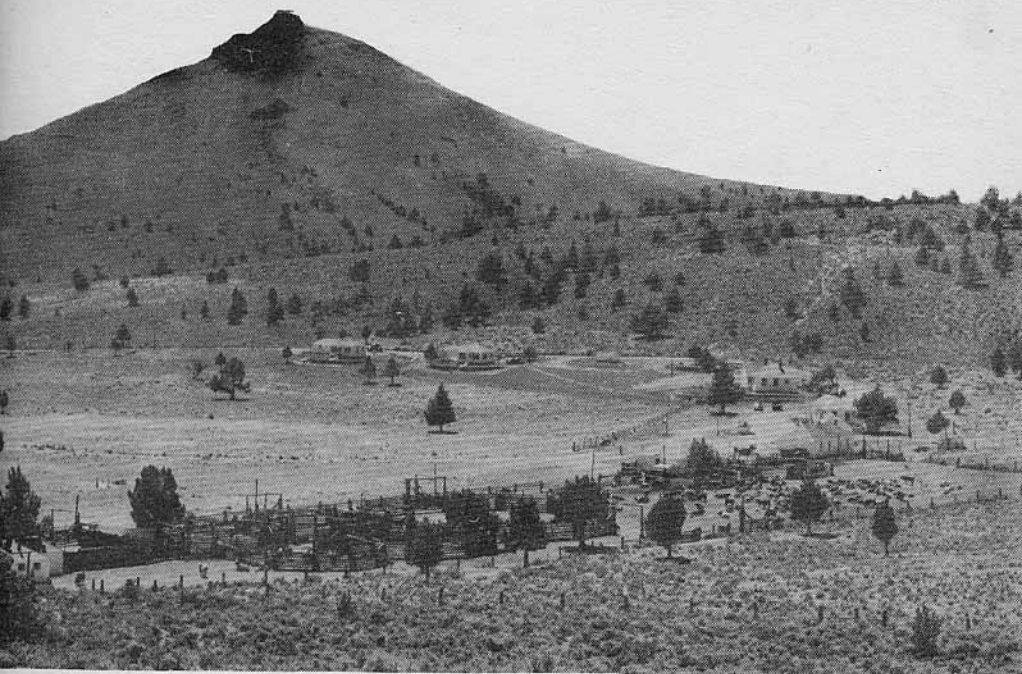


Permanent File

The Stockman's Laboratory



FIELD-DAY REPORT
Squaw Butte-Harney
Range and Livestock Experiment Station
Burns, Oregon

AGRICULTURAL EXPERIMENT STATION AND THE U. S. DEPARTMENT
OF INTERIOR COOPERATING, OREGON STATE COLLEGE, CORVALLIS

1953 Field-Day Report

Squaw Butte-Harney Range and Livestock Experiment Station

Burns, Oregon

The Stockman's Laboratory

W. A. Sawyer, Superintendent

American agriculture has made great strides in production and efficiency since the turn of the century. But compared to industry, agriculture's advancement is lagging far behind. Much of the advancement in both fields may be from applying the results of research. Industry invests about 5 per cent of its income in research while agriculture is investing only a fraction of 1 per cent.

The population of the nation is increasing at the rate of about 7,500 per day, but the acres of land producing the food and fiber to feed and clothe the nation is the same. This means either a continuing increase in production per acre or fewer well-fed people.

Few large areas in the United States have so great an opportunity to increase the output of food and fiber as does the service area of the Squaw Butte-Harney Experiment Station, which includes southeastern Oregon, southern Idaho, northern Nevada, and northeastern California. It has been estimated that by the application of practices and methods now known or being developed, range land can be made to produce 2 to 3 times more forage than at the present. Also, wild flood meadows can be made to produce at least twice as much hay as they are now producing. Added feed production, plus improved livestock breeding and management, means continued prosperity and meat for the nation's tables.

Forward looking livestock men in this area assisted in planning and developing the Squaw Butte-Harney Range and Livestock Experiment Station as the industry's field laboratory. As such, the Station is carrying a heavy program of research of immeasurable value.

The Squaw Butte Range unit of the Station is about 40 miles west of Burns, Oregon. The area is typical sagebrush-bunchgrass range, lying at an elevation of about 4,600 feet and receiving about 11 inches annual precipitation. The range, like that of much of the service area, is in need of improving. Improvement is made more difficult because grazing must begin before ranges are ready to be grazed in the spring, and must continue through the summer and fall after feed quality has dropped.

The Section Five meadow is typical of more than 1,000,000 acres of mountain or wild flood meadows in the service area. Wild hay, which provides the winter feed for much of the area's range livestock, is low in quality and often in short supply.

A brief report of the results from some of the major work on the station is presented here for review and consideration. Suggestions and comments from ranchers and technicians will be appreciated. Ranchers are asked to consider the work reported here and to work with their county Extension Agents in testing those methods and practices that offer an increase in the economic return from their range operations.

Clee S. Cooper, Agronomist

Cutting Management Studies

Purpose of the experiment

The relationship between time of cutting and stage of maturity has been studied on many hay crops. From these studies a number of facts have been established. Some of the more important are:

- ▶ Crude protein content of hay decreases as the plants mature.
- ▶ A given time of cutting may be better for one plant than for another.
- ▶ Cutting for hay at certain stages of maturity is better for continued production than at other stages.
- ▶ Cutting too early may cause lower yields in following years because the plant has not had time to store ample root reserves.

Similar studies of these relationships on native meadows are very limited and information is needed to properly manage them. This study, in which hay is cut at different stages of maturity and at three cutting heights at each stage of maturity, is an attempt to find the extent to which the above relationships apply. Cutting heights were used to leave different amounts of stubble for translocation of reserves to roots. The relationships of cutting treatments to plant growth and species composition may be complex. For this reason it will be a long-time study.

