1952

FIELD DAY REPORT

Squaw Butte - Harney Range and Livestock Experiment Station

BURNS, OREGON
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>THE SQUAW BUTTE-HARNEY RANGE AND LIVESTOCK EXPERIMENT STATION</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station Operation</td>
<td>1</td>
</tr>
<tr>
<td>Service Area</td>
<td>1</td>
</tr>
<tr>
<td>Station Facilities</td>
<td>1-2</td>
</tr>
<tr>
<td>History of Development</td>
<td>2</td>
</tr>
<tr>
<td>Why the Present Research Program</td>
<td>2-4</td>
</tr>
<tr>
<td>Station Staff</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOUNTAIN MEADOW IMPROVEMENT STUDIES</th>
<th>5-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Effect of Date and Height of Cutting on the Yield and Vegetative Composition of Native Meadows and on the Chemical Composition of Native Meadow Hay.</td>
<td>5-8</td>
</tr>
<tr>
<td>Yield Response of Native Meadows to Six Rates and Two Dates of Ammonium Phosphate Fertilizer Application.</td>
<td>9-10</td>
</tr>
<tr>
<td>Projects in Progress on Which Data is not Available</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RANGE NURSERY TESTING OF NATIVE AND EXOTIC SPECIES</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects in Progress on Which Data is not Available</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BEEF CATTLE RESEARCH</th>
<th>12-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison of Hereford and Hereford Crossbred Cattle under Eastern Oregon Conditions</td>
<td>12-16</td>
</tr>
<tr>
<td>Nutrition Studies</td>
<td>16-18</td>
</tr>
<tr>
<td>Production of a Commercial Beef Herd on Sagebrush Bunchgrass Range With and Without a Protein Supplement Followed by Three Levels of Winter Nutrition</td>
<td>18-19</td>
</tr>
</tbody>
</table>
Projects Underway on which Data is not Available 19-20

Testing of a method for improving a commercial beef cattle breeding herd through selection for type and ability to gain rapidly and efficiently. 19-20

A comparison of rations for testing the ability of beef cattle to gain in the dry lot and subsequently on the range. 20

A comparison of trailing and hauling cows, calves and yearlings to and from summer range. 20

RANGE IMPROVEMENT STUDIES 21-31

Control of Big Sagebrush by Spraying 21-27

Use of growth regulators for the control of big sagebrush 21-24

The comparison of different growth regulator formulations 24-25

Solvent type and volume evaluation 25-26

Solvent screening 26

Big sagebrush - good and bad 26-27

Reseeding Methods 27

Methods of Planting Crested Wheatgrass 27-28

The application of roller equipment to improve results from drilling 28-29

Season and method for broadcast planting of crested wheatgrass 29

Methods of planting crested wheatgrass for optimum emergence and survival of seedlings 30

- Planting crested wheatgrass without soil tillage 30

Rate of planting crested wheatgrass 31

Dryland alfalfa 31
THE SQUAW BUTTE—HARNEY RANGE AND LIVESTOCK EXPERIMENT STATION

Station Operation

The Squaw Butte—Harney Range and Livestock Experiment Station is cooperatively operated and financed by the Bureau of Land Management, U. S. Department of the Interior, and the Oregon Agricultural Experiment Station of Oregon State College. The research program developed and approved by the cooperating agencies is subject to the review and recommendations of a station advisory board. The management and operation of the station is not unlike that of a livestock ranch. There are problems of hay production and use; livestock production and marketing; and range management and use just as are found on livestock ranches of the area. This situation lends greatly to the practical application of the research program.

Service Area

The Station has a definitely defined service area which was set up because of conditions almost identical to those on the Station. This has been described as Southeastern Oregon, Southern Idaho, Northern Nevada and Northeastern California. It is the belief of people familiar with the Station program that most of the results of the work are applicable over the entire big sagebrush—bunchgrass range country. Some of the work is usable wherever cattle are produced and pasture, range or hay is grown.

Station Facilities

The Squaw Butte Range unit of the Experiment Station consists of 16,265 acres of rather typical sagebrush—bunchgrass range. Fourteen thousand twenty-five acres of this land and the improvements are owned by the Federal Government. The other 2,240 acres of range is owned by Harney County and the State of Oregon. The land is representative of a vast area of similar range land in the west. Squaw Butte is located 43 miles west of Burns on U. S. Highway 20 and has an elevation of roughly 4,500 feet. The ranges are covered with a dense stand of sagebrush with the dominant livestock forage being supplied by bunchgrasses. The annual precipitation of the area is under ten inches. Most of the precipitation occurs outside of the growing season. The range is properly a spring—fall range. Throughout most of the service area of this station there is a deficiency of summer range resulting in a heavy demand for summer use on the spring—fall range.

The Section Five winter unit consists of 660 acres of flood irrigated native meadow land. This land and improvements are owned by the State of Oregon. The meadow land is similar to large acreages found in Oregon, Idaho, Montana, Wyoming, Colorado, Utah, Nevada and
California. Section Five is located seven miles south of Burns on Oregon Highway 205. This area is in the flood irrigated Harney Valley and is typical of more than one million acres of native meadow within the service area. This meadow is flooded to varying depths from mid-April to late June. The hay produced on the meadow is composed of rush and sedges with a minor amount of grass.

The Harney Branch unit of the Station contains 180 acres of pump irrigated crop land which, with improvements, is owned by Harney County. It is located six miles east of Burns and is important to the station primarily because of the facilities for producing alfalfa hay and grain and because of the houses provided for the station labor. The State of Oregon owns a herd of approximately 170 grade Hereford breeding cows, plus the calves and yearlings carried with the herd. Both the Bureau of Land Management and Oregon State College own the equipment necessary to operate the Experiment Station and carry the present research program. The Station maintains a central office in the Federal Building in Burns.

History of Development

The Range and Livestock Experiment Station had its beginning when Mr. F. R. Carpenter, Director of the Grazing Service, and Mr. P. M. Brandt, Head of the Division of Animal Industry of Oregon State College, at a meeting in Vale, Oregon, in the spring of 1935 determined that there was a critical need for research work on range and range livestock management and improvement. The deliberations of these two men bore fruit with the signing of a cooperative agreement between the Grazing Service (now the Bureau of Land Management) and Oregon State College in the fall of 1935. In the spring of 1937 construction on the Squaw Butte range was completed to the point that a research program was begun. In 1941, the State of Oregon secured the Section Five property. This provided a regular winter base for the range livestock herd. In 1944, Harney Branch became a real working part of the Squaw Butte-Harney Station and the entire Station operation was placed under one supervision. This marked the completion of several years of planning and development directed toward securing a typical range livestock setup jointly operated by the Bureau of Land Management of the U. S. Department of the Interior and the Oregon Agricultural Experiment Station of Oregon State College.

