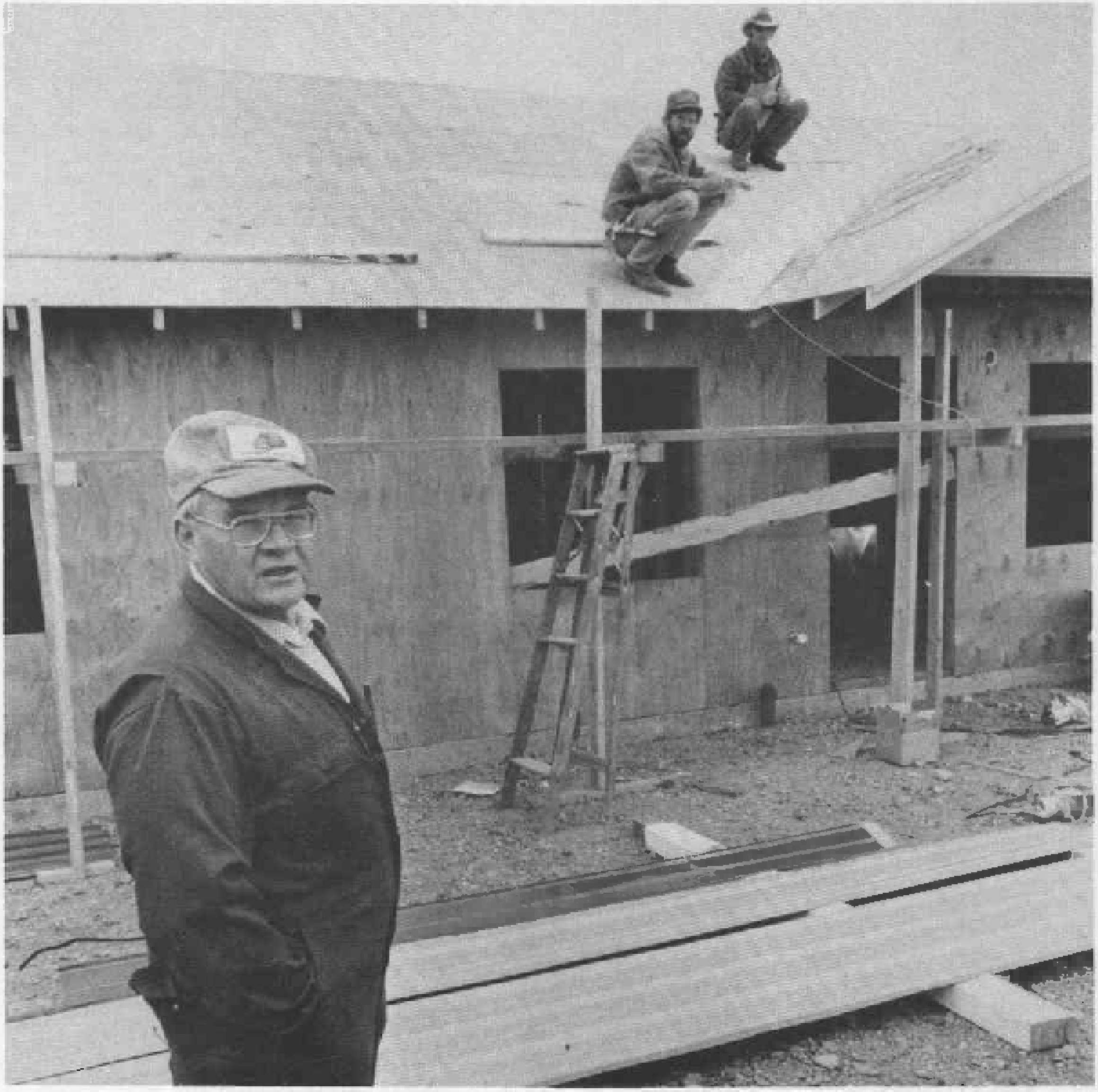
1982 Progress Report . . .

