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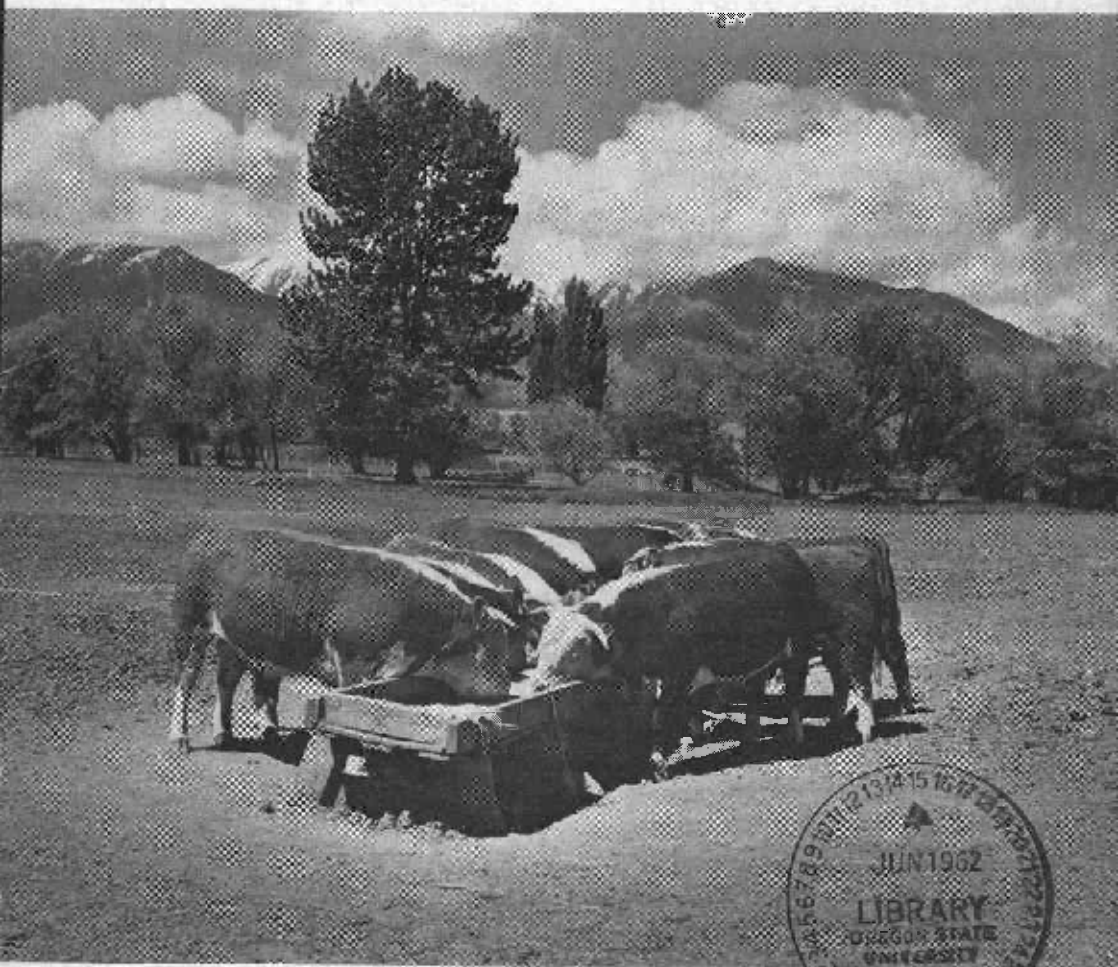
Fourth Annual Beef Cattle Day



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Beef Cattle Breeding Research At Oregon State University

RALPH BOGART

The beef cattle breeding research program at Oregon State University is a cooperative undertaking. Oregon cooperates with other western states and the Agricultural Research Service of the United States Department of Agriculture. In addition, this program has been strengthened by cooperation between the central station and four of the branch stations.

It has been recognized that no experiment station will make a large impact upon genetic structure of beef cattle of the nation, or, for that matter, of any state; consequently, this program has been aimed at developing concepts, methods, and explanations that may contribute to improvements in beef cattle which can be made by purebred breeders and commercial producers.

