion trials in which both steers and lambs were fed the various hays in order to provide information on the relationship of the chemical composition to the feeding results obtained. The third type of test was a series of feeding trials in which cows or calves were wintered on the various hays and the results measured in terms of gains made.

Most stockmen are familiar with the procedures of feeding trials, but digestion trials are more technical and the procedures may not be understood as well. Digestion trials provide information on what proportion of the various nutrients in feeds are digested and also how the proportions of the various nutrients may influence diges-

tibility. The following outline will serve to give some idea of what is involved in digestion trials.

To illustrate: lambs or steers are fed individually a carefully weighed amount of the various feeds to be tested, for a week or two before feces collection begins. This feeding period eliminates from the digestive tract all feed other than the hay or rations being tested. This is called the preliminary period. At the end of the preliminary period, individual feeding is continued but a canvas sack is fastened to the rear of each test animal to facilitate the collection of the feces. The time during which feces are collected is called the collection period and generally lasts 10 days.

All the feeds that are to be fed are accurately weighed to the nearest gram as are the feces that are collected. Chemical analyses are made on the feeds fed and the feces voided, so the amount of each nutrient taken in and excreted is known, and from this the apparent digestibility is calculated.

For example, if a lamb ate two pounds of feed that contained 10 percent protein, and two pounds of feces were excreted that contained 5 percent protein, the apparent digestibility of protein of that particular feed would be 50 percent. (2 lbs. of feed x .10 = .20 lb. protein in feed; 2 lbs. feces x .05 = .10 lb. protein in feces; .20 lb. — .10 lb. = .10 lb. protein digested; $\frac{.10}{.20} = .50$, or 50 percent of the protein was digested). Using this method it is possible to determine the amount of each nutrient the animal is actually digesting from the feed consumed, and enables one to formulate a livestock feeding program that will better utilize our home grown feeds.

Chemical Composition of Hays

Table 4 shows the chemical composition of representative hays harvested in the Eureka and Highmore areas and used in the digestion trials and winter feeding experiments. From this table it can be seen how the important and expensive nutrient, pro-

Table 4. Average Chemical Composition of Representative Prairie Hays Used in Digestion Trials and Feeding Experiments

Hay	Dry matter %	Crude Protein %	Ether extract %	Crude fiber %	Nitrogen-free Extract %
Eureka 1947					
Early-cut	85.64	7.08	2.75	27.98	39.49
Medium-cut	85.76	5.74	2.85	29.26	39.63
Late-cut	84.94	4.17	2.96	30.16	39.24
Eureka 1948					
Early-cut	91.30	7.09	2.56	29.50	41.67
Medium-cut	91.32	6.60	2.64	29.42	43.69
Late-cut	91.79	4.75	3.10	30.37	43.64
Storage hay (early-cut) (2 years old)	91.44	8.35	2.60	29.85	41.04
Highmore 1948*					
Early-cut	81.19	7.52	2.20	26.83	36.53
Medium-cut	83.89	6.50	2.91	27.80	38.31
Late-cut	74.26	3.56	2.76	25.27	35.50

*Analyses taken from hays used in digestion trial. These hays were in a severe snowstorm immediately following baling and contained some "ice spots" which accounts for the low percentage of dry matter.

tein, decreased as the stage of maturity increased. Note the high protein content of storage hay harvested as early-cut hay in 1946 and analyzed in 1949. Very little protein is lost due to storage if hay is stacked in such a way as to prevent spoilage and loss resulting from weathering.

Results of Digestion Trials

Separate digestion trials were conducted with hays cut at Eureka in 1947 and 1948 and fed to steer calves and lambs without any supplement. Further trials were conducted with hays cut at Eureka in 1947 and Highmore in 1948. In these latter trials only steer calves were used and to the hay was added one pound of oats and one pound of soybean oil meal per calf daily. A detailed summary of the data obtained is shown in Table 5.