Research in Beef Cattle Nutrition and Management



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Index to previous progress reports on back pages.

Cover picture: New headquarters building at Section 5, Squaw Butte Station, Eastern Oregon Agricultural Research Center.

COMPUDOSE® - A NEW GROWTH-PROMOTING IMPLANT

H. A. Turner and R. J. Raleigh

Anabolic or growth-promoting subcutaneous implants have been used in the cattle industry for a number of years. Increased daily gains usually result in improved feed utilization. The resulting improvement in feed efficiency is an important step in maximizing the efficiency of red meat production. Various implants have been very effective in promoting rapid weight gains.

Diethylstilbestrol (DES) was the most economic, provided the most consistent results and was the most widely used of the anabolic implants before being banned and removed from the market. Fortunately we were left with two alternatives in Ralgro® and Synovex®. Now it appears we soon may have a third choice on the market called Compudose®.

Compudose® implants contain estradiol-17β which has been known to have growth-promoting properties for many years. The active ingredient is embedded in silicone rubber, which forms a rather large implant about .2 inches in diameter and 1.2 inches long. The implant is designed to deliver a rather specific daily dosage over a specified length of time. Like the other implants, Compudose® is administered subcutaneously in the ear with an implant tool.

Two Compudose® studies have been conducted at Squaw Butte. In a 1976 study, calves, shortly after birth were implanted with an implant designed to last more than a year until the animal reached a choice slaughter grade. In a 1980 study, an implant designed to last 200 days was compared to a Ralgro® implant. The two studies will be briefly described in this paper.

BIRTH TO SLAUGHTER STUDY

The objectives of this study were to evaluate Compudose® delivering various levels of estradiol-17β to steers during the suckling, growing and finishing phases of production under a single implant regimen and with two forms of implant. Early work with Compudose® was concerned with the most effective levels and form of the implant. For this paper, the higher level treatments (30.9 and 47.7 μg) were combined and the form ignored. These were the most effective levels in this study and the form of implant did not affect results.

Sixty steer calves, averaging 59 days of age and 172 pounds, were stratified by breed, weight and age of dam to groups and randomly assigned to treatment. Calves ranged in age from 10 to 80 days at the time of implantation. Control calves received a placebo implant formulated from the nonmedicated silicone rubber. Implants were given once, at the initiation of the study, and were weighed individually before implantation. At the end of the study the implants were removed with a surgical cutting edge tool designed immobilize the implant in a groove. Implants were washed, dried and weighed to determine daily dosage rates.

The study began May 5 with calves born in March and April. Cow-calf pairs were grazed on wet meadow pastures to June 17 when they were moved to a mixed-conifer forest range. Calves were weaned on September 17 and put on alfalfa-grass hay aftermath pastures during the post-weaning period. During the wintering period, the steers were fed 2 pounds of barley and an appropriate amount of alfalfa hay, based on body weight to maintain approximately 1.5 pounds daily gain. The following spring, steers grazed improved irrigated pasture and received 1.5 pounds of barley. During the last month of the pasture period, barley was gradually increased to 7 pounds to lead into the feedlot phase. During the finishing phase, the animals were fed a standard feedlot ration with barley the primary concentrate and meadow hay providing roughage. Feed intake was measured during this time.

Gain results are presented in Table 1. Compudose® provided a positive gain response over the controls throughout the trial. Overall gains were increased 8 percent over the controls with the implants. Feed efficiency during the finishing phase was not improved with the implant because the increased gain was accompanied by increased feed intake. However, the implanted steers were heavier going into the feedlot, so increased intake was expected. Increased maintenance requirements of the heavier animals throughout the finishing period may be the reason average feed efficiency was not improved. Implanted steers were more than 70 pounds heavier than the controls by the end of the trial.

Table 1. Average daily gain of steers over the 499-day study period[1/]

Treatment	Suckling	Post-weaning	Wintering	Pasture	Finishing	Overall
	lb					
Control	2.23	1.28	1.43	2.38	3.26	1.98
Compudose	2.44	1.36	1.53	2.44	3.49	2.14

1/ The number of days for each phase was 135, 61, 173, 65 and 65, respectively, for the suckling, post-weaning, wintering, pasture and finishing periods.