Three Hereford lines developed

Three lines of Herefords—Lionheart, Prince, and David—and one line of Angus—based on Prince Sunbeam and Missouri Barbara breeding—have been developed as small closed herds at the central station. One line has been developed at the Union station.

Cattle at the central station have been selected on six traits: fertility, suckling gains, feed-test gains, feed efficiency, score for type and conformation, and freedom from inherited defects. Fertility and defects have been considered on the basis of minimum culling levels, while the other four traits have been given equal emphasis in the index upon which selections were based.

The feed test is conducted from 500 to 800 pounds body weight using a ration composed of two parts alfalfa hay to one part of concentrate mixture with both hay and concentrate put into a single pellet. All calves, both bulls and heifers, are tested.

Bulls gain rapidly

Data have shown that bulls gain more rapidly and efficiently than heifers but do not consume any more feed per day than heifers of the same weight. Also, rapidly gaining animals are more efficient than slowly gaining ones. For each one pound increase in gain per day there is a feed saving of 2.5 pounds on each pound of gain. Data show that, if records on feed efficiency were unobtainable, considerable improvement could be made in this trait by selecting for rapid rate of gain.

Results from selection during the first two generations (about 9 years) showed an increase of about 0.5 pound in feed-test rate of gain and a saving of about 1.5 pounds of feed on each pound of gain. A little progress in suckling gains was made during this time. Data suggest that selection and inbreeding have fixed inheritance in our three lines of Herefords to the degree that genetic segregation is so low as to materially reduce amount of selection which can be practiced. Consequently, we plan to combine the three Hereford lines to obtain information on their combining abilities and to cre-

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ate populations that will exhibit more genetic segregation so we can continue to make improvements through selection. It was not possible to determine if type and conformation scores were improved because we tend to score in relation to what we have. Thus, if improvement is made, we become more critical. If we go down in progress, we tend to score less severely. This has been well illustrated by work at the U. S. Sheep Breeding Station at Dubois, Idaho. Their scores for smoothness(freedom from wrinkles) and for face covering have remained the same over the years even though they have developed open-faced sheep without wrinkles. Selection pressure for the four traits—suckling gains, feed-test gains, feed efficiency, and score—was equal with selected bulls showing a 15% superiority over bulls from which they were selected. Selected heifers were about 5% superior to heifers from which they were selected.

Basic studies made

Some basic studies have been made on physiology of animals as a means of understanding how more rapid and efficient animals differ from those that are less rapid and efficient in gains. Blood and urine studies have shown that the better-doing calves have ability to draw materials from blood and use them in muscle growth, whereas slowly gaining calves do not draw heavily on these materials. As a consequence, the poorly gaining calf is faced with a problem of eliminating these materials. This is done through the urine. This means that materials fed are not properly used in growth but rather are eliminated in the slower gaining, less efficient calf. An attempt has been made to find the enzyme system involved in this physiological conversion, but we are dealing with a great complexity. One enzyme, alkaline phosphatase, is higher in blood of the better-doing calf. This enzyme is thought to be concerned with bone growth.

Another basic study has been concerned with effects of inbreeding on various traits. Suckling gains have been depressed by inbreeding of the calf, but birth weight, feed-test gains, and feed efficiency have not been depressed by inbreeding. These traits respond well to selection; therefore, it is concluded that the selection we practiced prevented inbreeding from depressing these traits. Suckling gains do not respond so readily to selection; therefore, our selection was not effective in preventing a decline in suckling gains resulting from increasing inbreeding.

Feed testing

Cooperative work with the Squaw Butte station has been concerned with feed testing under different levels of feeding to determine if a high level is necessary for differentiating good-doing from poor-doing cattle. This study has included three phases: 1) Comparison of rate and efficiency of gains the first winter with gains the following summer on the range. This comparison was made within levels of winter feeding and little relationship was found. 2) Comparison of rate and efficiency of gains the first winter under low and high levels of feeding with rate and efficiency of gains the second winter. A high relation was found between the two winters in the group tested the first winter under the high level of feeding. However, there was no correlation of rate and efficiency the first winter with rate and efficiency the second winter when cattle were tested the first winter under a low level of feeding. 3) Comparison of rate and efficiency of heifers feed tested under two

levels with rate and efficiency of their calves. This study is being analyzed at present and no conclusions can be drawn until analyses are complete.