The figures in the table show in each case the percentage of the nutrient in the feed that apparently was digested by the animals used in the trials. A scrutiny of these data brings

Table 5. Average Coefficients of Apparent Digestibility of Different Qualities of Prairie Hay Fed to Steer Calves and Wether Lambs

	Dry Matter percent	Crude Protein percent	Ether Extract percent	Crude Fiber percent	Nitrogen-free Extract percent
Eureka 1947*					
Early-cut hay					
Steers	47.61	43.96	50.81	55.20	50.88
Lambs	47.86	51.38	31.61	58.27	52.81
Medium-cut hay					
Steers	44.25	31.31	36.55	53.00	48.18
Lambs	41.82	32.48	30.16	50.16	47.18
Late-cut hay					
Steers	38.38	6.75	32.09	48.88	42.56
Lambs	41.27	23.04	23.27	51.99	44.41
Eureka 1948*					
Early-cut hay					
Steers	46.51	41.14	29.11	62.95	47.99
Lambs	40.55	34.38	19.12	54.03	43.10
Medium-cut hay					
Steers	42.76	29.80	21.98	56.62	46.66
Lambs	40.25	30.35	15.34	55.38	42.36
Late-cut hay					
Steers	40.51	11.88	37.39	56.96	43.79
Lambs	37.90	12.56	34.81	55.28	39.92
2-Yr. storage, early-cut hay					
Steers	46.44	45.98	34.60	59.26	47.04
Lambs	44.29	40.86	46.77	52.76	47.00
Eureka 1947†					
Steers only					
Early-cut hay	50.01	60.92	55.10	57.79	54.85
Medium-cut hay	52.01	55.27	33.77	59.59	54.86
Late-cut hay	47.53	45.78	54.46	56.28	49.92
Highmore 1948†					
Steers only					
Early-cut hay	50.04	61.58	40.98	54.26	54.03
Medium-cut hay	50.70	63.99	41.22	52.78	55.97
Late-cut hay	43.03	56.00	40.06	44.36	49.54

*Rations fed consisted of hay only.

†Rations fed consisted of the appropriate hay plus one pound of oats and one pound of soybean oil meal per head daily.

forth the fact that, with few exceptions, the digestibility of the various nutrients decreased as the stage of maturity of the grass increased. The greatest decrease in digestibility was found in protein which perhaps is the most important single nutrient in hay and certainly is the most expensive to replace in a ration. It may be pointed out that the results were similar for steer calves and lambs, though the actual digestibility differed somewhat.

The main exception to the general rule was for the hay from Highmore in 1948. It is believed that this is because the early-cut hay of that year was damaged badly by rain before it could be stacked, and was lower in digestibility than it would have been if it had cured normally.

It is of interest to note, (compare the two lots of Eureka 1947 data) that when oats and soybean oil meal were added to the hay the apparent digestibility for all nutrients tended to increase. This probably is because the supplement brought the protein content of the ration up to about 10 percent, which amount is necessary for good growth of the rumen bacteria that do much of the work of digesting fibrous feeds. However, it should be pointed out that adding the supplement did not make the ration containing late-cut hay equal to the ration containing early-cut hay.

When the data for digestibility were combined with those on chemical composition it was calculated that the early-cut hay furnished over five times more digestible protein for steer calves than the late-cut hay. The same comparison with lambs showed that early-cut hay furnished more than four times as much digestible protein as late-cut hay. (See Fig. 6).

Results of Feeding Trials

In the final analysis, the stockman is interested primarily in what the various hays will produce in the form of livestock gains. To get the answer to this, several feeding trials were conducted at the substations.

In 1947, early-cut, medium-cut, and late-cut hays were harvested at the Reed Ranch in Lyman county. These hays, together with medium- to late-cut hay harvested and stored in 1945, were used in a feeding trial with mature Hereford cows during the winter of 1947-48.

The cows in the lots receiving early-cut and medium-cut hay showed daily gains of 0.66 pound and 0.15 pound per head, respectively, while the cows receiving late-cut hay and those receiving the year-old storage hay lost 0.53 pound and 0.24 pound per head daily, respectively. The storage hay was not so good a quality as that which was used in subsequent trials.