Experimental plan

Plots were cut at five stages of maturity and three cutting heights in 1951 and 1952 to determine the influence of cutting treatments on yield, vegetative composition and crude protein content of meadow hay. The growth of Nevada bluegrass and Meadow barley was used to correlate cutting date to stage of maturity. The five stages of maturity or time of cutting were:

1. Nevada bluegrass -- full bloom, Meadow barley -- beginning bloom.
2. Nevada bluegrass -- soft dough, Meadow barley -- soft dough.
3. Nevada bluegrass -- hard dough, Meadow barley -- seeds dropping.
4. Nevada bluegrass and Meadow barley -- green color one-half gone.
5. Nevada bluegrass and Meadow barley -- green color all gone.

Cutting heights at each stage of maturity were 2, 4, and 6 inches.

Ten small samples were taken per plot before harvesting. These samples were hand separated into four vegetative groups (1) rush (2) sedge (3) grass and (4) forbs. All plots were clipped at 2 inches in the fall and aftermath removed.

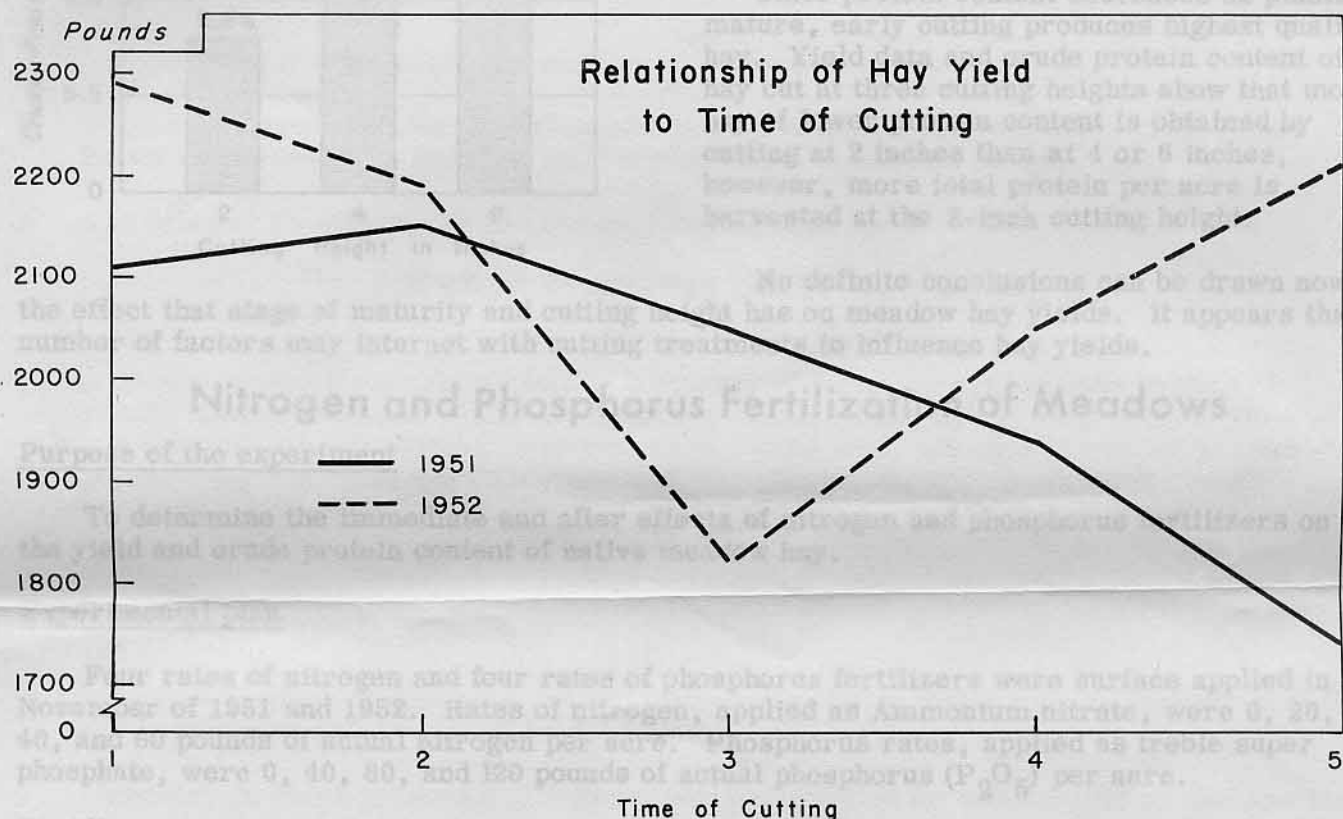
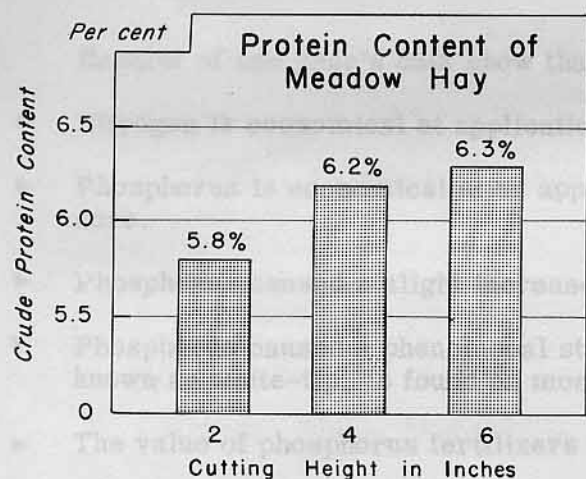


Figure 1. The reasons for differences between 1951 and 1952 yield trends are not yet known. See experimental plan for descriptions of time of cutting.