Three Hereford lines developed at the central station and the one developed at the Union station have been tested for genetic merit by mating bulls from these four lines to commercial cows at the Union station. Calves produced from these matings are used for three types of evaluations: 1) Some of the bulls are feed tested; 2) the rest of the bull calves are made into steers which are fed to about 1,000 pounds and provide data on growth rate and carcasses; and 3) heifers are kept for two calf crops to obtain information on their calf producing abilities. It was found that calves sired by bulls of the David line gained most rapidly and produced the heaviest carcasses. Calves sired by bulls of the Lionheart line excelled in marbling and carcass conformation. Calves sired by bulls of the Prince line had the highest dressing percent and their carcasses graded highest. Calves sired by bulls of the Union line were low in production and carcass traits but some of this low rating may have resulted from the slight relationship of the bulls to the commercial cows. This shows clearly that each of the three lines at the central station has some good traits but that no one line is superior in all traits.

Relationship negative

One striking finding was a negative relationship of scores for conformation and condition at weaning time with production and carcass traits. Better-scoring calves at weaning were the smaller calves at this time and were the ones that gained less and made less desirable carcasses. These two scores were closely correlated, indicating that finish at weaning contributed to the score for conformation more than would have been expected.

Some chronic bloaters

Some studies with abnormal conditions have been interesting. We have found that some calves on feed are chronic bloaters. When these animals have been mated together and to very closely related animals, 65% of the calves produced by such matings have been chronic bloaters. This shows definitely that tendency for chronic bloating is inherited. Chronic bloating is different from the acute type that leads to loss of life. One other condition, hydrocephalus, water on the brain, has given evidence of being a trait which results from an interaction of genetics and nutrition. If animals have a genetic tendency for it and undergo a nutritional stress, this defect may occur at an alarming frequency. Normally, most producers would not recognize this condition. Calves are born listless, perhaps in a coma, and die in a few days. The only way to determine whether death has been caused by hydrocephalus is to open the head to see if there is a brain cavity filled with fluid.

Results would indicate that a purebred breeder who is using a closed-herd system for development of breeding stock that will transmit with regularity when used in commercial herds will need to give special attention to fertility, suckling ability, and early life vigor through selection, good care, and management. Post weaning rate and efficiency of gains and certain carcass traits respond so well to selection that little difficulty should be experienced in improving them in a closed herd in which rate of inbreeding is not high. There is a great need for methods of appraising carcass merit in the live animal.

Effect of Various Feeding Practices On Palatability of Beef

WALTER H. KENNICK AND DAVID C. ENGLAND

Efforts being made by all segments of the beef industry to improve production efficiency are bearing fruit. Higher calf crops, larger weaning weights, and faster rates of gain are regularly reported in the literature along with methods of achieving these results. Now we are striving to produce a carcass which will yield a higher percent of trimmed retail cuts—cutability. While we are accomplishing these results, we must not lose sight of the fact that beef holds its position of preeminence among meats as a result of its ultimate ability to produce consumer satisfaction at the dinner table. Many efforts to improve production efficiency of the beef industry have too seldom been accompanied by palatability evaluations of meat produced.

No difference found

Workers in California (4) and Georgia (1) found no difference in palatability resulting from use of several different grains as concentrates. Georgia (1) workers found grain-fed beef was preferred over beef fattened on grass. This finding was developed further by studies at Cornell (2) which demonstrated that although there was no consistent difference in tenderness, aroma, or juiciness resulting from level of nutrition, flavor of meat from beef on a high level of nutrition was preferred over that from beef on a lower level. Ohio (5) and Oregon (3) workers have demonstrated that no consistent difference in palatability results from use of hormones in the feedlot.

Work reported here was carried out over a 4-year period. Various nutritional and hormone implantation regimes were used in these studies. It is not the purpose of this paper to present feedlot results of these studies. However, rates of gain and USDA grades are included in Table 1 so a clearer picture may be presented of taste-test results.