Why the Present Research Program

Range, livestock and base property management all basically must be practiced by people owning or operating livestock ranches. Each is a full 12-month or year-round job. Adjustment or change made to improve management in any one phase or portion of the year's cycle of operation is seldom accomplished without adjustment, change and improvement of the rest of the operation,
Within the big sagebrush—bunchgrass range area of the West there is always a reasonable, though not necessarily desirable, balance between supply of range, supply of winter feed, and livestock numbers. Very few livestock operators make a practice of moving cattle out of their home country for summer feed or purchasing hay from remote areas for wintering. There is constantly a demand for more livestock, hence more range and more hay. This situation indicates a healthy expanding livestock industry. An expansion in any direction (range, livestock or hay) results in the balance shifting. More livestock means more hay or more range or both; less range means more hay or less livestock or both, etc. The resulting shift in the balance creates problems for the livestock operator. These problems are not met satisfactorily by reducing livestock numbers, shortening the range grazing period, or producing less acres of hay, but rather by producing more of all three.

It is with full recognition of this close interrelationship between range, base property and livestock and the constant pressure for more range, more hay and greater livestock production, that the Bureau of Land Management and Oregon State College have set up the program on the Squaw Butte—Harney Range and Livestock Experiment Station.

Broadly, the program on the Station is directed toward improving the production and use of range; increasing the quantity and quality of beef and the economic return from beef production; and toward increasing the yield and quality of hay and other feeds produced on crop or improved lands. The above is not just an idle high-sounding objective. In general, the sagebrush—bunchgrass ranges of the west are producing far less forage than they are capable of producing. Many estimate that production could be three times greater. Calf crops vary from about 80% downward and calf weaning weights are frequently under 400 pounds. To indicate what might be done in this field, one needs only to point to the occasional ranch that is producing a 95% calf crop and weaning calves at a weight of 450 pounds or more. Considerably in excess of 50% of the range cattle using sagebrush—bunchgrass ranges of the west are wintered on native hay produced on irrigated meadow land. These meadows yield from 1/2 to 1 1/2 tons per acre. Their quality is low enough that livestock producers are supplementing the hay with thousands of dollars worth of protein supplement each year. It has been demonstrated that many of the flood meadow areas have the soil quality and water supply to produce as much as three tons of hay per acre, and to produce hay of much higher quality than the present native hay.

It is the job of research on this and other Experiment Stations to get basic or fundamental information that may be applied to the production or management problems on "Bill Smith's" ranch in Colorado or in Oregon. Research cannot usually tell "Bill Smith" how to solve his particular problem but can give him the information which will help him to work out the solution to his problem.
Research is of little benefit to the rancher or to the public agency who sits back and waits for the research worker to give him the complete and final answer to the problem as he bumps up against it out on the land or with the livestock. This Experiment Station and those responsible for its operation are of the belief that the research program now being carried is rapidly developing the kind of basic information that can be applied to the practical problems wherever they are in the west where conditions approach those found here.

The following report, though brief, will give a picture of the scope of the program of this station. Your comments and suggestions are solicited in making our program of utmost value to the area we serve.

Station Staff

Listed below are the members of the station staff as of June 20, 1952.

Administration

W. A. Sawyer, Superintendent
Naoma Hart, Clerk Stenographer
Virginia Cobb, Clerk Typist
Lorna Allen, Part time Clerk Stenographer

Range Research

Donald N. Hyder, Range Conservationist
Forrest A. Shev, Assistant Range Conservationist
Kenneth H. Livingston, Student Assistant (3 months)

Livestock Research

Farris E. Hubert, Jr., Animal Husbandman
Al J. Haslebacher, Student Assistant (3 months)

Forage Crops Research

Clee S. Cooper, Agronomist

Station Operation and Maintenance Crew

Lyle W. Hibbard, Foreman
Lawrence E. Benson
Eldon C. Currey
Warner T. Davidson
James W. Farley
Clay L. Friend
Elton Hibbard
William V. Vencil
Results of Experiment

Table 1. Mean yields of treatments expressed as pounds of air dry hay/acre

<table>
<thead>
<tr>
<th>Date</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 inches</td>
<td>3618</td>
</tr>
<tr>
<td>3 inches</td>
<td>3114</td>
</tr>
<tr>
<td>4 inches</td>
<td>3383</td>
</tr>
<tr>
<td>5 inches</td>
<td>2014</td>
</tr>
<tr>
<td>6 inches</td>
<td>590</td>
</tr>
</tbody>
</table>

Mountaint meadow improvements studies:

The goal of the investigations being conducted on native meadows by this station may briefly be stated as "More and Better Hay." The initial studies being conducted are on meadows under existing flood conditions and vegetation. Investigations on prepared seedbeds under present flood conditions and on prepared seedbeds with some water control by diking are to be made in the future.

(Progress Report)

The effect of date and height of cutting on the yield and vegetative composition of native meadows and on the chemical composition of native meadow hay.

Purpose of the Experiment

1. To determine the influence of date and height of cutting on the yield of native hay meadows.
2. To determine the influence of date and height of cutting on the vegetative composition of native hay meadows.
3. To determine the influence of date and height of cutting on the chemical composition of native hay.

The purpose of the dates of cutting in this experiment is self-evident. The purpose of the height of cutting needs explanation. Many operators have professed the belief that early cutting of hay is reducing their yields in following years. If this belief is true, and it is quite possible that it is, the reason is probably due to cutting the plant before enough food reserves have been translocated to the roots to maintain proper vigor in following years. Different cutting heights are used in this experiment to determine what the effect of leaving some stubble for translocation will have on the following year's yield.

Summary of Experimental Plan

Plots were cut on five dates: June 22, July 5, July 15, August 10, and August 31 and at three cutting heights of two, four, and six inches. Each cutting treatment was replicated four times. Samples were taken from each plot for analysis of crude protein content of forage.
Table 1. Mean yields of treatments expressed as pounds of air dry matter per acre.