Several winter feeding trials with Hereford calves were conducted at the Cottonwood, Eureka, and Highmore substations. In each case, early-cut, medium-cut, and late-cut hay was tested. In addition, in some years, early-cut hay stored for one or more years also was tested. In each trial the amount of hay offered per calf was the same for each hay and in addition one pound of oats and one pound of soybean oil meal per calf daily was fed.

The results at Cottonwood during the winter of 1947-48 showed average daily gains for the calves as 0.95, 0.68,

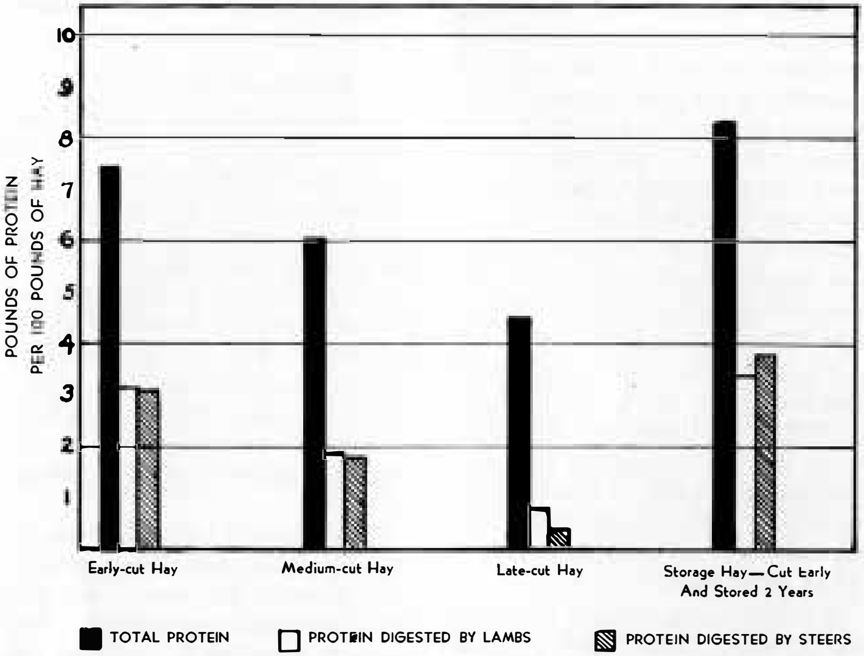


Fig. 6. Showing total protein content of various hays and proportion of protein digested by lambs and steers. The storage hay was not cut the same year as the other hays, so the difference in protein content is not indicative of improvement of protein content through storage.

and 0.34 pound, respectively, for those on early-, medium-, and late-cut hay.

During the winter of 1948-49 trials were undertaken at the three substations, but because of an unusually severe winter only the trial at Highmore was completed. The results from this trial are summarized in Table 6.

The feeding trials in 1948-49 did not show so great an advantage for the early-cut hay as did trials during other years, but the reason for this may have been the severe rain damage mentioned in the discussion of the digestion trials.

In 1949-50 trials were conducted at Cottonwood and Eureka and the results are tabulated in Tables 7 and 8.

In the Cottonwood trial the early-cut hay had a decided advantage in gain over the medium-cut hay as

Table 6. Average Daily Gains of Hereford Calves Fed Hays Cut at Various Stages of Maturity.* Highmore 1948-49. All Lots Fed 96 Days.

	Lot 1 Early-cut Hay	Lot 2 Medium-cut Hay	Lot 3 Late-cut Hay	Lot 4 1-yr. Storage Hay
Animals per lot	8	8	8	8
Average initial weight, pounds	414	413	414	414
Average daily gain, pound	.58	.68	.57	.61

*The calves were fed equal amounts of hay, plus 1 pound oats and 1 pound soybean oil meal per head daily.

Table 7. Average Daily Gains of Hereford Calves Fed Hays Cut at Various Stages of Maturity. Cottonwood 1949-50. All Lots Fed 112 Days.