OSU taste tests

Taste tests reported here were carried out under the direction of Mrs. Lois Sather of the Food Science and Technology Department of Oregon State University.

Tenth-eleventh rib roasts cooked to an internal temperature of 160° F. were used for taste testing. A trained panel, composed of staff and technical assistants of the departments of Animal Science and Food Science and Technology, did the testing. Each sample, served separately on warm porcelain dishes, was evaluated for aroma, flavor of lean, tenderness, juiciness, texture, flavor of fat, and overall score.

Data indicated no consistent difference in taste-test scores attributable to hormone treatment. The significant difference in aroma found in the 1957 trial was within hormone treatments, and it did not repeat in 1958 or 1960 and differed from the pattern found in 1959 data. This same lack of pattern is true of other significant differences found. No significant differences existed in overall scores.

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Table 1. Taste test results[1] of standing rib roasts from steer calves fed various rations for 250 days

Nutritional regime[2]	Av. daily gain	USDA grade			Aroma	Flavor of lean	Tender-ness	Juici-ness	Tex-ture	Flavor of fat	Overall score
	lbs.	Ch.	Gd.	St.							
1951											
1/2-1-1 1/2 + P.V.S.[3]	1.91	4	28	3	5.48	5.54	5.27	5.25	5.00	3.79	5.37
1/2-1-1 1/2 + alfalfa hay	2.09	6	23	7	5.37	5.45	5.16	5.13	4.94	4.02	5.24
1/2-1-1 1/2 + peavine hay	1.90	2	32	1	5.35	5.37	4.44	5.06	4.59	3.80	4.89
1/2 + alfalfa hay -1- + 1/2 alfalfa hay + 1/2 P.V.S. -1 1/2 + P.V.S.	2.19	9	24	2	5.48	5.63	5.49	5.35	5.11	3.86	5.56
L.S.D. (PL.05)					0.11	0.15	0.46	NSD	0.27	0.18	0.33
1960											
1/2-1-1 1/2 pelleted grain + P.V.S. + alfalfa pellets	2.07	11	24	0	5.40	5.40	5.21	4.95	5.05	3.90	5.15
1/2-1-1 1/2 rolled grain + P.V.S. + alfalfa pellets	2.36	11	22	0	5.45	5.40	5.10	4.95	4.90	4.05	5.10
1/2-1-1 1/2 pelleted grain + P.V.S. + chopped alfalfa hay	1.81	5	29	0	5.45	5.30	4.85	4.95	4.80	4.20	4.90
L.S.D. (CP.L05)					NSD	NSD	NSD	NSD	NSD	0.26	NSD

[1] Flavor factors scored on a 1 to 7 intensity scale; 1 the lowest and 7 the highest score possible.
[2] The figures (1/2-1-1/2, etc.) refer to percent of live weight fed as concentrate by equal divisions of the feed period.
[3] P.V.S. = Peavine silage.

There was no consistent association between average daily gain or USDA grade by treatment and taste evaluation. The 1957 results indicated lower feedlot performance and consistently less desirable taste-test results than for the other three years. It must be borne in mind here that these results are completely confounded with years, making it impossible to draw any valid conclusions between taste results of different trials.

A significant difference in aroma existed between consistent concentrate-level groups 1-1-1 and 1 1/2-1 1/2-1 1/2, and the sliding scale group 1/2-1-1 1/2 (Table 1). This difference was small and did not repeat in the 1958 trial. There was a small but significant difference in flavor of fat in the 1957 and 1960 trials which seemed to be associated with rate of gain and USDA grade. The faster-gaining, higher-grading groups had more bland fat.

The 1959 data showed the most consistent differences in taste-test scores. These differences were not attributable to level of concentrate but to type of roughage fed. Hay-fed groups were consistently lower in palatability scores than were silage-fed groups. These differences were significant in all characteristics except juiciness, and here the same pattern prevailed as in other characteristics where there were significant differences. It is interesting to note that although groups fed hay as the sole source of roughage scored consistently lower than groups receiving silage, the group receiving the highest average score on most taste-test characteristics was that receiving both types of roughage.