<table>
<thead>
<tr>
<th>HEIGHT OF CUTTING</th>
<th>DATE OF CUTTING</th>
<th>(lbs/A)</th>
<th>(lbs/A)</th>
<th>(lbs/A)</th>
<th>(lbs/A)</th>
<th>(lbs/A)</th>
<th>(lbs/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 inches</td>
<td>June 22</td>
<td>3618</td>
<td>3588</td>
<td>3258</td>
<td>3316</td>
<td>3114</td>
<td>3383</td>
</tr>
<tr>
<td>4 inches</td>
<td>July 5</td>
<td>1910</td>
<td>2296</td>
<td>2160</td>
<td>2008</td>
<td>1694</td>
<td>2014</td>
</tr>
<tr>
<td>6 inches</td>
<td>July 16</td>
<td>747</td>
<td>578</td>
<td>706</td>
<td>514</td>
<td>416</td>
<td>598</td>
</tr>
<tr>
<td>Mean</td>
<td>August 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>August 31</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>2101</td>
<td>2154</td>
<td>2048</td>
<td>1946</td>
<td>1742</td>
<td></td>
</tr>
</tbody>
</table>

The main point of interest in the above table is the apparent decrease in yield with delay in cutting. Apparently growth ceases about July 5 and after this date there is a gradual loss in dry matter. The dry matter loss is attributed to translocation of food reserves to roots, oxidation and dropping of leaves and seeds.

Of interest are the differences between yields at different cutting heights. Raising of the cutter bar from two to four inches decreased yields over one-third. The experiment serves to point out the concentration of forage in the lower six inches, particularly as compared to grass hays.

The wide difference in yields at different heights of cutting was naturally expected. If, in following years, this difference is narrowed, particularly during the early cutting dates, we may assume that early cutting can be causing a declining yield trend. We may then assume that the cause is due to cutting before ample translocation of food reserves to roots has taken place.
Table 2. Average crude protein content of yields for date and height of cutting treatments.

<table>
<thead>
<tr>
<th>HEIGHT OF CUTTING</th>
<th>DATES OF CUTTING</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>June 22</td>
<td>July 5</td>
<td>July 18</td>
<td>August 10</td>
<td>August 31</td>
<td>Mean</td>
</tr>
<tr>
<td>2 inches</td>
<td>( % )</td>
<td>( % )</td>
<td>( % )</td>
<td>( % )</td>
<td>( % )</td>
<td>( % )</td>
</tr>
<tr>
<td></td>
<td>7.12</td>
<td>6.53</td>
<td>5.67</td>
<td>4.44</td>
<td>3.53</td>
<td>5.45</td>
</tr>
<tr>
<td>4 inches</td>
<td>7.68</td>
<td>7.14</td>
<td>6.05</td>
<td>4.63</td>
<td>3.86</td>
<td>5.87</td>
</tr>
<tr>
<td>6 inches</td>
<td>7.78</td>
<td>7.26</td>
<td>6.38</td>
<td>4.64</td>
<td>3.66</td>
<td>5.94</td>
</tr>
<tr>
<td>Mean</td>
<td>7.52</td>
<td>6.97</td>
<td>6.03</td>
<td>4.56</td>
<td>3.68</td>
<td></td>
</tr>
</tbody>
</table>

The loss in crude protein content with delay in cutting is striking. About half of the protein is lost between the first and last cutting dates. The average protein value of 3.68 per cent for the August 31 date of cutting should be of interest to those operators who leave hay standing to be grazed off in the fall. This value is lower than the protein value given for oat straw.

The higher protein values for the four and six-inch clipping heights, as compared to the two-inch clippings, tends to show the distribution of protein in the plant with a higher portion being in the leaves and upper plant parts.
Table 3. Average crude protein yield per acre.

<table>
<thead>
<tr>
<th>HEIGHT OF CUTTING</th>
<th>DATES OF CUTTING</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>June 22</td>
<td>July 5</td>
<td>July 18</td>
<td>August 10</td>
<td>August 31</td>
<td>(lbs/A)</td>
</tr>
<tr>
<td>2 inches</td>
<td>257</td>
<td>234</td>
<td>186</td>
<td>147</td>
<td>110</td>
<td>186</td>
</tr>
<tr>
<td>4 inches</td>
<td>146</td>
<td>164</td>
<td>129</td>
<td>92</td>
<td>66</td>
<td>119</td>
</tr>
<tr>
<td>6 inches</td>
<td>61</td>
<td>42</td>
<td>46</td>
<td>24</td>
<td>15</td>
<td>38</td>
</tr>
</tbody>
</table>

Mean 154 147 120 88 63

The yields in pounds protein per acre are obtained by multiplying yields by protein per cent and are therefore a reflection of both protein and yield drop. The value of the loss with delay in cutting is easily computed by multiplying the difference between the yields of any two dates by $.011$, the cost of a pound of protein in cotton seed cake.

Summary

The results of one year's data emphasize the value of cutting at an optimum time for maximum production of high quality hay. It remains to be seen what the effect of early cutting will be on the following year's yield. If early cutting does not cause a decrease in yield trends, there is little doubt as to the value of this haying practice. Many operators can cut at an earlier date than they have been doing. For the large operator with a long haying period a change in practice is indicated either by a change in haying method or by speeding up the operation with the use of more haying equipment.
(Project Report)

YIELD RESPONSE OF NATIVE MEADOWS TO SIX RATES AND TWO DATES OF AMMONIUM PHOSPHATE FERTILIZER APPLICATION

**Purpose of Experiment**

1. To determine if the yield response to ammonium phosphate is significant enough to warrant recommending the use of this fertilizer for increasing the production of native meadows.
2. To determine the optimum rate of ammonium phosphate fertilizer application.
3. To determine which date of application, before flooding or after flooding, gives the greatest increase in yield.

**Summary of Experimental Plan**

Ammonium phosphate fertilizer (11-48-0) was applied at six rates of application (1) none (2) 100 lbs. (3) 200 lbs. (4) 300 lbs. (5) 400 lbs. and (6) 500 lbs. per acre both before and after the spring flooding period. Each fertilizer treatment was replicated four times and a sample was taken from each plot of the "before flood application" for analysis of crude protein content of forage.

**Results of Experiment**

Figure 1. Yields of fertilizer treatments in terms of tons of air dry matter per acre.
The yield curve of the before flood date of application is presented in Figure 1. There was no response to application made after the flooding period was over and the data is not presented herein. Chemical analysis of forage samples showed no change in protein content due to fertilization before flooding. Analysis was not made on samples from the after flood date of application.

Of interest in this experiment are observations made during the growing season. On all plots fertilized before the flooding period a luxurious growth of clover was present. Inspection revealed that this clover was also present on non-fertilized plots, but made little growth. Grasses were also stimulated considerably. The changes in composition of the vegetation of native meadows may well be one of the most important aspects of the use of commercial fertilizers. A change in vegetative composition which favors the more productive species to the point of exclusion of less desirable species will greatly increase the yield potential.

Summary of Experiment

The results of one year's data are very encouraging toward the possibilities of using commercial fertilizers. The increase in yield more than paid for the cost of fertilizer and of application. Residual yield increases will be all profit.