Table 1. Average Crude Protein Content (N x 6.25) of Hay Cut at Five Stages of Maturity

Year	Stage of Maturity					Average
	1	2	3	4	5	
1951	7.52	6.97	6.03	4.56	3.68	5.75
1952	6.91	6.99	6.88	6.20	5.38	6.46
Average	7.21	6.98	6.45	5.38	4.52	

The loss of protein with advance in stage of maturity was much less rapid in 1952, and is believed to be associated with a longer flood period. Plots were submerged three weeks longer in 1952 than in 1951.



► Figure 2. Crude protein content of hay cut at 2 inches was less than hay cut at 4 and 6 inches because the samples analyzed probably contained more stems.

Since protein content decreases as plants mature, early cutting produces highest quality hay. Yield data and crude protein content of hay cut at three cutting heights show that more hay of lower protein content is obtained by cutting at 2 inches than at 4 or 6 inches, however, more total protein per acre is harvested at the 2-inch cutting height.

No definite conclusions can be drawn now on the effect that stage of maturity and cutting height has on meadow hay yields. It appears that a number of factors may interact with cutting treatments to influence hay yields.

Nitrogen and Phosphorus Fertilization of Meadows

Purpose of the experiment

To determine the immediate and after effects of nitrogen and phosphorus fertilizers on the yield and crude protein content of native meadow hay.

Experimental plan

Four rates of nitrogen and four rates of phosphorus fertilizers were surface applied in November of 1951 and 1952. Rates of nitrogen, applied as Ammonium nitrate, were 0, 20, 40, and 60 pounds of actual nitrogen per acre. Phosphorus rates, applied as treble super phosphate, were 0, 40, 80, and 120 pounds of actual phosphorus (P_2O_5) per acre.

Results

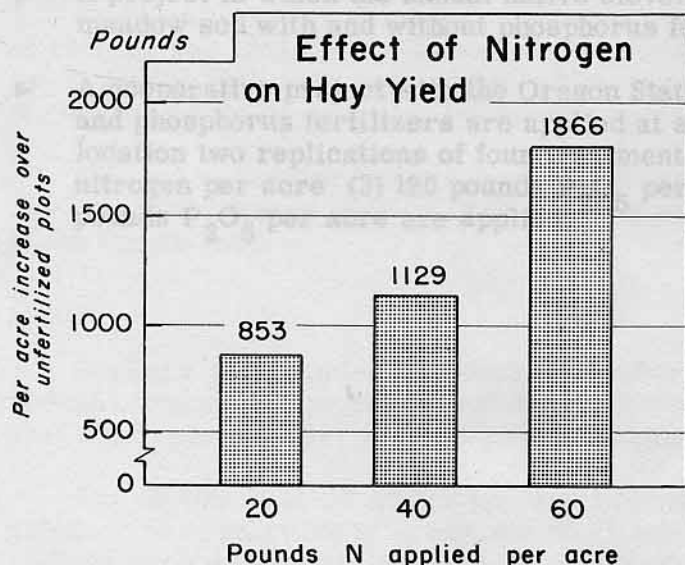


Figure 3. Unfertilized plots in this experiment yielded an average of 2,694 pounds per acre.

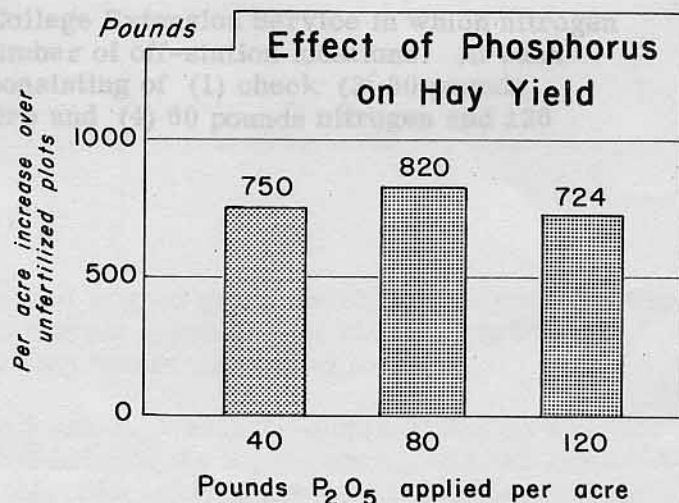


Figure 4. Unfertilized plots in this experiment yielded an average of 2,694 pounds per acre.

Results of one year's data show that:

- ▶ Nitrogen is economical at application rates of 20 to 60 pounds of actual nitrogen per acre.
- ▶ Phosphorus is economical at an application of 40 pounds of actual phosphorus (P_2O_5) per acre.
- ▶ Phosphorus caused a slight increase in crude protein content.
- ▶ Phosphorus caused a phenomenal stimulation of an annual native clover. This clover, known as white-tip, is found on most meadowlands in eastern Oregon.
- ▶ The value of phosphorus fertilizers may depend upon the presence of clover.

Research in Progress on Which There is No Data to Report

- ▶ A project in which the relationship of frequency of fertilizer applications to time of cutting is being studied. Plots are being cut at two cutting dates: early (July 1-10) and late (July 20-30). On plots comprising each cutting date, nitrogen is applied at 1- and 2-year intervals alone and in combination with phosphorus applied at 1-, 2-, and 4-year intervals.
- ▶ A project in which the effect on yield of the minor fertilizer elements copper, boron, manganese, and zinc are being compared at two nitrogen and two phosphorus fertility levels.
- ▶ A project in which six grasses and two legumes are being tested for adaptability alone and in mixtures on a prepared seedbed.
- ▶ A nursery in which grasses and legumes are being tested for adaptability on meadow land.
- ▶ A project in which the annual native clover (*T. variegatum*) has been seeded on native meadow sod with and without phosphorus fertilization.
- ▶ A cooperative project with the Oregon State College Extension Service in which nitrogen and phosphorus fertilizers are applied at a number of off-station locations. At each location two replications of four treatments consisting of (1) check (2) 60 pounds nitrogen per acre (3) 120 pounds P_2O_5 per acre and (4) 60 pounds nitrogen and 120 pounds P_2O_5 per acre are applied.