These results indicate that type of roughage fed may have a more direct bearing on palatability of meat than level of concentrate or hormone implantation.

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Wintering Levels for Replacement Cattle

J. A. B. McArthur

Raising of replacement heifers can be divided into four periods: suckling, wintering as a weaned calf, summer grazing as a yearling, and wintering as a bred long yearling. To raise a replacement 2-year-old heifer of sufficient size to produce a normal calf with a minimum of calving trouble, it is necessary to make best use of feed to get most efficient and economical gains during these four periods. Considerable research has indicated that cheapest gains are made when an animal is under one year of age, and that forage is more economical than concentrates. There is a negative correlation between gains made during winter by a weaner calf and gains made the following summer on good pasture by the same animal. Research data indicate that for every pound calves gain daily during the wintering period, they will make from 0.2 to 0.6 pound less gain during the grazing period the following summer. It is necessary, therefore, to strike a balance in level of winter feeding to make most economical use of summer grazing and still grow an animal to sufficient size to calve as a 2-year-old.

Some winter gains economical

There are ranges of winter gain that do not depress summer gains to the point where they are not economical. Research on wintering levels of replacement heifers conducted at the Union station was designed to give some indication of what might be the most economical winter gains. It is important to realize that gains made on summer pasture are greatly influenced by type of summer pasture (grass, grass-legume, legume, dry or irrigated).

At the Union station, hay fed analyzed 9% to 10.8% of crude protein. It was grass-alfalfa hay and fed long. Supplement was fed as a cube, analyzing 16% to 17% crude protein. The supplement was fed at three levels—0, 2, or 4 pounds daily either in the first or second winter along with hay ad lib. Summer pastures at the station were rated "good condition." Yearling heifers grazed during summer on either or both nonirrigated and irrigated pastures at the main station and/or foothill range at the Hall ranch. Type of summer pasture did not affect summer gains to any great extent.

Animals gained satisfactorily

Under all methods of feeding, animals have reached a satisfactory 24-month weight of 970 to 1,020 pounds. Since under all methods of feeding, animals grow to sufficient size, the best method would be the one which costs least. This would be influenced most by amount of concentrate fed during the two wintering periods. Data on "total cost of ration for two wintering periods" answers this question. The most economical method was wintering weaner calves on hay ad lib. and giving them 2 pounds of concentrate with hay ad lib. as bred long yearlings. The most expensive method was feeding weaner calves 2 pounds of concentrate in the first winter and 4 pounds the second winter or 4 pounds as calves and 2 pounds in the second winter.

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Data indicated that levels of concentrate fed in this experiment did not influence ability of yearling heifers to conceive nor were calving difficulties affected. It would appear that a winter gain of approximately 0.9 to 1.0 pounds daily as a weaner calf was very satisfactory. However, if weaner calves can not make at least this gain on hay alone, then a supplement should be fed to enable them to make such a gain. Winter gains of up to 1.32 pounds a day as weaner calves were not detrimental, although they did depress summer gains slightly. With the short breeding season of 6 weeks at the Union station, we think 65% to 70% calf drop from heifers calving as 2-year-olds is very good. All animals fed over the years in this experiment are being kept for at least two calf drops to determine effect of the feeding regime on mature weight and productivity of the animals. It is important to remember that replacement heifers always need good summer pasture as yearlings if maximum use of the grazing period is to be realized.

Value of Range Research In Beef Cattle Improvement

D. W. Hedrick

The large western and southern range areas of the United States are important sources of forage for breeding stock and production of feeders. Any increase from these regions will have to come either from increased forage production per unit area or improved management and breeding of livestock using it. Since recreation and game uses will greatly expand in the next few decades, total available land for forage will continue to shrink.

This inevitable trend toward emphasizing recreational and wildlife values increases the importance of an integrated range and livestock program on wildlands producing chiefly nonculti-vated forages. The Joint Committee on Grassland Farming reviewed the problem of grasslands and their improvement in the United States in a series of articles appearing in the *Journal of Agricultural and Food Chemistry* in 1954 and 1955. A summary of total land utilization in the United States was presented in an article by Sprague (1954). According to him, acreage of total grasslands did not change appreciably between 1930 and 1950. However, pastures and ranges in federal and state domains decreased from approximately 400 to 300 million acres during the same period. Additional increases in population are bound to decrease total grassland acres available, since more room will be needed for other harvested crops. This means that production from remaining acres will become more important in the future.