PASTURE STUDY

The objective of this trial was to compare a single dose of Compudose® to a single dose of Ralgro® on rate of gain in growing steers on pasture for approximately 200 days. The recommendation for Ralgro® is to reimplant after about 100 days, but for this trial it was decided to look at a single implant. On many ranches it is difficult to gather steers from the range and reimplant them.

Sixty-three fall-born steers, averaging 375 pounds, were stratified by breed, weight and age and randomly assigned to treatment. Calves were dropped in October and November, weaned during April and averaged 180 days of age at the start of the trial on May 14. Steers were run on crested wheatgrass range and moved to fresh pastures as feed availability became limiting. To maintain adequate gains, additional feed was provided on pasture as nutrient quality of the range declined with maturity of the plants. Barley was provided at the rate of 1 pound per day starting on July 18 and was increased to 2 pounds on August 7 to termination on November 26. A combination of native meadow hay and alfalfa also was provided on pasture starting August 7. As in the previously described trial, Compudose® implants were weighed individually before insertion and after removal to determine dosage rate. Delivery rate in this trial was 64 μg per head per day.

Gain data are presented in Table 2. Overall control steers gained 1.30 pounds per day, those implanted with Ralgro® 1.43 and Compudose® 1.50 pounds. This represents a 10 percent increase over controls with Ralgro® and 15 percent with Compudose®. Normally, Ralgro® is reimplanted every 90 to 100 days but in this trial the response to Ralgro® and Compudose® was identical through the first 168 days of the trial. The difference between the two implants occurred during the last 28 days of the trial. Ralgro® appeared to give an anabolic response throughout the 196-day trial period as did Compudose®. However, the last 28-day period may have signaled the end of Ralgro® response, whereas, Compudose® promoted a higher level of growth response.

Table 2. Average daily gain of control steers and steers receiving Ralgro® or Compudose® implants on pasture (196 days)

Treatment	No.1/	Initial weight	Gain	Average daily gain	Increase over control
		----------------	lb	----------------	%
Control	20	379	255	1.30	-
Ralgro®	18	380	281	1.43	10
Compudose	21	368	294	1.50	15

1/ During the first few days of the trial, four steers died of lead poisoning from prior ingestion of lead base paint from the dry lot fences.

SUMMARY

These studies show that Compudose® can improve weight gains over a long period of time (499 days in the first trial) and compares favorably to Ralgro®. Also, the implant appears to stay in the ear well (only one implant was lost in more than 90 steers implanted). Stimulatory activity

from a single implant over a long period and the ability to remove the implant are important considerations. In many cases, producers using other implants cannot or will not gather their steers for reimplantation and lose a portion of the potential benefit. With a long-lasting implant like Compudose®, this expensive and time-consuming task of gathering and handling steers for reimplantation is eliminated. Clearance of Compudose® appears to be close and possibly without withdrawal. Even if withdrawal becomes necessary before slaughter, the implant provides the capability of being physically removed. It looks like the initial clearance of Compudose® will be an implant designed to last 200 days. It is not known if clearance will be sought on longer lasting implants.

THE EFFECTS ON GAIN OF FEEDING SELENIUM TO COWS AND CALVES AND INJECTING SELENIUM IN CALVES

K. E. LANKA AND M. VAVRA

Selenium concentration in forage and hay crops in Oregon varies from zero to more than 1 part per million (ppm), and local concentrations often are highly different, even from one ranch to another. The minimum dietary level of selenium should be between .03 and .1 ppm, depending on the content of vitamin E and possibly other substances which may influence selenium utilization. Cattle may build up selenium reserves by consuming high selenium diets for a few months, and these reserves may protect them and their offspring from severe selenium deficiency related diseases for up to a full year.