Results

During a mild winter, a ration of new hay stacked in good green condition will provide enough carotene for pregnant beef cows. When feeding old hay it is best to feed it in the early part of the winter. Put cows on good green hay as long before calving as possible.

The severe 1951-52 winter apparently adversely affected fetus development and post-natal gains. The appearance of symptoms of Vitamin A deficiency during the spring of 1952 suggests that carotene or Vitamin A metabolism was adversely affected by the winter conditions. Work under way should shed further light on the problem.

Beef Cattle Research

Farris Hubbert, Jr., Animal Husbandman

A herd of about 160 Hereford cows are used in livestock research on the Squaw Butte-Harney Range and Livestock Experiment Station. The calves are marketed as long yearlings after grazing on the sagebrush range.

The herd is managed similarly to many operations where sagebrush-bunchgrass range is the only summer feed. Winter feeding usually begins in December and continues until late April. Cattle are then moved to the sagebrush range until September.

Old vs. New Meadow Hay in Beef Cow's Winter Ration

Purpose of the experiment

Meadow hay during the winter and green grass during the summer are the main sources of carotene for meeting the cow's needs. Carotene is converted in the animal's body to the essential Vitamin A. As a general rule, cattle can store enough carotene and 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 summer feed are on green grass about 3 months.

Because of this short period of abundant carotene, this study is being conducted to provide answers for the following questions:

- ▶ What carotene level is necessary in the winter ration to protect the breeding herd from Vitamin A deficiency?
- ▶ Will native meadow hay that has been in the stack for longer than 1 year meet the winter carotene needs of pregnant beef cows as well as hay that has been stacked less than 1 year?

Experimental plan

Eighteen pregnant Hereford cows were 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 from the 1949 crop each winter. The remainder of the animals received hay harvested during the summer preceding the feeding period.

The native hay used in this work was from meadows of the wet land type with over 80 per cent of the forage consisting of rush and sedge. Mixed grasses and forbs make up the rest of the forage feed.

Results

During a mild winter, a ration of new hay stacked in good green condition will provide enough carotene for pregnant beef cows. When feeding old hay it is best to feed it in the early part of the winter. Put cows on good green hay as long before calving as possible.

The severe 1951-52 winter apparently adversely affected fetus development and post-natal gains. The appearance of symptoms of Vitamin A deficiency during the spring of 1952 suggests that carotene or Vitamin A metabolism was adversely affected by the winter conditions. Work underway should shed further light on the problem.

Feeding Supplements on Sagebrush Range and during Winter Feeding Period

Purpose of experiment

- ▶ To find if it's profitable to feed a protein supplement to a commercial breeding herd while the herd is grazing on a sagebrush-bunchgrass range.
- ▶ To find the influence of 3 levels of winter nutrition on Hereford cow production with and without a protein supplement while they are on summer range.

Experimental plan

Work started in the summer of 1951 with 90 Hereford cows and their calves. One-half of the group received a salt-cottonseed meal mix while on the sagebrush range. Cottonseed meal containing 43 per cent crude protein was used.

After leaving the sagebrush range in September, all cows grazed together on the meadows where bunched hay and aftermath were available. Winter feeding generally began in late December.

The cows were divided into 3 groups of 30 head each for the winter phase of the work. Fifteen cows for each lot came from the range supplemented group with the other 15 from the non-supplemented herd. The winter rations fed were:

- ▶ Full feed of meadow hay.
- ▶ Full feed of meadow hay and 3/4 pound cottonseed meal.
- ▶ Full feed of meadow hay, 1 pound cottonseed meal, and 1 pound barley.

Results (Range supplementing phase)

The mix was fed for the first time during the summer of 1951 from July 4 through September 10. By increasing the salt concentration of the mix from 40 per cent early in the season to 50 per cent during August, the cottonseed meal intake was held at 1 pound per day per cow.

The results of one pound cottonseed meal supplementation were:

- ▶ No increase in weaning weights of calves.
- ▶ A slight increase in number of calves dropped.
- ▶ The 1952 average calving date of supplemented cows was 11 days earlier than for the non-supplemented group.

The mix was fed in 1952 from June 25 through September 15. The cottonseed meal intake was held at approximately 2 pounds per day by increasing the salt concentration from 30 per cent early in the season to 40 per cent by September. The influence of the supplementing on the 1953 calving results is not available for this report.

After the 1952 summer feeding season, the calves from the supplemented group averaged 29 pounds heavier than those from the non-supplemented cows. This difference was primarily due to an advantage of 0.06 pounds per day gain from birth to weaning for the supplemented group. Also, calves from the supplemented cows averaged 11 days older at weaning. During the 1952-53 winter feeding period a greater gaining ability was shown by calves from supplemented cows.

Results (Winter nutrition phase)

Completed research has shown that it does not pay to limit the amount of meadow hay fed during the winter feeding period.

The most promising winter ration under test is the full feed of meadow hay, plus 3/4 pound of cottonseed meal. An increase in production of calf weaning weight per cow due to the highest supplemental level was offset by higher feed costs.

Brahman x Hereford Crossbreds Under Eastern Oregon Conditions

Purpose of experiment

- ▶ To compare the wintering ability of first-generation Brahman x Hereford weaners with Hereford weaners under eastern Oregon conditions.
- ▶ To compare the gains made by the crossbred and Hereford cattle as yearlings on sagebrush-bunchgrass range.
- ▶ To study the grazing habits of the animals on the sagebrush-bunchgrass range.