Three alternatives are available to maintain and increase present productivity. The first involves direct application of improvement measures to land by increasing forage quantity and quality; the second requires improved livestock management on the range; and the third involves improvement of livestock through breeding. All are desirable and necessary to obtain the most efficient production from a given range

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area. Good cattle alone are unable to reach full genetic potential if hampered by inadequate forage. On the other hand, there is no point in providing scrub animals with the best forage. The proper answer is to supply well-doing livestock with the most valuable forage available under the best management possible. As pointed out by Bogart (1960), this usually can be accomplished in range herds by culling out the lower producing 25% of the cows. Such a reduction provides good forage for the remaining herd. From a production standpoint, increased output of the better-doing animals remaining about makes up for those culled and net costs per pound of beef are usually lowered.

Value of range research

In reviewing the value of range research in beef cattle improvement, we must keep in mind that maximum returns from any expenditure on range land can be realized only when combined with appropriate breeding and livestock management practices.

Before presenting the research program and results at Oregon State University, different types of range improvement currently available to producers and how these measures are interrelated with other land uses will be reviewed.

Range Improvement Practices and Land Uses

All range improvement efforts can be divided roughly into two categories, natural and artificial. Among important natural means are: rate of stocking, season of use, and distribution of livestock. All three of these cardinal principles in good range management can be considered under the heading of grazing systems. In other words, any grazing system that incorporates these three concepts—correct rate of stocking, proper season of use, and adequate distribution—will enable any beef producer to improve his range if enough good plants are present and worthless plants can be replaced by adjustments in grazing management.

Artificial measures necessary

Artificial measures such as spraying, rotobeating, or root plowing may be necessary where stubborn woody plants such as sagebrush and mesquite are abundant. Normally, reseeding will not be necessary if 15% to 20% of the good grasses are still present. If less than this amount remains, seeding adapted forage plants should normally follow removal of undesirable species. If there is to be a lasting benefit, all improvement practices should be accompanied by proper grazing.

Range fertilization is an improvement practice that has received a lot of attention on annual grasslands in California and is being studied in other regions as well. In general, improved grasslands and ranges seeded to adapted species respond more favorably to fertilizer applications than native, noncultivated forage species. Also, we do not know enough about effects on species composition to recommend fertilization of most native ranges. Mineral elements, particularly phosphorus, are essential if legumes are to be grown in combination with grasses. Although nitrogen gives the greatest immediate response of any fertilizer element, most studies show an economic advantage resulting from the use of proper mineral amendments so that legumes provide needed nitrogen.

Other land uses

Other land uses important to range improvement include: cropland agriculture, forestry, watershed management, game management, and recreation. Whenever range improvements are planned, it is important that interrelationships with these other uses be understood. For example, if ranges are producing less forage at one season than is needed by livestock that can be supported the rest of the year on cultivated land, range improvement is necessary to balance feed supply throughout the year. In this case, range improvement is the limiting factor in producing maximum livestock products. On the other hand, if hay supplies are short, meadow improvement or diversion of arable land to forage will be needed to achieve a seasonal balance of feed. Forestry is favorably influenced by range improvements if grazing pressure is relieved on young regenerating stands. In addition, in some areas planting grasses may hold down establishment of dense tree seedlings, thus avoiding "dog-hair" or stagnated stands. Forest cutting practices influence livestock range by temporarily reducing feed, whereas on predominately game range, cutting normally increases forage which is reduced as forest cover becomes reestablished. Range improvement can be very helpful to watershed management when better plant covers are established. Any increase in herbaceous plants generally controls erosion and results in better quality water than nearly bare hills covered with worthless shrubs or inferior woody species. Game species may be either benefited or adversely influenced by range improvement practices. Although increased production from ranges is good for both game and livestock, complete removal of browse species can be disastrous on big game winter ranges. Although recreation seems to be far removed from range improvement, the fact remains that recreational uses of wildlands will continue to rise phenomenally in years ahead. To avoid competition on choice outdoor spots, it will be essential to spend more on range improvement in areas less attractive to recreationists.