The most common selenium responsive disease in northwestern United States is white muscle disease which afflicts calves and lambs, especially those less than six months old. Inadequate dietary selenium in cattle on pasture and range can be compensated by including supplemental selenium in the diet or by injecting selenium into cows before they calve. Another common method is to inject calves at birth. Since injection may be difficult for some ranchers, feeding supplemental selenium, especially through salt mixes, is most convenient.

To examine the adequacy of crops in meeting the selenium needs of livestock, samples from different regions of Oregon were collected and analyzed (Figure 1). Most of the analyses were made on alfalfa, because it is grown in most geographical areas. Samples from the western half of Oregon contained very low levels of selenium (less than .05 ppm in more than 80 percent of the samples). Only the Harney Basin in east-central Oregon was found to be generally adequate in selenium concentrations in hay crops. However, ranchers should be aware that even in the Harney Basin, some losses from white muscle disease may be expected, especially if hay from selenium deficient regions is fed.

In a subsequent examination of the selenium content in high summer range, grasses of eastern Oregon showed the same geographic pattern as the earlier study, depicted in Figure 1.

For ranchers who are unable to inject cows and/or calves, feeding selenium may meet the needs of preventing severe deficiencies in cattle. In addition to preventing white muscle disease, administration of selenium as a feed supplement or injection can also affect thriftiness and gain in the cattle. The research described in this report was done to evaluate the effects on gain of feeding selemium to range cows and calves. In addition, feeding and injecting selenium versus no selenium administration were compared to determine any differences in gain.

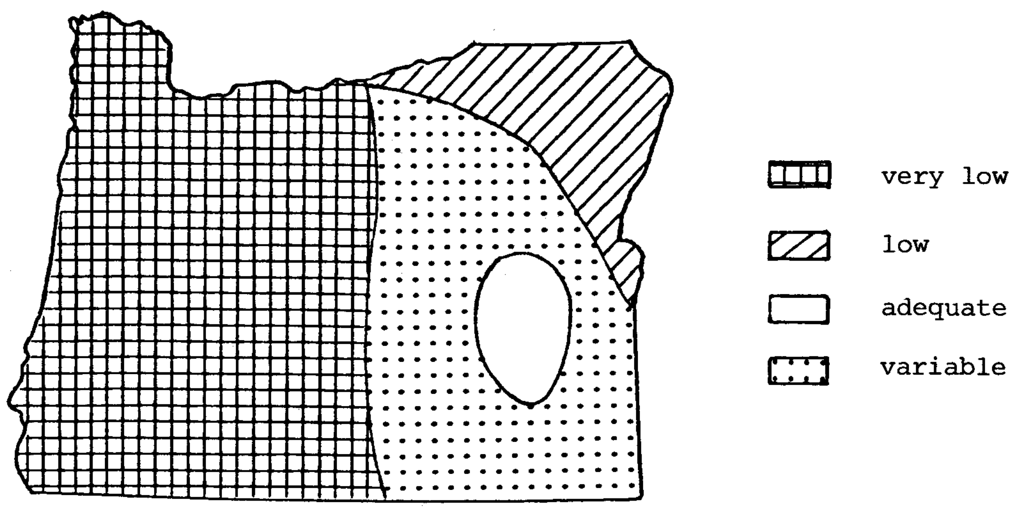

Figure 1. Selenium content of forages in Oregon.

EXPERIMENTAL PROCEDURE

Calves born in February through April of 1981 were used for the studies. All calves were injected with a commercially prepared selenium at birth to prevent white muscle disease. Twenty cow-calf pairs were chosen to be given salt with selenium mixed at the level of 50 ppm. A second group of twenty pairs, with comparable uniformity, was selected to act as a control group and received no supplemental selenium in the salt. The study began on June 1, and all cows and calves in the supplemented and control groups were weighed. The calves remained on range until September 23, at which time they were weaned and placed on alfalfa pasture. The dams remained on range until October 20, when they were placed on alfalfa pasture. Throughout the summer, experimental animals were weighed periodically. When placed on alfalfa pasture, the supplemented groups were given selenium at the level of 30 ppm in the salt.