PROJECTS IN PROGRESS ON WHICH DATA IS NOT AVAILABLE:

1. A study complementary to the date and height of clipping experiment. In this study clippings are to be made at weekly intervals for a period of eight weeks. The study is designed to more effectively study the decrease in dry matter with delay in cutting observed in last year's data.

2. A project in which nitrogen and phosphorus were fall applied each at four rates of application, alone and in all possible combinations with the other. This experiment is designed to study the relationships of these two elements to yield response and to determine the most effective ratio of nitrogen to phosphorus that can be used economically.

3. An experiment in which nitrogen was applied by spraying on the foliage. This is a basic pilot type of experiment designed to investigate the possibilities of aerial application of nitrogen during the flooding period.

4. A project in which nitrogen was applied in water on diked plots. This project is designed to determine the effects of nitrogen applied during the flooding period.
**RANGE NURSERY TESTING OF NATIVE AND EXOTIC SPECIES:**

Projects in progress on which data is not available:

1. A project in which promising new strains of crested wheatgrass are being compared with the standard strain now being used. Some of these strains are a result of several generations of breeding, others are selections which have been isolated for seed increase. It is believed that production increases, comparable to that which has been obtained through selection and breeding in other grass species, can be made with crested wheatgrass.

2. A project in which sixteen alfalfa varieties are being tested for possible use on western rangelands. Most of these strains are of the dryland alfalfa type. They will be subjected to simulated grazing treatments after establishment to determine whether they can exist under grazing and under the adverse conditions of the sagebrush-bunchgrass type of rangeland.

**SPECIAL STUDIES**

*(Program Report)*

**COMPARISON OF HEREFORD AND BRAHMAN X HEREFORD CROSSBRED CATTLE UNDER EASTERN OREGON CONDITIONS**

**Purpose of the Experiment**

1. To compare the wintering ability of Brahman x Hereford weaners with Hereford weaners under Eastern Oregon conditions.

2. To compare the gains made by the crossbred and Hereford cattle as yearlings on sagebrush-bunchgrass type range.

3. To study the grazing habits of the animals on the sagebrush-bunchgrass range.

**Summary of Experimental Plan**

The animals included in this study have been fed in the winter phase of the work from December until late April. The basic ration used was 7.5 pounds of meadow hay; 2.5 pounds of alfalfa; 1 pound of barley; and 0.5 pound of cottonseed meal. The amount of meadow hay fed was adjusted so each lot received the same total digestible nutrients intake per pound of metabolic weight.

All animals grazed on the same sagebrush-bunchgrass range during the summer months. A short period was spent on the meadow aftermath during the fall.
The livestock research on the Squaw Butte-Harney Range and Livestock Experiment Station is conducted with cattle managed in a manner similar to most ranches depending on sagebrush-bunchgrass range for their summer feed. Winter feeding is usually begun in December and continues until late April, making an approximate 130-day winter feeding period. The cattle are then moved to the sagebrush range on the Squaw Butte unit of the station. They are held on the sagebrush-bunchgrass range until September. The cattle are then moved back to the valley where they clean up the meadows and graze on bunched hay until December.

The station maintains a commercial breeding herd of approximately 170 Hereford cows. The calves are marketed as long yearlings after grazing on the sagebrush-bunchgrass range during the summer.

**BREEDING STUDIES**

**(Progress Report)**

**COMPARISON OF HEREFORD AND BRAHMAN X HEREFORD CROSSBRED CATTLE UNDER EASTERN OREGON CONDITIONS**

**Purpose of the Experiment**

1. To compare the wintering ability of Brahman × Hereford weaners with Hereford weaners under Eastern Oregon conditions.
2. To compare the gains made by the crossbred and hereford cattle as yearlings on sagebrush-bunchgrass type range.
3. To study the grazing habits of the animals on the sagebrush-bunchgrass range.

**Summary of Experimental Plan**

The animals included in this study have been fed in the winter phase of the work from December until late April. The basic ration used was 7.5 pounds of meadow hay; 2.5 pounds of alfalfa; 1 pound of barley; and 0.5 pound of cottonseed meal. The amount of meadow hay fed was adjusted so each lot received the same total digestible nutrient intake per pound of metabolic weight.

All animals grazed on the same sagebrush-bunchgrass range during the summer months. A short period was spent on the meadow afternoon during the fall.
A total of forty animals were included in the study during 1950-51. Twenty-eight animals are included in the 1951-52 work. Both steers and heifers are included.

**Summary of Results**

(winter Phase)

Table 1. Summary of average daily gains made by Hereford and Brahman x Hereford crossbred steers during approximately the first half and second half of the wintering periods of 1950-51 and 1951-52.

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>Hereford</th>
<th>Brahman x Hereford</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1950-1951</td>
<td>1951-1952</td>
</tr>
<tr>
<td></td>
<td>(lbs/day)</td>
<td>(lbs/day)</td>
</tr>
<tr>
<td>54 days</td>
<td>1.04</td>
<td>0.60</td>
</tr>
<tr>
<td>69 days</td>
<td>1.05</td>
<td>0.76</td>
</tr>
<tr>
<td>Avg.</td>
<td>1.05</td>
<td>0.69</td>
</tr>
</tbody>
</table>

Table 2. Summary of average daily gains made by Hereford and Brahman x Hereford crossbred heifers during approximately the first half and second half of the wintering periods of 1950-51 and 1951-52.

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>Hereford</th>
<th>Brahman x Hereford</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1950-1951</td>
<td>1951-1952</td>
</tr>
<tr>
<td></td>
<td>(lbs/day)</td>
<td>(lbs/day)</td>
</tr>
<tr>
<td>54 days</td>
<td>1.00</td>
<td>0.44</td>
</tr>
<tr>
<td>69 days</td>
<td>0.86</td>
<td>0.62</td>
</tr>
<tr>
<td>Avg.</td>
<td>0.91</td>
<td>0.51</td>
</tr>
</tbody>
</table>
Results of the two winters' data show that all lots of animals gained considerably less during the winter of 1951-52 than during 1950-51. However, all animals were in a healthy condition at the end of the wintering period. All feed offered was consumed by the animals during both wintering periods.

The Hereford cattle used in the study have been produced in the herd maintained by the Squaw Butte-Harney Station. The crossbred animals used during 1950-51 were out of cows from the station herd and sired by a good type Brahman bull loaned to the station by the Gill Cattle Co. of Frenchglen, Oregon. The crossbreds used during the past winter were purchased from matings of registered Brahman sires and grade Hereford cows.

Table 3. Summary of average minimum temperature, number of days with temperature below 10°F and number of days with snow covering ground during approximately the first half and second half of the wintering periods of 1950-51 and 1951-52.