	Lot 1 Early-cut Hay*	Lot 2 Medium-cut Hay*	Lot 3 Late-cut Hay*	Lot 4 1-yr. Storage Hay*	Lot 5 2-yr. Storage Hay*	Lot 6 2-yr. Storage Hay†
Average daily gain lbs.	1.07	0.90	0.72	1.02	0.88	0.87
Feed offered per 100 lbs. gain						
Hay lbs.	1039.4	1225.4	1538.9	1109.8	1250.4	1257.6
Protein Supplement lbs.	89.6	105.7	132.7	95.6	107.8	96.9
Oats lbs.	93.8	110.6	138.9	100.1	111.9	112.3

*Supplemented with 1 pound each of oats and pelleted soybean oil meal per head daily.
†Supplemented the same as other lots except pelleted soybean oil meal contained 5 percent urea and 5 percent molasses.

Table 8. Average Daily Gains of Hereford Calves Fed Hays Cut at Various Stages of Maturity. Eureka 1949-50. All Lots Fed 75 Days.

	Lot 1 Early-cut Hay*	Lot 2 Medium-cut Hay*	Lot 3 Late-cut Hay*	Lot 4 3-year-old Storage Hay*
Average daily gain lbs.	1.5	1.5	0.83	1.4
Feed offered per 100 lbs. gain				
Hay lbs.	786.2	783.7	1391.0	867.4
Protein Supplement lbs.	52.6	51.9	96.2	57.6
Oats lbs.	52.6	51.9	96.2	57.6

*Supplemented with 1 pound each of oats and pelleted soybean oil meal per head daily.

shown by average daily gains of 1.07 against 0.90 pounds. In turn, the medium-cut hay had a similar advantage over late-cut hay with gains of 0.90 against 0.72 pound. The storage hays, stored one and two years, were on a par with the early- and medium-cut hays of the current year.

In the Eureka trial the gains on early-cut hay were identical with those on the medium-cut hay at 1.5 pounds per day. The late-cut hay did not do so well, producing average daily gains of only 0.83 pound. Again the storage hay, in this case three years old, was on a par with the early-cut and medium-cut hay of the current year.

In summarizing the results of these various feeding trials, it is evident that the late-cut hay was inferior to either early-cut or medium-cut hay in terms of its ability to produce winter gains in cows and calves. In all cases the early-cut and medium-cut hays were superior. The difference between early-cut and medium-cut hay was not as great, but the early-cut hay did produce the best results in terms of gain. Furthermore, the data show that storage hay cut at the early to medium stage and stored for as long as three years was definitely superior to late-cut hay used the year of harvesting.

To put these facts in practical terms it was calculated, on the basis of the results from Cottonwood in 1949-50 (Table 7), that for 100 pounds of gain on calves the ration of early-cut hay compared to late-cut hay saved 500 pounds of hay, 45 pounds of oats, and 53 pounds of 40 percent soybean oil-meal. A similar comparison at Eureka (Table 8) showed a saving of 605 pounds of hay, 44 pounds of oats, and 44 pounds of 40 percent soybean oil meal for each 100 pounds of gain.

Summary and Conclusions

Young grasses, and the hays made from them, should serve as a more economical source of feed for livestock than mature grasses.

From 1942 to 1946, samples of western wheatgrass and blue grama were collected at various growth stages from 11 areas in South Dakota and analyzed for moisture, crude fat, crude fiber, crude protein, ash, nitrogen-free extract, calcium, phosphorus, manganese and iron.

Seasonal trends and major differences were found as the season advanced; crude protein and phosphorus contents declined, while crude fiber and manganese contents increased. Other constituents were variable.

While there were yearly variations in the composition of the two species, all analyses showed the necessity of cutting the grasses for hay early (shooting stage of growth).

The late cuttings, or over-mature stages, of both species of grasses were likely to be deficient in both protein and phosphorus, necessitating supplementary feeding.

Differences in chemical composition of the two species of grasses were noted among the 11 areas and within the same area.