Experimental plan

All animals included in the study were lot fed from December until late April in the winter phase of work. The basic ration used was 7.5 pounds of meadow hay, 2.5 pounds of alfalfa, 1 pound of barley, and 1/2 pound of cottonseed meal. The amount of meadow hay was adjusted so each lot received the same amount of total digestible nutrients per pound of metabolic weight.

The crossbred animals used during 1950-51 were out of Hereford cows from the station herd and sired by a Brahman bull loaned to the station by the Gill Cattle Company of Frenchglen, Oregon. The crossbreds used during 1951-52 were purchased from matings of registered Brahman sires and grade Hereford cows. The animals were born and raised to weaning on a ranch 30 miles from Burns. The crossbreds were found to be more nervous, alert, and curious than the Herefords.

Practical results

First generation Brahman x Hereford crossbreds offered no advantage in gaining ability over what could reasonably be expected from a Shorthorn x Hereford cross. Also it does not appear that any important influence was exerted by other valuable characteristics credited to Brahman crossbred cattle.

Measuring Gaining Ability of Beef Cattle on a Full-Fed Roughage Ration

9

Purpose of experiment

- ▶ To determine if it is possible to select the most rapid and efficient gaining heifers for herd replacements by allowing the animals to consume all of the dry roughage they want, plus a limited amount of concentrate, during the winter following weaning; and by including in the measurement of gaining ability the gains made on grass as yearlings.
- ▶ To compare the results of the test made on a full-feed of dry roughage followed by gains made on grass with results from testing heifers on a full-fed fattening ration.

Experimental plan

Twenty-eight Hereford heifers were individually fed during the winter testing period. The animals graze together on sagebrush-bunchgrass range during the summer.

Fourteen of the heifers were fed a ration made up largely of roughage which should have resulted in an average daily gain of one pound per day for the group. Only the roughage portion of the ration was full fed. The remaining heifers were full fed a fattening ration that should have resulted in an average daily gain of 1 3/4 pounds per day for the group.

Results

Table 2. Summary of Average Gains and Average Efficiency of Winter Gains of Two Most Rapid Gaining and Two Slowest Gaining Heifers on Full-Fed Roughage and Limited Concentrate Ration.

Calf numbers	Winter		Summer
	Gain	T.D.N./lb. Gain	Gain
	pounds	pounds	pounds
A 972 and B 18	80	8.17	190
A 974 and B 69	40	16.87	168

Ration feed provided for only maintenance and growth during a severe winter. Yet differences in rate and efficiency of gain were apparent. This study will be repeated again this year.

Research in Progress on Which There is No Data to Report

- ▶ A project to determine if any response in gains due to copper or cobalt supplements, alone or in combination, is shown by weaner calves on a winter growing ration. The winter ration to consist of a full-feed of meadow hay and 3 pounds of barley.
- ▶ A project to study the effects of trailing as compared to hauling cows with calves approximately 43 miles to summer range, with calves of both groups hauled. Also, to study the effects of trailing, as compared to hauling, when returning to winter headquarters from summer range.

Cooperators

Staff members of the departments of Agricultural Chemistry and Animal Husbandry at Oregon State College have been active as advisors and cooperators in various phases of research.

All chemical analyses have been made in the department of Agricultural Chemistry.

Range Improvement Research

Donald N. Hyder, Range Conservationist
and
Forrest A. Sneva, Assistant Range Conservationist

Chemical Control of Big Sagebrush

Seven separate projects have been initiated (beginning in 1950) to find the answers on chemical control of big sagebrush. It is not feasible to present objectives and descriptions of each project in this report. Factors studied are as follows:

- ▶ Difference in effectiveness between the growth regulators 2,4-D and 2,4,5-T.
- ▶ Difference in effectiveness of those growth regulators due to formulating materials: sodium salt, amine salt, isopropyl ester, butyl ester, propylene glycol butyl ether ester, and emulsified acids.
- ▶ Acid equivalent rates of the growth regulators.
- ▶ Carrier solvents: water alone, water with several different additives, diesel oil, helix oil, aromatic oil, kerosene, and oil emulsions.
- ▶ Volume rates of spray solution: 1 to 10.9 gallons per acre.
- ▶ Dates of spraying in March to July inclusive.
- ▶ Influence of soil moisture on concluding date of effective spraying.
- ▶ Influence of site exposure on the dates when spraying is effective.
- ▶ Vegetative development of companion species as related to the period when spraying is effective.
- ▶ Production increase of companion species (mostly grasses) following sagebrush control.
- ▶ Simultaneous control of larkspur and big sagebrush by spraying.

Most of the work has been done by knapsack spraying on 500-square-foot plots. Factorial combinations of factors have been included to find causes of variation and interaction. Some of this work is now in progress. Airplane applications were made in May, 1953 to test the conclusions of previous work and to further study solvent type and volume.

Summary of Results

Grass production increased three-fold after sagebrush control

Herbage production was taken with and without controlling big sagebrush to find how much the brush restricts production. Complete control of sagebrush was obtained by grubbing -- compared with spraying, which killed 83 per cent of the sagebrush as shown in Figure 5. Sagebrush control gave a big increase in production in 1 year. The change in species (succession) and maximum production reached in the next few years will, of course, be of more interest and importance than the first-year increase in production.