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>1950-1951</th>
<th>1951-1952</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Avg. min. temp.</td>
<td>Below 10°F</td>
</tr>
<tr>
<td></td>
<td>(°F)</td>
<td>(Days)</td>
</tr>
<tr>
<td>54 days</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>69 days</td>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>51</td>
</tr>
</tbody>
</table>

The animals were exposed to more severe conditions during the winter of 1951-52 as shown in table 3. The only protection any of the animals had during the winter was a solid board fence on the west side of the lots. Generally, wind is not a serious problem. An abundance of bedding was not provided.
(Summer Phase)

Table 4. Summary of average daily gain made by Hereford and Brahman x Hereford cattle on sagebrush range and meadow aftermath during 1951.

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>Hereford Steer (lbs/day)</th>
<th>Hereford Heifer (lbs/day)</th>
<th>Brahman x Hereford Steer (lbs/day)</th>
<th>Brahman x Hereford Heifer (lbs/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Sagebrush range)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4/27/51-9/22/51</td>
<td>0.87</td>
<td>0.87</td>
<td>1.09</td>
<td>1.00</td>
</tr>
<tr>
<td>(Meadow)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/22/51-10/25/51</td>
<td>0.15</td>
<td>0.24</td>
<td>0.76</td>
<td>0.46</td>
</tr>
<tr>
<td>4/27/51-10/25/51</td>
<td>0.74</td>
<td>0.76</td>
<td>1.03</td>
<td>0.90</td>
</tr>
</tbody>
</table>

The range used for summer grazing was composed primarily of big sagebrush (Artemisia tridentata) and bunch grasses. There was no green feed on the range from the time the grasses matured, around July 15, until the grazing season ended. Dry meadow aftermath was the main feed available on the meadow.

(Grazing Habit Phase)

Table 5. Summary of average distance traveled, average time spent traveling (not grazing), and average time spent grazing per day during eight 24-hour observation periods by Hereford and Brahman x Hereford steers during 1950-51 study.

<table>
<thead>
<tr>
<th>PERIOD OBSERVED</th>
<th>Herefords Distance Traveled (Ml)</th>
<th>Herefords Travel Time (Hr)</th>
<th>Herefords Grazing Time (Hr)</th>
<th>Crossbreds Distance Traveled (Ml)</th>
<th>Crossbreds Travel Time (Hr)</th>
<th>Crossbreds Grazing Time (Hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/24-5/30</td>
<td>4.8</td>
<td>0.46</td>
<td>9.7</td>
<td>5.7</td>
<td>0.55</td>
<td>10.7</td>
</tr>
<tr>
<td>6/19-6/22</td>
<td>4.8</td>
<td>1.50</td>
<td>8.7</td>
<td>3.1</td>
<td>0.38</td>
<td>10.7</td>
</tr>
<tr>
<td>7/17-7/20</td>
<td>4.2</td>
<td>0.85</td>
<td>8.4</td>
<td>3.4</td>
<td>0.65</td>
<td>8.3</td>
</tr>
<tr>
<td>8/14-8/18</td>
<td>5.3</td>
<td>2.00</td>
<td>9.2</td>
<td>3.2</td>
<td>0.70</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Average 4.8 1.20 9.0 3.8 0.57 9.3
The summary of the grazing habit study conducted during the summer of 1951 (table 5) shows:

1. Hereford steers averaged one mile more travel per day in their grazing activities during the observation periods than the Brahman x Hereford steers.
2. Hereford steers spent approximately one-half hour more time per day traveling when they were not grazing than did the Brahman x Hereford steers.
3. Approximately the same amount of time was spent by the two groups of animals in actually grazing.

**NUTRITION STUDIES**

*(Progress Report)*

**RESPONSE OF HEREFORD COWS AND CALVES TO OLD AND NEW MEADOW HAY IN THE WINTERING RATION**

**Purpose of the Experiment**

1. To determine whether it is a better practice to winter pregnant beef cows on native meadow hay that has been in the stack less than one year, or on hay that has been in the stack one year or longer.
2. To determine what level of carotene is necessary in our meadow hay to protect the breeding herd from vitamin A deficiency.
3. To determine how much carotene our meadow hay generally contains when it is one, two, and three years old.

**Summary of Experimental Plan**

Eighteen pregnant Hereford cows have been used in the study during the winter feeding periods of 1950-51 and 1951-52. All cows were individually fed with one-half of the animals receiving hay each winter which was stacked during 1949. The remainder of the animals received hay from the crop put up during the summer preceding the feeding period.

The main factors being studied were the condition of calves at birth; rate of gain of calves from birth to 28 days of age; rate of gain of calves from birth to weaning; the blood carotene and vitamin A content of cows and calves during the winter period; conception rate of cows during following summer; and symptoms of borderline or acute vitamin A deficiency.

Carotene, a chemical constituent of green forage, is converted in the animal body to vitamin A. A certain amount of vitamin A is essential to the health and production of beef cattle. A deficiency of vitamin A can result in abortion, stillborn calves, blind calves at birth, calves that are weak and susceptible to infectious diseases such as scour and reduced fertility of both sire and dam. As a general rule it is said that cattle can store enough carotene or vitamin A during 4 to 5 months on green grass to protect them for 6 to 7 months on dry feed. Cattle depending
upon sagebrush-bunchgrass range for their only source of summer feed are on green grass approximately 3 months. Because of this short period of abundant carotene, it is believed that more information is needed on the winter carotene requirements of our breeding herds.

Summary of Results

Table 6. Summary of average daily hay consumption by cows during 1950-51 and 1951-52 winter feeding periods.

<table>
<thead>
<tr>
<th>Hay</th>
<th>Old Hay Cows</th>
<th>New Hay Cows</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>'50-'51</td>
<td>'51-'52</td>
</tr>
<tr>
<td></td>
<td>(lbs/day)</td>
<td>(lbs/day)</td>
</tr>
<tr>
<td>1949 Crop</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>1950 Crop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1951 Crop</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The 1949 hay fed during the 1951-52 feeding period was similar in vegetative composition to the old hay fed during 1950-51. In addition to the difference in chemical composition (Table 7) the old hay fed during 1951-52 appeared to be very slightly browned, probably due to being stacked with a moisture content too high for proper curing.

The new hay fed during both winters was very similar. The average difference in consumption can at least be partially attributed to a difference in consumption between four cows during 1950-51 and their replacements during 1951-52.

Table 7. Summary of crude protein and carotene content of hays fed during 1950-51 and 1951-52.