On October 21, three additional experimental calf groups of 15 animals each were added to the study. The calves in each of these groups were injected with selenium at first weighing. One group received no further injections. A second group received an additional injection of copper at first weighing. A third group received no copper, but was given an additional shot of selenium on December 22. Weights were taken at approximately 30-day intervals until January 19, 1982.

RESULTS AND DISCUSSION

Summer gain data for 1981 spring-born calves and their dams are displayed in Table 1. The periods of weight gain were 115 days for the calves, until they were weaned, and 142 days for the dams, which continued on range after the calves were weaned. The selenium supplemented cattle gained significantly better than the controls. Those receiving selenium in the salt were physically separated from the controls, and the stocking rate of cattle was lower in the pasture containing selenium salt. This may have made the effect of supplementation with selenium even more pronounced.

The improvements in gain for selenium supplemented steers and heifers were .28 and .30 pound per day, respectively. Percentages in improvement in gain over controls for steers and heifers were 12.2 and 14.0 percent, respectively. These improvements in growth from selenium supplementation are compatible with results shown by other scientific studies. Weight gain by cows supplemented with selenium was .56 pound per day greater than in the controls. This is more than 444 percent improvement in gain.

Table 1. Summer gain data of dams and spring-born calves.

Treatment	Average initial weight	Average final weight	Average gain[1/]	Increase in gain over control	
	lb				%
Control					
Steers	267	530	263	-	-
Heifers	241	491	250	-	-
Dams	1,067	1,085	18	-	-
Selenium supplemented					
Steers	247	542	295	32	12.2
Heifers	249	534	285	35	14.0
Dams	1,080	1,178	98	80	444.4

1/ Periods of gain were 115 days for calves and 142 days for their dams.

The gain data did not continue to follow the same trends in the calves during the fall and winter months (Table 2). Because calf weight gains were not significantly different for steers and heifers during the fall and winter, they were pooled for both sexes. The effects of weaning and changes in diets during the autumn added to variability in growth in the calves.

In addition, a reduction in the level of selenium from 50 to 30 ppm in the salt may have lowered the selenium concentration below the level useful for increasing weight gain. The period of gain for the weights shown in Table 2 was 90 days.

During this time, the selenium supplemented calves gained .11 pounds per day less than the controls, resulting in a decrease in gain by 11.8 percent. The calves injected with selenium increased in gain from .06 to .09 pounds per day over controls. The percentage in improvement in gain over controls ranged from 5.9 to 9.4 percent. These data indicate that selenium was useful in improving gain in growing calves although dietary supplementation at the level of 30 ppm in salt was not enough to cause increased growth. Copper injection did not aid in improving weight gain in selenium injected calves.

Longer term studies will be useful in determining the effects of feeding and injecting selenium in growing calves.

Table 2. Fall and winter gain data of spring-born calves.

Treatment	Average initial weight	Average final weight	Average gain[1/]	Increase in gain over control	
	lb				%
Control	507	592	85	-	-
Selenium supplemented	532	607	75	-10	-11.8
Selenium injected					
Injected once	460	553	93	8	9.4
Injected twice	452	544	92	7	8.2
Selenium and copper injected	449	539	90	5	5.9

1/ Period of gain is 90 days.

The level of 30 ppm selenium in trace mineralized salt may not be high enough to improve gain in cattle, but it may be sufficient to prevent severe deficiencies leading to white muscle disease. In areas of extreme selenium deficiencies, where calves are born with the disease, the feeding of selenium can be a management asset that eliminates having to give injections to preparturient cows. Dietary supplementation through salt may be particularly beneficial in cattle on range, where it is difficult or impossible to give injections at the optimum time before calving. In addition to the effects of selenium on white muscle disease and growth, selenium has been shown to reduce the incidence of placental retention at the time of calving.

Since most areas of Oregon are known to be deficient in soil and forage contents of selenium, it is recommended that selenium be administered to calves and pregnant cows. Research described has shown that selenium supplemented in a salt mix is effective in increasing gains of cattle on summer range. Injections of selenium also have caused an improvement in gain in calves.