Windrowed hay samples and adjacent standing grass samples also were collected from several locations and analyzed. In general, the crude protein and phosphorus contents of the windrowed hay samples remained unchanged while they declined in the standing grass samples.

Average yields of early-cut hay during a 2-year period from three stations, were over 400 pounds more dry matter and about 50 pounds more protein per acre than for late-cut hay.

During the past three years (1946-49) chemical analyses have been made on prairie hays to be used in digestion and feeding trials. These hays were cut at three stages of maturity; namely, early-cut (usually from early to mid-July), medium-cut hay (mid-August), late-cut hay (late September to early October) and early-cut hay that has been stored for a varying number of years.

Digestion and feeding trials in which both sheep and cattle were used as test animals were conducted to study further the nutritive content and feeding value of these hays. From this work the following conclusions were drawn:

Protein content of hays used in the digestion and feeding trials was affected materially by time of harvest. Late-cut hay contained only 50 to 70 percent as much total protein as early-cut hay.

Dry matter, ether extract, crude fiber, and nitrogen-free extract were not affected seriously by the stage of growth.

The period in which hay is cut affects the digestibility of the nutrients in the hay. This is particularly true of protein and to a lesser degree for nitrogen-free extract. Early-cut hay furnished five times more digestible protein for steers and four times more for lambs than the late hay, on a pound basis.

The digestibility of dry matter, ether extract, and fiber was reduced

only slightly when late-cut hay was fed as compared to early-cut hay.

Greater differences between hays were noted both in feeding and digestion trials when hays alone were fed. Adding supplement showed an improvement over hay alone, but supplementing all hays equally did not make a late-cut hay ration equal in digestibility or feeding value to a ration using early-cut hay.

Early-cut hay produced greater animal gain than late-cut hay when both hays were supplemented with one pound of oats and one pound of 40 percent soybean oil meal. Calves fed late-cut hay and supplement usually gained only 50 to 75 percent as much as calves fed early-cut hay and supplement.

Calves fed early-cut hay supplemented with oats and soybean oil meal gained 100 pounds on 500 to 600 pounds less hay, 40 to 50 pounds less oats, and 44 to 53 pounds less soybean oil meal than calves receiving an equal amount of late-cut hay, oats, and soybean oil meal.

Appendix

Appendix Table 1. Composition (Percent) of Grass Samples Cut at Different Growth Stages for the Year 1944. 12 Percent Moisture Basis.