<table>
<thead>
<tr>
<th>Year Fed</th>
<th>1949 Crop</th>
<th>1950 Crop</th>
<th>1951 Crop</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Protein</td>
<td>Carotene</td>
<td>Protein</td>
</tr>
<tr>
<td></td>
<td>(%)</td>
<td>(p.p.m.)</td>
<td>(%)</td>
</tr>
<tr>
<td>1950-51</td>
<td>7.0</td>
<td>22</td>
<td>7.0</td>
</tr>
<tr>
<td>1951-52</td>
<td>9.1</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>
(1950-51 Summary) The blood of all cows in the study was analyzed at approximate 60-day intervals during the feeding period for the carotene content of the plasma. The results showed that the blood carotene content of the cows receiving the 1949 hay was approaching a level considered to be critical for reproduction. However, no symptoms of vitamin A deficiency were noted in any of the cows or calves.

(1951-52 Summary) Blood analysis during the 1951-52 winter period indicated that a higher level of carotene was maintained by the cows on old and new hay than was the case with either group during 1950-51. The old hay group was lower in the blood content of both carotene and vitamin A.

Definite symptoms of vitamin A deficiency were observed in some calves from cows receiving both types of hay. Symptoms observed in various animals were exophthalmos (a bulging eye condition), night blindness, incoordination, and an edematous swelling of the knees. Also several calves suffered from scours for varying lengths of time.

The cows were subjected to much more severe weather conditions during the winter of 1951-52 than during 1950-51 (see table 3 in the report on the Hereford vs. Brahman x Hereford comparison). The average birth weight of all calves born during 1952 was approximately 12 pounds less than during 1951. Gains made by the calves from birth to 28 days of age were also lower during the spring of 1952.

Analysis of the data has not been completed, so definite conclusions cannot be made. This work will be continued in an attempt to get more basic information on the winter carotene requirements of cows on a sub-optimum carotene intake during late summer and fall months.

(Progress Report)

PRODUCTION OF A COMERCIAL BEEF HERD ON SAGEBRUSH-BUNCHGRASS RANGE WITH AND WITHOUT A PROTEIN SUPPLEMENT FOLLOWED BY THREE LEVELS OF WINTER NUTRITION

Purpose of the Experiment

1. To determine whether it is profitable to feed a protein supplement to a commercial breeding herd while grazing on a sagebrush-bunchgrass range.

2. To determine the influence of 3 levels of winter nutrition (see summary) on the production of Hereford cows that depend upon sagebrush-bunchgrass range, with and without a protein supplement, for their only summer feed.

Summary

This project was initiated during the summer of 1951. A total of 90 Hereford breeding cows and their calves were assigned to the study. One-half of the group received a supplement of one pound
of cottonseed meal per day from July 4 until September 11 when they were removed from the range. The intake of the supplement was controlled by mixing salt with it at the rate of one pound of salt with one pound of cottonseed meal. The remaining 15 cows and their calves received no protein supplement while on the range.

After leaving the range the cows and their calves grazed together on the meadows where bunched hay and meadow aftermath forage was available.

When winter feeding was initiated during early January the 90 cows were divided into three lots of 30 each. The group that received the supplement on the range provided 15 cows for each lot, and the remaining 15 came from the group that received no range supplement. The winter rations fed were as follows:

Lot 1 - Full feed of meadow hay.
Lot 2 - Full feed of meadow hay and 3/4 pound of cottonseed meal per day.
Lot 3 - Full feed of meadow hay, one pound of barley and one pound of cottonseed meal per day.

It does not appear, from preliminary analysis, that supplementing at the rate of one pound of cottonseed meal per day on the range under the described conditions resulted in a profitable increase in weaning weight of calves. The influence of the supplement on conception rate during the 1951 breeding season is not known as yet.

PROJECTS UNDERWAY ON WHICH DATA IS NOT AVAILABLE

TESTING OF A METHOD FOR IMPROVING A COMMERCIAL BELT CATTLE BREEDING HERD THROUGH SELECTION FOR TYPE AND ABILITY TO GAIN RAPIDLY AND EFFICIENTLY

Purpose of the Experiment

1. To determine what progress can be made in improving the herd of cattle maintained by the station through application of the method described in the summary.

Summary

Essentially the method for improving the herd consists of maintaining a small breeding herd to produce replacement heifers for the remainder of the herd. In our case a one-sire breeding herd will be used to provide the replacements. Final selection of the heifers to be used as replacements will be based on type, rate of gain from birth to weaning, and rate and efficiency of gain following weaning.

Such a method provides for maximum benefit from an outstanding sire because it is possible to mate him to select cows. If the
sire is selected on the basis of both type and ability to gain rapidly and efficiently it makes possible more intensive use of these hereditary characters in improving the entire herd.

A comparison of the improvement being made in type and gaining ability between the heifers produced by the small breeding herd and a random selection of heifers from the commercial herd is being made. This work was initiated during the summer of 1951.

A COMPARISON OF RATIONS FOR TESTING THE ABILITY OF BEEF CATTLE TO GAIN IN THE DRY LOT AND SUBSEQUENTLY ON THE RANGE

Purpose of the Experiment

1. To compare rations of low roughage and high roughage content in testing the ability of cattle to gain in the dry lot.
2. To compare gains made by cattle on grass after being tested for ability to gain under dry lot conditions on a low roughage and a high roughage ration.
3. To determine what relationship exists between gains made by the same animal under dry lot feeding conditions and subsequently on the range.

Summary

This study was initiated during the winter of 1951-52. Twenty-eight Hereford heifers were individually fed during the winter testing period and are grazing together on sagebrush-bunchgrass range during the summer grazing period.

Fourteen of the heifers were individually fed a ration made up largely of roughage which should result in an average daily gain of approximately one pound per day for the group. The roughage portion of the ration was full fed. The remaining fourteen heifers were fed a ration made of a smaller portion of roughages which should result in an average daily gain of 1 3/4 pounds per day for the group.

A COMPARISON OF TRAILING AND HAULING COWS, CALVES, AND YEARLINGS TO AND FROM THE SUMMER RANGE.

Summary

This project was initiated during the fall of 1951 to compare the influence of hauling and trailing cattle approximately 40 miles to and from the summer range.
RANGE IMPROVEMENT STUDIES

The research program is designed to study two of the quickest methods that are useful in restoring big sagebrush range to good grass production. These are as follows:

1. Control of big sagebrush
2. Reseeding.

These two methods can permit rapid improvement on carefully selected areas that will alleviate a tough job in range and livestock management and lead the way to over-all range improvement.

Putting more grass on the better sites in a short period of time as a first step in range improvement is better than reduction in stocking.

A. CONTROL OF BIG SAGEBRUSH BY SPRAYING

1. THE USE OF GROWTH REGULATORS FOR THE CONTROL OF BIG SAGEBRUSH

Purpose of Experiment

To evaluate the practical possibilities and scope of research needed to develop the essential information for controlling big sagebrush by spraying.