Whether you choose to feed or inject selenium depends on your management system.

THE RANGE BEEF CATTLE PRODUCTION SYSTEM

R. J. Raleigh and H. A. Turner

The production of red meat from range forage can be as simple as turning the breeding herd on range and gathering the offspring and survivors, selling the steers and culls and hoping you get another crop of calves next year. This probably occurred 100 or more years ago and in some cases 50 years ago or less. However, those days are gone. No longer can we take what we get and survive with it. Each year the raising of beef becomes more complicated.

We continually ask, "What can we do to become more efficient in production?" Experimentation by reseach scientists, and by ranchers themselves, has resulted in new products, improved management, better breeding, changes in forage and other agronomic management, hybrids and crossbreds and a host of items that have led to increased production and efficiency. Some of this is the result of very basic science and some of it trial and error but there have been great increases in total production and efficiency of production. Have we gone as far as we can? Have we reached the pinnacle of production? No. We have only scratched the surface, and we had better continue searching because we have to produce more food more efficiently to meet the needs of a hungry world. We also have to keep the rancher or farmer solvent and make agriculture profitable if this nation's production is to continue.

It seems that new products, new breeds, new forages, new management techniques and a host of alternatives are available to the producer. But, which one or which combination should be used? The producer has a choice between a variety of options in management, in his range or forage management, harvesting methods, feed additives and adjuvants, breeds and sizes. Neither the rancher nor the researcher can test them all singly, let alone in combination. It appears the computer age is here for the range livestock operator and for all segments of agriculture. Automobiles are now computerized so the computer selects the fuel mixture, engine temperature, and gear ratios for optimum efficiency. So be it for the cow and the rancher.

We have for years been conducting research at the Squaw Butte and Union Stations of the Eastern Oregon Agricultural Research Center on forage production and management with native and seeded forages, and have gathered beef production data for various classes and management schemes. We can relate beef production to forage quality and forage quality and yield to precipitation patterns and various cultural practices. We have experimented with fall and spring calving, artificial insemination and estrus synchronization and various products that increase production efficiency.

Systems Science. System and modeling research is becoming common in today's world. It employs various techniques to study the operation and management of complex systems.

This research station is attempting to develop a computer model to optimize the use of range, complementary forages and supplements, or available byproducts, for red meat production. The data base will be the Squaw Butte Station. Data from other research stations in the western United States will be used, when required, to complement the data that we have. The model under development includes four major aspects as presented in Table 1.

Table 1. Major components of the model

Major factors	Components	
ENVIRONMENTAL	Climatic 1. rainfall 2. humidity 3. temperature 4. radiation	Non-climatic 1. forage available 2. forage quality
ANIMAL	Physiological status Physical activity Forage intake	
ECONOMIC	Land use alternatives Red meat demand Red meat available Residue feed availability	
MANAGEMENT	Supplementation Range improvement - seeding - spraying, etc. Water development Time of calving and weaning Method of forage utilization Age of marketing	

Information in the table is an oversimplification. Submodels will be developed to permit exploration and testing of various components. For example, under "management factors" a submodel will permit evaluation of supplementation under various types of ranges with fall or spring calving, or yearlings versus weaner calf production, etc. Also, the use of various additives or implants can be simulated here. Economics or environmental parameters can be placed at nearly any point in the model or submodel.

SUMMARY

Agriculture is becoming too complex to solve or evaluate alternatives with a pencil. The computer model should make it possible to answer such a question as, "Will I get the greatest economic return from fertilizing my meadows, my range or from some management change in my livestock program? I only have so much money to spend."

The computer can give the answer and set priorities for the next increment. It is our intent to use and test the model on the statio operation. Not only should it tell us where we can get the greatest return from inputs, but tell us which research areas need emphasis.