Date Collected	Growth Stage	Location Area No.	Ash	Crude Protein	Crude Fiber	Ether Extract	N-Free Extract	Cal-cium	Phos-phorus	Man-ganese*	Iron*
					Western Wheatgrass						
7/11	Shooting	1	7.52	8.95	30.21	2.57	38.75	.23	.14	3.53	71.20
9/2	Seed-ripe	1	8.50	7.29	28.49	2.87	40.83	.24	.12	20.89	59.17
7/11	Shooting	2	6.98	10.26	29.58	2.65	38.53	.30	.24	4.47	89.75
9/6	Seed-ripe	2	7.25	7.41	28.44	2.64	42.26	.27	.18	7.16	73.04
10/30	Mature	2	7.76	4.56	31.92	2.29	41.47	.28	.10	7.06	78.99
7/18	Shooting	3	7.42	7.84	28.20	2.87	41.67	.27	.17	5.46	38.87
9/6	Seed-ripe	3	6.78	6.09	29.86	3.10	42.17	.25	.11	7.95	72.27
7/17	Shooting	4	6.75	7.35	31.76	2.65	39.49	.29	.20	4.75	16.14
9/5	Seed-ripe	4	7.25	5.78	29.27	2.84	42.86	.31	.14	10.00	54.56
11/3	Mature	4	7.93	3.39	33.32	2.31	41.[illegible]5	.32	.09	8.11	54.62
7/18	Shooting	5	7.48	7.37	28.80	3.13	41.22	.27	.21	2.82	80.99
9/6	Seed-ripe	5	8.68	5.80	27.71	3.30	42.51	.29	.13	9.43	21.48
11/3	Mature	5	9.73	2.95	31.35	2.78	41.19	.32	.07	12.26	53.64
7/12	Shooting	6	5.71	6.95	34.49	2.12	38.73	.18	.17	3.82	42.16
9/6	Seed-ripe	6	5.76	4.94	32.31	2.14	42.85	.16	.13	5.82	44.81
10/30	Mature	6	6.26	2.88	35.99	1.87	41.00	.21	.09	10.91	21.78
9/7	Seed-ripe	7	8.22	6.91	28.82	3.31	40.74	.28	.12	21.22	60.28
10/31	Mature	7	8.47	4.07	33.20	2.36	39.90	.31	.08	4.82	55.38
7/12	Shooting	8	8.48	5.50	30.64	1.74	41.64	.26	.15	2.26	94.25
7/13	Shooting	9	7.28	7.02	28.79	3.22	41.69	.30	.17	1.94	28.61
9/1	Seed-ripe	9	7.26	4.22	29.46	3.34	43.72	.32	.11	2.91	40.15
11/1	Mature	9	7.18	2.63	32.19	2.68	43.32	.29	.05	5.90	69.68
7/19	Shooting	10	7.62	7.45	29.15	3.16	40.62	.22	.19	6.09	61.79
9/5	Seed-ripe	10	7.19	5.06	28.78	3.36	43.61	.25	.13	8.68	127.92
11/4	Mature	10	7.16	2.63	33.00	2.59	42.62	.20	.05	16.77	129.16
7/17	Shooting	11	6.85	7.64	30.42	2.56	40.53	.25	.18	5.32	56.22
9/8	Seed-ripe	11	7.14	5.87	28.98	3.13	42.88	.31	.11	11.16	68.64
11/2	Mature	11	7.58	3.38	32.53	2.52	41.99	.28	.06	19.79	105.35
					Blue Grama						
7/11	Shooting	1	7.04	8.53	30.59	2.02	40.32	.25	.16	6.79	73.16
9/2	Seed-ripe	1	7.77	8.34	29.72	1.57	40.60	.27	.16	8.56	79.65
7/11	Shooting	2	7.54	7.35	31.95	1.58	39.58	.31	.23	5.14	78.63
9/6	Seed-ripe	2	9.12	5.78	29.94	1.04	42.12	.33	.17	9.04	95.08
10/30	Mature	3	10.46	4.03	28.96	1.06	43.49	.38	.11	10.40	52.32
7/17	Shooting	4	6.68	6.42	29.96	1.60	43.34	.30	.23	6.66	31.61
9/5	Seed-ripe	4	7.60	5.30	29.95	1.19	43.96	.31	.19	12.42	31.13
11/3	Mature	4	7.95	3.75	31.26	1.22	43.82	.33	.12	9.77	38.29
7/18	Shooting	5	8.92	8.00	27.83	1.64	40.61	.31	.22	8.88	88.53
9/6	Seed-ripe	5	7.92	6.91	27.62	1.39	44.16	.35	.16	15.81	131.28
11/3	Mature	5	10.03	5.45	28.30	1.26	42.96	.37	.10	12.37	155.37
7/12	Shooting	6	6.64	7.15	31.11	1.51	41.59	.36	.19	9.13	76.25
9/6	Seed-ripe	6	9.14	5.08	29.68	1.07	43.03	.30	.12	8.96	64.07
10/30	Mature	6	10.21	3.91	29.23	.88	43.77	.37	.10	9.98	57.98
9/7	Seed-ripe	7	9.29	5.62	27.79	1.37	43.93	.38	.15	33.34	75.11
10/31	Mature	7	11.13	3.56	29.19	1.09	43.03	.41	.10	20.08	74.33
7/12	Shooting	8	6.82	4.99	32.67	1.35	42.17	.24	.13	3.35	121.44
7/13	Shooting	9	7.25	6.00	27.51	1.78	45.46	.37	.19	3.34	70.50
9/1	Seed-ripe	9	9.98	4.41	26.32	1.51	45.78	.38	.13	9.80	147.64
10/31	Mature	9	9.73	4.27	26.72	1.67	45.61	.44	.12	9.22	218.01
7/20	Shooting	10	7.46	6.56	29.30	1.62	43.06	.31	.16	9.66	226.95
9/5	Seed-ripe	10	5.31	3.02	35.20	1.08	43.39	.23	.13	7.82	177.36
11/4	Mature	10	4.47	2.43	36.41	.79	43.90	.19	.03	11.73	303.24
7/17	Shooting	11	7.24	7.49	29.94	1.77	41.56	.35	.17	3.77	70.30
9/8	Seed-ripe	11	8.28	5.74	28.67	1.29	44.02	.40	.13	6.54	129.24
11/2	Mature	11	8.41	4.65	31.52	1.31	42.11	.34	.09	7.43	127.69