Summary of Experimental Plan

During 1950 four growth regulator formulations were sprayed at acid equivalent rates of 1, 2, and 3 pounds per acre on 9 dates during the months of April, May, June, and July. The experiment was conducted as a factorial in three randomized blocks located on different sites.

During 1951 2,4-D butyl ester was sprayed at 1½ pounds per acre on 17 dates during the months of March, April, May, June, and July.
Results

a. Average effectiveness by formulations for applications on May 2, 16, and 24 (the most effective applications).

1:1 mix of isopropyl esters of 2,4-D and 2,4,5-T in oil emulsion:

- 90% killed

2,4-D butyl ester in oil emulsion:

- 86%

2,4-D butyl ester in water:

- 84%

2,4-D sodium salt in oil emulsion:

- 35%

b. Average effectiveness by acid equivalent rates when applied on May 2, 16, and 24. These averages include the three ester materials.

<table>
<thead>
<tr>
<th>Pounds of Acid Per Acre</th>
<th>1 lb.</th>
<th>2 lb.</th>
<th>3 lb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Cent Kill</td>
<td>77%</td>
<td>89%</td>
<td>93%</td>
</tr>
</tbody>
</table>
During 1950 the most favorable period of spray application included the first 24 days of May. A good rain during early June, 1951 apparently extended the period during which the spray effectively killed big sagebrush.

During 1951 good effectiveness began on May 2 and dropped sharply after June 5.

So far it looks like spraying should be planned for the first three weeks of May. See the figure below.

Date of Spray Application

- Brush
- Kill (%)

Date of Spraying

1950 average mortality resulted from application of the three ester materials at rates of 1, 2 and 3 pounds per acre. 1951 average mortality resulted from application of 1½ pounds acid equivalent per acre of 2,4-D butyl ester.

Practical Application of Results

Big sagebrush is quite easily killed with growth regulators. Although the 1:1 mix of 2,4-D and 2,4,5-T gave best control, the higher cost of 2,4,5-T will restrict its use. The sodium salt formulation was very poor and should not be used. When both cost and effectiveness are considered the butyl ester of 2,4-D was the best formulation in this study.
From 1 to 2 pounds of acid equivalent per acre is needed. Control, rather than eradication, should be the objective. Kills as high as 90 per cent have been attained with applications of 1 pound per acre.

Spraying should be done during the month of May. During years when little or no rain falls during May, effectiveness may be poor during the last week or ten days. During the years when May is quite rainy, mortality can remain high for a week or two in June. Since effectiveness drops a week or two earlier on the drier south slopes than on the better sites, it seems essential that large applications be planned for the first three weeks of May.

In this study the materials were prepared with water and oil emulsion solvents at a volume rate of about 10 gallons per acre. If spraying is to be done with ground equipment, which would be suitable on many recessed areas, that amount of solvent seems desirable; but an application of 10 gallons per acre would not be practical with airplanes. The cost of airplane spraying has been quoted at about 50 cents per gallon. As yet we are unsure of the results that may be attained with spraying at low volumes that could be practical with airplanes.

2. THE COMPARISON OF DIFFERENT GROWTH REGULATOR FORMULATIONS

Purpose of the Experiment

2,4-D acid is a solid which is insoluble in water. To make it soluble, it is formulated in many different ways of which amine salt, sodium salt, and esters are more common. The way in which the growth regulators are prepared for use is important to their effectiveness. Also, the solvent with which the material is mixed for spraying is important, and many materials are available which will increase the wetting, sticking, and penetrating properties of the spray solution.

Much work is needed to evaluate the many possibilities for improving effectiveness.

Summary of Experimental Plans

The initial phase of study included 24 different solutions which were applied in a complete random design with three replications and one date of spraying each during 1950 and 1951.

All spraying was done at an acid equivalent rate of one pound per acre, and a solution volume of about 10 gallons per acre.
The screening program will continue indefinitely as time and materials permit.

Results

THE SOLUTIONS USED VARIED IN EFFECTIVENESS FROM AN AVERAGE OF 3 PER CENT TO 89 PER CENT.

Consistently poor in effectiveness were the amine salts of both 2,4-D and 2,4,5-T, and the isopropyl ester of 2,4-D. The sodium salt of 2,4-D was reported above with low kills. Mixtures of 2,4-D and 2,4,5-T, and mixtures of 2,4,5-T and MCPA have been most effective; however, such mixtures are probably not practical at the present time due to high cost.

The best solvent used was straight kerosene. The addition of vatsol or tween 80 at 0.10 per cent to water was nearly as effective as the kerosene spray, and might be more practical.

Practical Application of Results

Amine and sodium salts are commonly used forms of 2,4-D. These have been much less effective on big sagebrush than ester forms; although the isopropyl ester also gave poor control. 2,4-D butyl ester has given good kills and is reasonable in cost. The addition of a wetting agent such as vatsol or tween 80 seems advisable. The wetting agent may be added at a rate of 1 pint to 130 gallons of water before the 2,4-D is added.

PRESENT SPRAYING PROGRAM

The biggest cost item is for application when spray volume is as high as 10 gallons per acre. Spray volume must be reduced to a minimum to permit practical airplane spraying. It is hoped that present projects will give us the information we need for reducing spray volume without similar reductions in effectiveness.

3. SOLVENT TYPE AND VOLUME EVALUATION

Purpose of the Experiment

To evaluate the practical limits of spray volume reduction.

Summary of Experimental Plans

Water, diesel oil emulsion, and diesel oil will be used as solvents, each at 3 and 6 gallons per acre for spraying 2,4-D butyl ester, 2,4-D low volatile ester, and 2,4,5-T low volatile
ester, each at acid equivalent rates of one and two pounds per acre. Spray applications will be made on 6 dates spaced at two-week intervals.

The study will be conducted as a factorial in randomized block with two replications each during 1952 and 1953.

All living sagebrush on an area almost 10 acres in size will be counted before spraying and again one year after spraying to determine the effectiveness of the sprays. Thus solvent volumes of 3 and 6 gallons per acre will each be evaluated by average effectiveness over an area of about 5 acres. Solvent types (water, emulsion, and diesel oil) and the three formulations will each be evaluated by average effectiveness over an area of about 3 1/3 acres.

**Results**

Preliminary results will be available in 1953 and final results will be taken in 1954.

**4. SOLVENT SCREENING**

**Purpose of the Experiment**

To supplement the study described immediately above and select a suitable solvent for applying growth regulators at low spray volume on big sagebrush.

**Summary of Experimental Plans**

Each of the three formulations used in the above study will each be applied at an acid equivalent rate of one pound per acre in 14 different solvents at three gallons per acre.