REVEGETATION WITHIN THE ST. HELENS ASH FALLOUT ZONE

M. R. Haferkamp, F. A. Sneva and R. F. Miller

An estimated 2.5 to 3 million acres of rangeland received an ash layer ranging from 1/2 to 2 inches deep. The potential exists for increased rates of sedimentation in low areas and of stream loading with sediment from volcanic ash on rangelands with poor vegetation cover. Seeding rangelands with perennial grasses may stabilize the ash and prevent high rates of sedimentation and stream loading. Thus, two studies were initiated in 1981 to evaluate methods for revegetating ash covered lands in eastern Washington. The research is being funded by a grant from the United States Department of Agriculture, Agricultural Research Service, and is being conducted in cooperation with the Soil Conservation Service on private rangeland.

Successful establishment of range seedings usually requires use of adapted species or varieties of plants, preparation of weed-free seedbeds and planting at the proper rate, date and depth. Eastern Washington has low precipitation, especially during the summer months, temperature extremes of -23°F to 112°F, and competition from cheatgrass and Sandberg bluegrass.

Two species of grasses, Nordan crested wheatgrass and Secar bluebunch wheatgrass, have been selected for the study. Crested wheatgrass, an introduced, cool-season, perennial bunchgrass, has been successfully seeded on many acres in the sagebrush zone in the western United States.

Secar bluebunch wheatgrass, a recent release, was developed by the Soil Conservation Service Plant Materials Center, Pullman, Washington. The variety was selected for its superiority in drought tolerance, forage production in precipitation zones of less than 14 inches annually, spring recovery, the ability to establish and provide ground cover, root and crown production, dryland seed yield potential and irrigated seed yield potential. It is a densely tufted bunchgrass with an abundance of narrow leaves, numerous fine stems, small seeds and divergent awns.

Plantings of perennial forage species on cheatgrass ranges have often resulted in failures, mainly because of competition between seedlings and cheatgrass plants during the first growing season. Cheatgrass, a winter annual, is well adapted to ranges in eastern Washington. Seed germination occurs very rapidly after late summer or early fall rains. Young plants remain alive during winter and renew rapid growth early the following spring. If inadequate rainfall occurs in late summer and early fall, the majority of cheatgrass seeds do not germinate until the following spring. Usually these plants head early and mature by early summer.

Successful control of cheatgrass generally requires destruction of two successive seed crops. Seeded stands in southern Idaho were successful when cheatgrass stands were reduced to 12 plants on a square foot during the first growing season. Fall control of cheatgrass and seeding appears effective only in years when there is early and almost complete fall germination of cheatgrass. Some report all or nearly all seeds of cheatgrass germinate the first season when external conditions are favorable. However, others suggest a residue of seeds is left in the soil and litter.

Several methods suggested for seed and plant destruction include tillage, tillage plus herbicide application, and controlled burning followed by tillage or herbicides. Burning can be a desirable initial treatment, destroying seeds and removing the standing crop. Tillage and herbicides can be used to destroy seedlings after germination of the remaining seeds. Removal of standing crop can improve tillage as well as the performance of herbicides.

Results from burning cheatgrass ranges have varied from increasing to decreasing cheatgrass density, and it is apparent that time of burning is very important. Many mechanical methods of seedbed preparation have been used, but discing is the method commonly utilized. The methods utilized, however, usually are determined by cost and availability of equipment. Chemicals that have been effectively utilized in research efforts to kill cheatgrass include paraquat, glyphosate, metabuzin and atrazine.

Conventionally drilling or furrow plantings are considered the best methods of planting except where terrain or obstructions prevent the use of equipment. However, on ash-covered lands, broadcasting alone or broadcasting and packing seeds into the ash layer with heavy rollers such as land imprinters may be quite effective. Broadcast coated seeds also may have an advantage over broadcast uncoated seeds. Use of pelleted seeds on rangelands in the past has been researched and publicized but, generally, results of the practice have been poor and cannot be recommended. One problem encountered with broadcast seeds is lack of soil penetration and coverage except in very loose sandy soils. However, coated seeds broadcast into ash-covered soils may be adequately buried and seedling establishment may be enhanced by coating.