One of the greatest obstacles facing both livestock owners and range administrators interested in applying improvement practices on ranges under their control is dearth of economic data on costs and returns which are essential to provide an adequate basis for sound management planning. Whether or not a range improvement practice will pay off is largely dependent upon increased production that can be expected, how effectively it is incorporated into the management program, and how long this increase can be maintained without additional expensive treatment. In general, if good grazing management is used following brush control and range seeding practices, the initial investment may be amortized long before benefits taper off appreciably. Many records show that costs can be retired in 6 to 10 years in addition to paying 5% interest on the investment required to undertake the improvement practice.

Federal land policies change

In the past, uncertain and changing land policies of the federal government have made it difficult to initiate and implement needed long-time programs of improvement. In the last decade, however, both the Bureau of Land Management and the United States Forest Service—the largest federal agencies managing public lands—have committed themselves to substantial long-range

plans for improvement. If this new era of public land policy, referred to by Clawson and Held (1957) as one of intensive management, integrates user or permittee participation with that of the managing agency, rapid strides can be made in strengthening the position of the range livestock producer. For maximum benefits, this positive policy of improving our range forage production on public lands must be coupled with a program of increased livestock efficiency and better management of animals when on the range. If range producers and public land administrators cooperate, the meat and wool industry will continue to occupy its rightful place on wildlands even though game and recreation pressures increase tremendously.

Oregon Agricultural Experiment Station Range Research

In order to review experiment station present and proposed research programs in range management in their proper perspective, it is necessary to indicate the program of other organizations in Oregon and to point out their principal work centers. The United States Forest Service, through the Pacific Northwest Forest and Range Experiment Station, has been active in this field since 1936. The principal range research center is located at Starkey near La Grande, where most grazing intensity and improvement research has been undertaken. Game-range and game-livestock relationships are being studied in the Silver Lake area near Bend.

Range research at Squaw Butte

A range and meadow improvement research program was started in the late 1940's at Squaw Butte near Burns. This station was operated cooperatively by the Bureau of Land Management and Oregon State University. In 1956, the Agricultural Research Service took over from the Bureau of Land Management. The program of this station has been concerned primarily with range improvement by seeding crested wheatgrass and spraying sagebrush with 2,4-D. Increases in forage production up to 5 to 10 times for seeding and 3 to 5 for spraying compared with pretreatment yields have been common.

At Washington State University's land grant college centennial celebration (1962), the range research program of the Oregon Agricultural Experiment Station was presented as an example of interdisciplinary research directed toward more efficient land management in the range areas of Oregon. Since this summary statement is the most recent digest of our objectives, procedures, and results of range research at Oregon State, it will be used in the remainder of this presentation. Range ecology, improvement, nutrition, and land use represent the principal areas of emphasis in the station's range research effort.

Range ecology work cooperative

Dr. C. E. Poulton is directing research in range ecology which is being carried on cooperatively with Idaho and Washington in sagebrush-grass ranges of the Northwest. This work is concerned first with characterizing natural groupings of vegetation and soil in nonforested areas of eastern Oregon, and second with studying successional changes brought about by the disturbances of grazing and fire. Work-

ers in range ecology, e.g., Poulton and Tisdale (1961), study vegetation and soil together. By starting in relatively undisturbed or near climax conditions, basic plant and soil relationships are worked out. When the characterization phase is completed, other range scientists can identify these same units, which are called habitat types, in a deteriorated condition as an index of range site. Joint study of vegetation and soils helps explain many ecological questions. Unraveling patterns of secondary succession is the second objective in these studies. When completed, this second phase is immediately useful to administrators interested in evaluating range condition and trend.

In addition to increasing knowledge about the nature of the resource itself, the range ecology project has enabled investigators to pursue other research and apply results more effectively. For example, Eckert's (1957) work at Squaw Butte and vicinity has provided basic information on the nature of soil and vegetation units found there. Basic ecological information has permitted investigators concerned with range improvement research to locate study sites on habitat types most typical of an area. This important step permits more reliable extension of experimental results to adjacent and distant locations of the same habitat types within the sagebrush zone.