The study will be conducted in randomized block design with three replications.

**Results**

Results will be taken in 1953.

**5. BIG SAGEBRUSH--GOOD AND BAD**

**Purpose of the Experiment**

To determine the influence of big sagebrush upon grass production,
Although sagebrush draws heavily upon soil moisture and consequently restricts grass production, it isn't all bad. It serves to drift the snow during winter and permits the snow to begin melting earlier in the spring. These features, and perhaps others, are benefits.

Summary of Experimental Plans

Data pertaining to soil moisture and grass production will be taken under living brush, under dead standing brush which has been killed by spraying, and on an area cleared of sagebrush by grubbing.

Results

Initial response will be reported in 1953.

B. RESEEDING METHODS

1. METHODS OF PLANTING CRESTMED WHEATGRASS

Purpose of the Experiment

A preliminary study to evaluate the use of roller equipment and compare drilling with broadcasting and late fall planting with early spring planting.

Summary of Experimental Plans

The study was conducted in split plot design with two replications.

All plots to be firmd were rolled after planting. The seedbed was prepared by plowing once over with a whealand type disk plow.

Rate of planting was 3.3 pounds of viable seed per acre.

Results

The difficulties of planting small seed on soil still rough and loose from plowing were emphasized. With drilling, the seed may be dropped on the surface or drilled as deep as 5 inches. With broadcasting, seed coverage is commonly left to the weather. Both methods can be poor.

Drilling during the fall resulted in slightly more seedlings than did broadcasting, but broadcasting was about 3 times better than drilling on the spring-planted plots. It appears
that drilling was at a disadvantage when rolled after planting. Rolling should probably be done before drilling but after broadcasting if incorporated into planting methods.

Of particular interest in this initial phase of study is the influence of rolling after broadcasting and the difference between fall and spring planting in terms of seedling stand and survival.

Rolling to firm the soil upon the seed improved fall broadcasting by 1300 per cent. Apparently broadcasting need not be a poor method of planting. The following table shows the number of seedlings emerged during the spring, 1951, and the number remaining during the spring, 1952.

<table>
<thead>
<tr>
<th>Number of Grasses per Square Foot</th>
<th>Fall Broadcast</th>
<th>Spring Broadcast</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not Rolled</td>
<td>Rolled</td>
</tr>
<tr>
<td>Number of Seedlings</td>
<td>0.23</td>
<td>3.07</td>
</tr>
<tr>
<td>Number Survived</td>
<td>0.03</td>
<td>1.55</td>
</tr>
</tbody>
</table>

Survival in per cent favored fall planting by 48 per cent to 25 per cent for spring. Survival with rolling was 3/4 per cent as compared with 26 per cent without rolling.

**Practical Applications of Results**

In this initial phase of study it appears that rolling can be used to advantage when planting crested wheatgrass on range land. In present studies it seems possible to improve both drilling and broadcasting methods by rolling—before drilling to help regulate depth of planting and after broadcasting to cover the seed with firm soil. Since drilling seemed to be at a disadvantage with rolling after planting in this study, the comparative results are not shown.

2. **THE APPLICATION OF ROLLER EQUIPMENT TO IMPROVE RESULTS FROM DRILLING**

**Purpose of the Experiment**

To compare rolling before drilling with rolling after drilling and rolling both before and after drilling.
Summary of Experimental Plans

The experiment will be conducted as a factorial in randomized block with four replications each during 1951, 1952, and 1953.

Drilling of crested wheatgrass will be done with a single disk surface drill at a rate of about 5 pounds per acre.

All planting will be done in the fall. Rolling will be done with an 8-foot roller weighing about 3 tons.

Results

We hope to have initial results ready to report during field day.

3. SEASON AND METHOD FOR BROADCAST PLANTING OF CRESTED WHEATGRASS

Purpose of the Experiment

To compare four seasons of broadcast planting—early fall, late fall, early spring, and mid-spring.

To further evaluate the influence of rolling to firm the soil upon broadcast seed. This objective is further accentuated by different rolling treatments to assist in determining the best soil condition and season for rolling.

Summary for Experimental Plans

The study will be conducted in randomized block with three replications and continue for a minimum of three years and possibly be continued for seven years.

Seasons of planting will be determined more by weather and soil condition than calendar date. Early fall planting will be done while the soil is still dry and fluffy, weather permitting. Late fall planting will be done after the soil has received enough moisture to permit good firming. Early spring planting will be done immediately after snow melts with rolling delayed to prevent puddling. Late spring planting will be done as early as the soil is dry enough to prevent puddling when rolled immediately.

Results

We hope to have initial results ready to report during field day.
4. METHODS OF PLANTING CRESTED WHEATGRASS FOR OPTIMUM EMERGENCE AND SURVIVAL OF SEEDLINGS

Purpose of the Experiment

To compare drilling by a single disk drill and a press drill with broadcasting.

To determine the influence of firming with a 1-ton cultipacker and a 3-ton roller. Rolling will be accomplished before drilling but after broadcasting.

To compare spring plowing while the soil is moist with summer plowing while the soil is dry.

Summary of Experimental Plan

The study will be conducted as a factorial in randomized block with four replications each during 1951, 1952, and 1953.

The seedbed will be prepared by plowing with a wheatland type disk plow and all plots planted during the fall. Broadcasting will be done with the single disk drill uncoupled to permit seed dissemination while the disks are up. This will assure a more uniform rate of planting at about 5 pounds per acre.

Two replications each year will be plowed during the spring while the soil is moist and the other two will be plowed during the summer while the soil is dry.

Results

We hope to have initial results ready to report during field day.

5. PLANTING CRESTED WHEATGRASS WITHOUT SOIL TILLAGE

Purpose of the Experiment

This is a preliminary study to compare plowing with roto-beater and spraying treatments in terms of sagebrush control and planting success.

Summary of Experimental Plans

The plots were prepared by the three separate methods listed above during May, 1951 and planted to crested wheatgrass by broadcasting and rolling during the spring, 1952.

Results

We hope to have initial results ready to report during field day.
6. RATE OF PLANTING CRESTED WHEATGRASS

Purpose of the Experiment

To determine the optimum grass density for maximum production of feed and resistance to encroachment of brush.

Summary of Experimental Plans

Crested wheatgrass was planted at rates of 1 through 6 pounds per acre inclusive during the fall, 1951. Data on density of survived grasses, production by clipping, and reinvasion of brush will be taken beginning in 1953.

7. DRYLAND ALFALFA

Nomad and Sevelra alfalfa have been planted with crested wheatgrass for observation and future evaluation. So far both seem to be doing well.