*parts per million

Appendix Table 2. Composition (Percent) of Western Wheatgrass and Blue Grama Cut at Different Growth Stages in Areas 6, 7 and 9 During 1946. 12 Percent Moisture Basis.

Date	Growth Stage	Location Area No.	Rep.	Ash	Crude Protein	Crude Fiber	Ether Extract	N-Free Extract	Calcium	Phos-phorus	Man-ganese*
					Western Wheatgrass						
7/10	Shooting	6	1	6.53	9.24	31.21	2.84	38.18	.26	.22	10.37
7/10	Shooting	6	2	6.57	10.27	30.65	2.81	37.70	.22	.23	12.22
7/10	Shooting	6	3	6.84	10.14	30.88	2.68	37.46	.24	.22	14.79
8/26	Seed-ripe	6	1	6.10	6.39	30.50	3.10	42.41	.21	.13	8.53
8/26	Seed-ripe	6	2	5.86	6.60	30.06	3.53	41.95	.21	.12	23.64
8/26	Seed-ripe	6	3	6.66	5.87	30.46	3.04	41.97	.22	.12	35.47
11/4	Mature	6	1	6.89	3.88	34.57	2.52	40.14	.23	.10	17.35
11/4	Mature	6	2	7.10	3.89	33.25	2.75	41.01	.26	.14	20.13
11/4	Mature	6	3	7.29	3.54	33.36	2.70	41.11	.23	.09	18.34
7/10	Shooting	7	1	9.10	7.88	28.68	3.33	39.01	.40	.20	6.26
7/10	Shooting	7	2	9.83	10.38	28.24	2.40	37.15	.34	.24	4.44
7/10	Shooting	7	3	8.49	11.82	26.62	3.13	37.94	.37	.17	7.45
8/28	Seed-ripe	7	1	10.32	5.02	26.61	3.87	42.18	.27	.12	10.26
8/28	Seed-ripe	7	2	8.73	6.82	27.86	3.98	40.60	.30	.13	7.78
8/28	Seed-ripe	7	3	7.21	9.09	26.22	4.10	41.38	.31	.11	6.46
11/5	Mature	7	1	13.49	2.93	28.65	3.51	39.42	.33	.11	12.12
11/5	Mature	7	2	10.87	3.96	30.69	3.80	38.68	.33	.09	8.78
7/11	Shooting	9	1	9.47	7.24	28.33	3.01	39.95	.36	.20	5.97
7/11	Shooting	9	2	8.32	6.87	27.43	2.55	42.83	.29	.16	5.80
7/11	Shooting	9	3	7.12	6.88	27.57	2.51	43.92	.32	.16	4.41
9/6	Seed-ripe	9	1	10.21	3.39	31.06	2.20	41.14	.22	.08	11.02
9/6	Seed-ripe	9	2	7.92	4.02	29.75	2.67	43.64	.24	.08	6.77
9/9	Seed-ripe	9	3	7.95	4.45	31.29	2.16	42.15	.25	.08	7.40
11/7	Mature	9	1	7.72	3.57	33.13	2.85	40.73	.33	.06	11.48
11/7	Mature	9	2	8.02	2.66	34.68	1.92	40.72	.27	.06	6.82
11/7	Mature	9	3	6.97	3.33	28.71	1.51	47.48	.31	.06	12.39
					Blue Grama						
8/26	Seed-ripe	6	1	7.80	5.73	29.63	1.14	43.70	.36	.16	28.36
8/26	Seed-ripe	6	2	6.87	5.14	29.59	.84	45.56	.32	.12	18.99
8/26	Seed-ripe	6	3	9.06	4.48	28.89	1.18	44.39	.32	.11	14.70
11/4	Mature	6	1	9.05	5.08	28.65	1.16	44.06	.32	.09	9.64
11/4	Mature	6	2	8.51	4.24	29.79	1.11	44.35	.34	.07	10.65
11/4	Mature	6	3	10.85	4.05	27.25	1.15	44.70	.27	.07	12.37
8/28	Seed-ripe	7	1	10.56	5.42	26.24	1.32	44.46	.40	.16	19.16
8/28	Seed-ripe	7	2	13.41	5.43	23.68	1.43	44.05	.51	.18	22.87
8/28	Seed-ripe	7	3	9.45	6.58	28.39	1.57	42.01	.40	.14	13.00
11/5	Mature	7	1	12.00	4.45	25.49	1.68	44.38	.32	.10	31.25
11/5	Mature	7	2	10.02	4.60	29.50	1.70	42.18	.42	.11	7.12
9/9	Seed-ripe	9	1	10.40	4.69	28.63	1.29	42.99	.39	.18	6.79
9/6	Seed-ripe	9	2	11.04	4.23	27.39	1.21	44.13	.36	.11	9.95
9/9	Seed-ripe	9	3	10.49	4.73	26.98	1.23	44.57	.39	.11	10.88
11/7	Mature	9	1	11.64	3.50	27.05	1.36	44.45	.35	.10	14.44
11/7	Mature	9	2	10.93	3.81	27.94	1.39	43.93	.36	.10	10.11
11/7	Mature	9	3	9.82	4.06	28.48	1.28	44.36	.45	.07	7.44