Our research efforts will include two studies to evaluate various methods of seedbed preparations and planting on ash-covered lands. Duration of research projects will be about 3 years.

Procedure:

The study site will be 20 miles east of Ritzville, Washington. This is within the area of deeper depths of ash deposition and represents the fine silt-type ash which fell over the largest area. This ash type presents greater problems in terms of contributions to air and water pollution than the fine sand type deposited in the Yakima area.

Study 1

The investigation will be designed to evaluate the effect of fall applied methods of seedbed preparation, seed coating, seeding method and season of planting on weed control and seedling establishment of two perennial grass species. Seedbeds will be prepared by (1) discing in early September and again in late October 1981, (2) burning in late September 1981 or (3) burning in late September 1981 followed by spraying with glyphosate (1 pound active ingredient/acre) in late October 1981. Coated (CelPril) and uncoated seeds of Nordan crested wheatgrass (6 pound pure live seed per acre) and Secar bluebunch wheatgrass (6.25 pound pure live seed per acre) will be planted on treated plots by the methods listed in Table 1. The Nordan seed will be purchased from a commercial source; the Secar seed will be provided by the Soil Conservation Service.

Table 1. Seeding methods, species and dates of planting to be utilized in Study 1 near Ritzville, Washington, in 1981 and 1982.

Method	Variety	Treatment	Date	Comments
Rangeland drill	Nordan	Uncoated	Oct. 1981	
Oregon press seeder	Nordan	Uncoated	Oct. 1981	
Brillion seeder	Nordan	Uncoated	Oct. 1981	
	Secar	Uncoated	Oct. 1981	
Broadcast seed	Nordan	Uncoated	Oct. 1981	broadcast after
in conjunction with		Uncoated	Oct. 1981	broadcast before
land imprinter		Coated	Oct. 1981	broadcast after
	Secar	Uncoated	Oct. 1981	broadcast after
		Uncoated	Oct. 1981	broadcast before
		Coated	Oct. 1981	broadcast after
Broadcast with	Nordan	Uncoated	Oct. 1981	
no additional treatment		Uncoated	Feb. 1982	
		Coated	Oct. 1981	
		Coated	Feb. 1982	
	Secar	Uncoated	Oct. 1981	
		Uncoated	Feb. 1982	
		Coated	Oct. 1981	
		Coated	Feb. 1982	

Study 2

The investigation will be designed to evaluate the effect of fall and spring applied methods of seedbed preparation and seeding method on weed control and seedling establishment of Nordan crested wheatgrass and Secar bluebunch wheatgrass. Seedbeds will be prepared by methods listed in Table 2. Seeds will be planted in fall 1982. Nordan seeds will be planted on the soil surface and in furrows with the rangeland drill. Nordan and Secar seeds, coated and uncoated, will be broadcast planted by the method deemed optimum from the 1981 planting.

Table 2. Seedbed preparation methods and dates of application utilized in Study 2 near Ritzville, Washington, in 1981 and 1982

Method	Proposed date of application	
	First treatment	Second treatment
Untreated	-	-
Discing	Spring 1982	Fall 1982
Burning	Spring 1982	-
Burning	Fall 1982	-
Burning + glyphosate (1 lb. a.i./ac)	Spring 1982	Fall 1982
Burning + paraquat (.5 lb. a.i./ac)	Spring 1982	Fall 1982
Atrazine (1 lb. a.i./ac)	Fall 1981	-
Glyphosate (1 lb. a.i./ac)	Spring 1982	Fall 1982
Paraquat (.5 lb. a.i./ac)	Spring 1982	Fall 1982

PREVIOUS LIVESTOCK FIELD DAY REPORTS
SQUAW BUTTE EXPERIMENT STATION

These reports are available upon request from the Squaw Butte Experiment Station, P. O. Box 833, Burns, Oregon 97720.

Special Report 189 1965

Special Report 210 1966

Special Report 232 1967

Special Report 251 1968

Special Report 270 1969

Special Report 288 1970

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