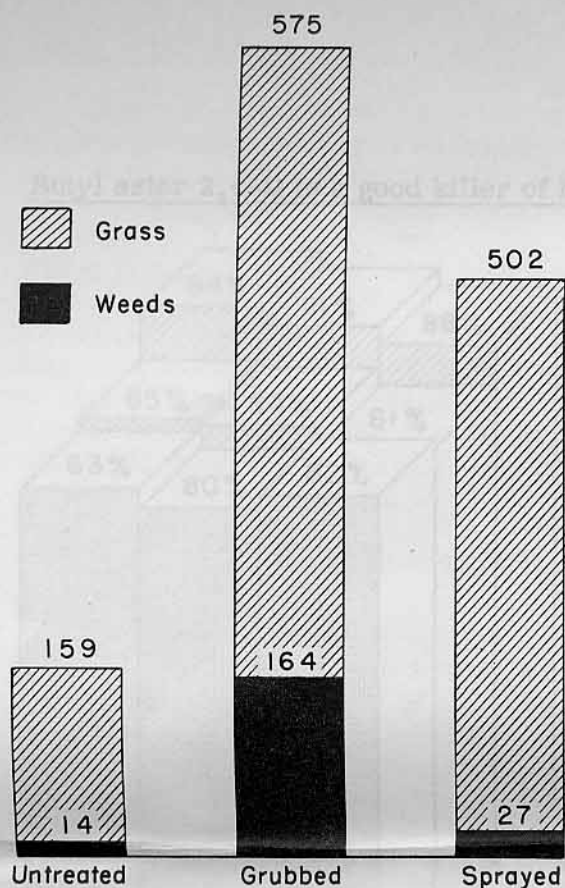


Figure 5. Herbage production one year after sagebrush control, in pounds per acre.

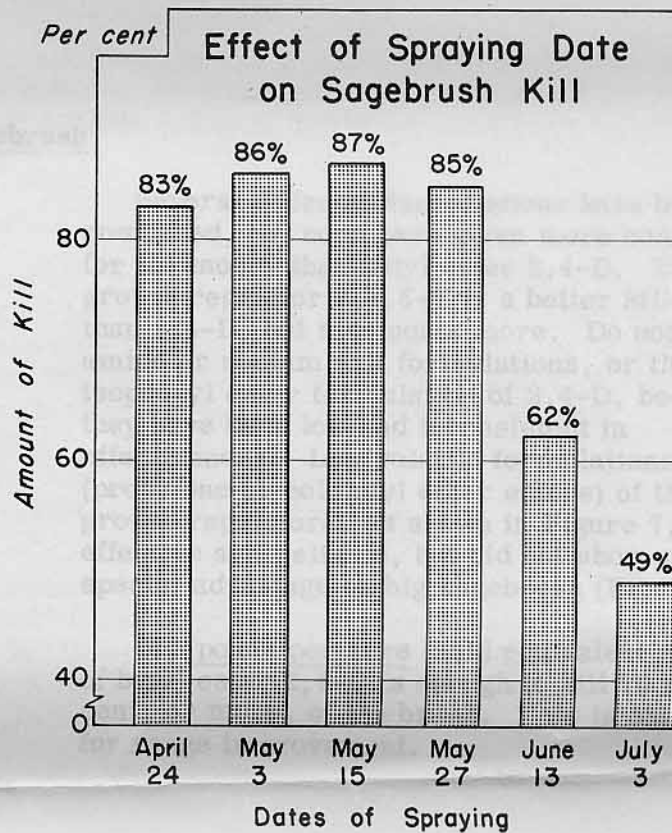


Figure 6. Average per cent kill of big sagebrush by dates of spraying in 1952.

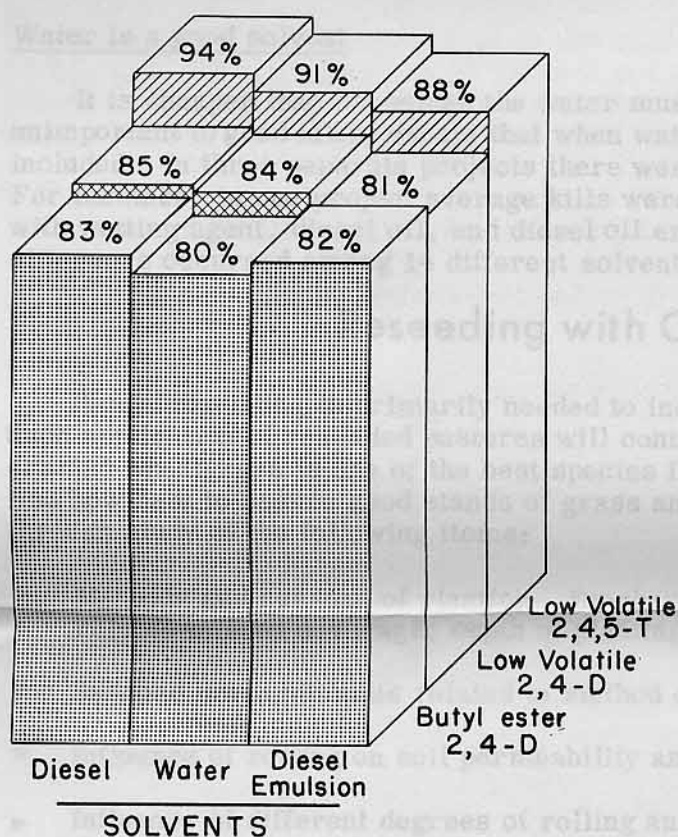
Other results and observations were as follows:

- ▶ Standing sagebrush (dead or alive) has value for holding snow.
- ▶ Weeds were reduced by spraying in 1951, but were slightly more abundant on the sprayed plots in 1952 than on untreated plots.
- ▶ June grass and squirrel tail are grasses which increased the most.
- ▶ It is essential to select areas for spraying that have an understory of grass. A sagebrush-bunchgrass type in fair range condition will respond well to spraying.

Spray when the brush is growing rapidly

At an elevation of 4,600 feet spray south exposed sites in early May and north exposed sites in mid to late May. Average kills by dates of spraying in 1952 are shown in Figure 6. Results in 1950 and 1951 are given in the "1952 Field Day Report." Where and when soil moisture is enough for rapid growth after May, spraying may be continued until about the middle of June. At higher elevations spraying should probably be delayed about one week for each thousand feet above 4,600.