*parts per million

Greater Feed Value from Prairie Hays

During the past few years (1946-49) chemical analyses have been made on prairie hays to be used in digestion and feeding trials. These hays were cut at three stages of maturity: early-cut hay (cut from early to mid-July), medium-cut hay (mid-August), late-cut hay (late September to early October) and also early-cut hay that had been stored for a number of years.

Digestion and feeding trials in which both sheep and cattle were used as test animals were conducted to study the nutritive content and feeding value of these hays. From this work the following conclusions were drawn:

1. Protein content of hays was affected materially by the time of harvest. Late-cut hay contained only 50 to 70 percent as much total protein as early-cut hay.

2. Not only did the late-cut hay contain considerably less protein, but digestibility was much lower in the small amount of protein which the late-cut hay did contain. Early-cut hay furnished five times more digestible protein for steers and four times more for lambs than the late hay, on a pound basis.

3. Greater differences between the hays were noted both in feeding and digestion trials when hays alone were fed. Adding supplement showed an improvement over hay alone, but supplementing all hays equally did not make a late-cut hay ration equal in digestibility or feeding value to a ration using early-cut hay.

4. Early-cut hay produced greater animal gains than late-cut hay when both hays were supplemented with one pound of oats and one pound of 40 percent soybean oil meal. Calves fed late-cut hay and supplement usually gained only 50 to 75 percent as much as calves fed early-cut hay and supplement.

5. Calves fed early-cut hay supplemented with oats and soybean oil meal gained 100 pounds on 500 to 600 pounds less hay, 40 to 50 pounds less oats, and 44 to 53 pounds less soybean oil meal than calves receiving an equal amount of late-cut hay, oats, and soybean oil meal.

6. Average yields of early-cut hay, in the 2-year period from three stations had over 400 pounds more dry matter and about 50 pounds more protein per acre than the late-cut hay.