Butyl ester 2,4-D is a good killer of big sagebrush



Several different formulations have been compared, but none have given more control for the money than butyl ester 2,4-D. The growth regulator 2,4,5-T is a better killer than 2,4-D, but also costs more. Do not use amine or sodium salt formulations, or the isopropyl ester formulation of 2,4-D, because they have been low and inconsistent in effectiveness. Low volatile formulations, (propylene glycol butyl ether esters) of the growth regulators, as shown in Figure 7, were effective and reliable, but did not show any special advantage on big sagebrush (Figure 7).

One pound per acre (acid equivalent rate) of butyl ester 2,4-D is enough to kill 70 per cent, or more, of the brush. This is enough for range improvement.

► Figure 7. Percentage sagebrush kill as influenced by formulations and solvents. The two low volatile formulations are propylene glycol butyl ether esters.

Table 3. The Influence of Spray Date, Acid Rate, and Solution Volume upon the Effectiveness of Butyl Ester 2,4-D on Big Sagebrush in Per Cent of Kill

Date	1 ppa AE ^{1/}		2 ppa AE	
	3 GPA ^{2/}	6 GPA	3 GPA	6 GPA
	Per cent	Per cent	Per cent	Per cent
April 24, 1952 .	60	94	78	83
May	68	82	87	92
May	68	90	81	94
May 27	75	88	78	92
June	48	69	48	80
June	38	56	51	57

^{1/} ppa AE = Pounds per acre acid equivalent

^{2/} GPA = Gallons per acre

Spray with 5 or 6 gallons per acre

Solution volume was one of the most important items in doing a good job of spraying. Table 3 presents average results with butyl ester of 2,4-D to show the respective importance of date of spraying, acid equivalent rate, and solution volume. Note in Table 3 that solution volume was more important than acid equivalent rate.

Water is a good solvent

It is cheaper than oil unless the water must be hauled a long distance. Type of solvent was unimportant to good kills, except that when water is used a wetting agent additive should be included. In three separate projects there were only small differences due to type of solvent. For instance, in one project average kills were 76, 77 and 74 per cent, respectively, for water with wetting agent, diesel oil, and diesel oil emulsion. In another project no significant difference occurred among 14 different solvents.

Reseeding with Crested Wheatgrass

Range reseeding is primarily needed to increase the supply of forage for spring grazing. Such application of reseeded pastures will contribute greatly to range improvement. Because crested wheatgrass is one of the best species for this purpose, research is being conducted to find how best to assure good stands of grass and how to obtain maximum forage production through study of the following items:

- ▶ Methods and seasons of planting. Emphasis in research is presently given to rolling as related to seed coverage, depth of planting, and rate of emergence.
- ▶ Seedbed preparation as related to method of planting.
- ▶ Influence of rolling on soil permeability and herbage production.
- ▶ Influence of different degrees of rolling and harrowing upon soil moisture trends and rate of seedling emergence. A sectioned roller has been developed for this study.
- ▶ Rate of planting crested wheatgrass to find the optimum density for production and protection from sagebrush invasion.
- ▶ Fertilization with ammonium nitrate to find the influence of nitrogen fertilization on herbage production of crested wheatgrass.
- ▶ Grass and legume adaptability trials.

Although much of the study is not conclusive at the present time, the following summary gives results that will help to assure good stands of crested wheatgrass.

Summary of Results

Crested wheatgrass yielded over 800 pounds per acre

The yield of an established stand of crested wheatgrass was over 800 pounds air dry weight per acre in 1952, as compared with an average production of about 140 pounds per acre on 4,200 acres of sagebrush-bunchgrass range. The benefits of reseeding are considerable, and a good stand of grass can be obtained with careful seedbed preparation and planting.

Roll a soft seedbed before drilling crested wheatgrass

Plots were rolled before, after, or both before and after drilling for comparison with unrolled plots. Crested wheatgrass was drilled on all plots at 5 pounds per acre with a single-disc surface drill having depth bands welded to the discs. Plots arranged in four randomized blocks were seeded in the fall, 1951. Rolling was done with an 8-foot concrete roller weighing about 3 tons.

The results of this experiment on the initial stand of crested wheatgrass showed results as follows: Without rolling, 4.76 grasses per square foot; rolling after drilling, 3.76; rolling before drilling, 5.83; rolling before and after drilling, 5.09. The study will be repeated for the third time this fall.

- ▶ As measured by square-foot occupancy, there was no difference in established stand density on the above plots. The average stand density for all plots was 92 per cent.
- ▶ Rain crusted the plowed seedbed before drilling, and depth bands on the drill discs gave adequate control of planting depth.
- ▶ Have depth bands about 1 1/2 inches wide fixed to drill discs for drilling crested wheatgrass about 1 inch deep.
- ▶ Roll a soft seedbed before drilling.

Drilling is more reliable than broadcasting

Plots were seeded with a single-disc surface drill having depth bands, with a double-disc press drill without depth bands, and by broadcasting. The plots also were seeded without rolling, by rolling with a cultipacker weighing about 1 ton, or by rolling with a concrete roller weighing about 3 tons. Rolling was completed before planting on plots to be drilled and after planting on plots to be broadcast. The study will be repeated for the third time this fall.

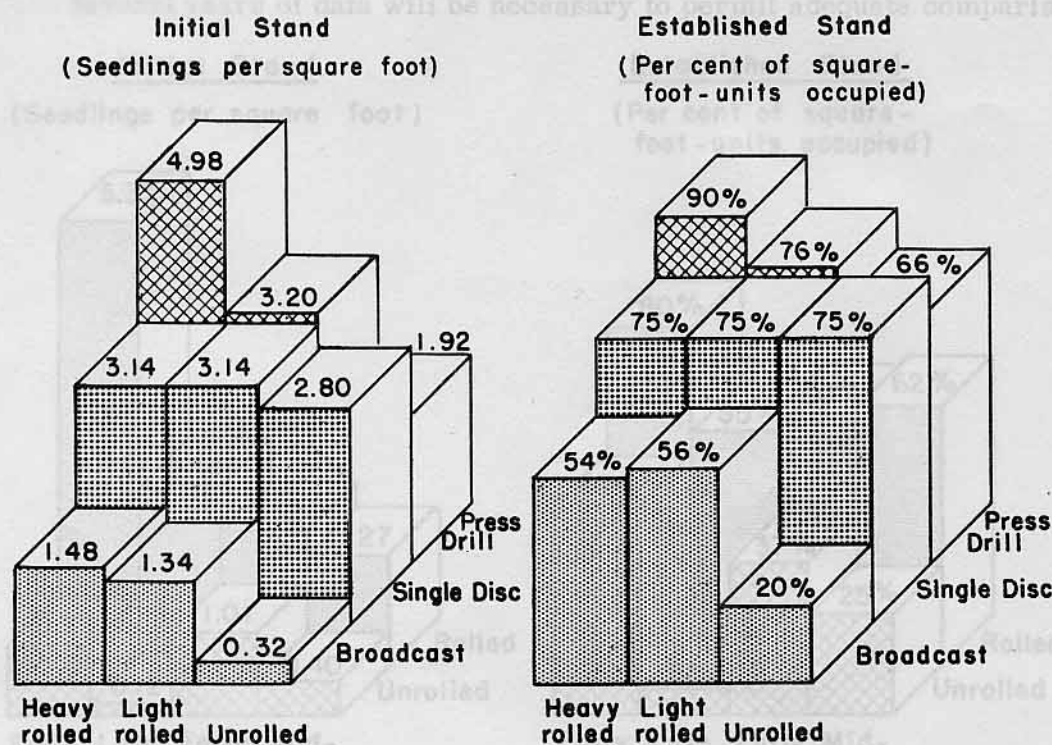


Figure 8. Influence of planting method on the density of crested wheatgrass.

Present results in Figure 8 show:

- ▶ If plowing is done during the summer while the soil is dry, a good rain can adequately firm the soil for drilling when depth regulator bands are used.
- ▶ Rolling a soft seedbed before drilling is of benefit through regulation of depth of drilling.
- ▶ Use depth bands on drill discs.
- ▶ A crusted seedbed is unsuitable for broadcasting.
- ▶ Drilling is more reliable than broadcasting.
- ▶ Roll to cover broadcast seed with firm soil. If the surface of the soil is crusted, it should probably be harrowed before broadcasting.
- ▶ A soft irregular seedbed is essential if seed is to be broadcast.
- ▶ The press wheels (on press drill) were helpful in firming the soil upon drilled seed when seedbed was firm.
- ▶ Without rolling and without depth control bands crested wheatgrass grew only where equipment wheels had firmed the soil, and further emphasized the value of rolling for controlling depth of drilling.

Season and method for broadcast planting crested wheatgrass

This study is to compare early fall, late fall, early spring, and mid-spring broadcast plantings of crested wheatgrass, and to further find the value of rolling to cover broadcast seed.

Several years of data will be necessary to permit adequate comparison of seasons.

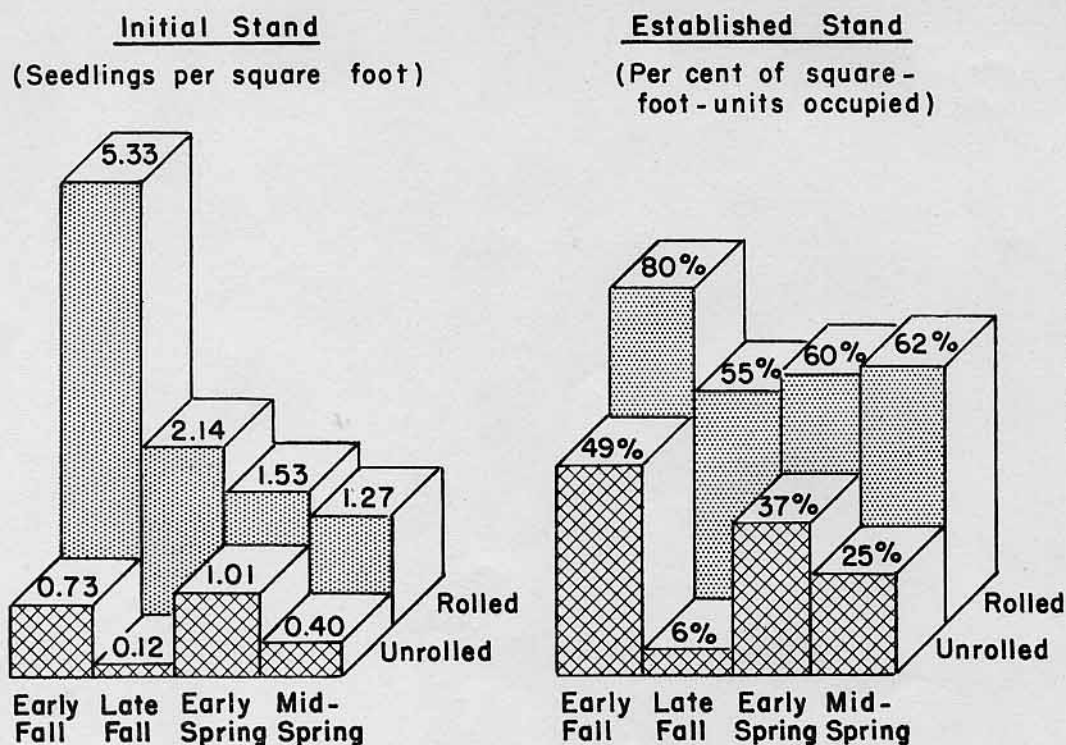


Figure 9. Influence of season of planting and rolling on the density of crested wheatgrass when seeded by broadcasting.