Western Oregon range research

Range improvement research has been undertaken in western Oregon to study performance of native and introduced forage plants under different management and fertility systems, Valassis, et al. (1957) and Hedrick (1957, 1957a). From these and other results, Bogart and Hedrick (1955) pointed out some applications for more efficient management of sheep on Willamette Valley hill pastures. More recent results obtained from clipping and fertility work on orchardgrass and subclover have provided a basis for the new common-use grazing experiment to be started at the central station on the Adair lands. This experiment will attempt to answer the question: What is the best proportion of sheep and beef cattle to use on two different grasses in combination with subclover?

Eastern Oregon range research

In eastern Oregon, range improvement work has been undertaken cooperatively with Squaw Butte. Here, principal emphasis has been directed toward studying ecological changes following sagebrush removal by chemical and mechanical methods. If big sagebrush removal operations are undertaken, it is essential to know what happens over a long period of time. Treatments were made in 1955 and these areas continue to show interesting changes. Better grasses are continuing to increase even though total production has not changed appreciably in the past four years. Although sagebrush is beginning to come back, the amount is small on plots well covered with good grass. In contrast, range in poor condition is rapidly reverting to sagebrush, even though forage yields of inferior species remain high.

Range nutritional studies are essential in making more efficient use of range forage. Inherent soil fertility, seasonal growth patterns of important plants, and animal requirements are all involved. In order to make these studies more effective, it has occurred to Oregon researchers that all three factors should be investigated together. If vegetation-soil units characterized in the range ecology project provide a more scientific basis for range land classification and evaluation, then why

not undertake range nutritional studies on an ecological basis? To explore this hypothesis, range sites or habitat types are now being used as working units for collecting and analyzing nutritional data on the Hall ranch in the foothill ponderosa pine ranges of northeastern Oregon. Results to date, Walton (1961), are incomplete yet they point to the ultimate value of this approach in providing a more systematic and interpretable basis for collecting and analyzing experimental data.

Land use research

Research in land use has been directed primarily toward a better understanding of relative value of farm forestry and grazing on marginal foothill areas. Hall, et al. (1959), found that effect of proper grazing by sheep on areas planted to Douglas-fir was largely beneficial since reduction in palatable forage improved soil moisture available for tree growth. Although many opinions have been presented to support or refute value of grazing in forest management, unfortunately few quantitative studies are available to clarify complex interrelationships, particularly under conditions of good livestock management. If only domestic livestock were involved, consequences would not be so serious, since these can be removed or added to commercial or farm forestry areas depending on economic objectives or interest of an owner or administrator. With wildlife, both big game and rodents, the problem is more complex. In addition to the owner's or administrator's views on grazing, we must add that of the sportsman and the increased difficulty of effective control of the game animals. Since game species can not be eliminated from areas in the same way as domestic animals, the landowner, administrator, and sportsman must learn to live with the problems of wildlife and its influence on other land uses and to ameliorate their abuses of the basic forage resource by wise herd management.

Recognizing the contribution that range management might make to a better understanding of these problems, the Oregon State Game Commission has agreed to support research aimed at clarifying relationships between game populations and Douglas-fir browsing damage in western Oregon. Studies are underway at Cedar Creek located in the Tillamook Burn to investigate the influence of varying deer populations on young plantations of Doulgas-fir. In order to make damage studies as effective as possible, concurrent work in ecology is being undertaken to interpret natural vegetation-soil units found there. These studies will provide a better basis for extending detailed results obtained at Cedar Creek to other areas of the Tillamook Burn, and, in fact, to all similar second growth Douglas-fir stands throughout western Oregon.

Range improvement and big game

The most recent cooperative program with the Game Commission involves a study of influence of range improvement practices on big game winter range. This study in part has been prompted by rightful concern of game managers as to what eventual effects of wholesale brush removal programs will be on already limited winter ranges for deer.

The latest interdisciplinary effort involving livestock, game, and forestry problems on ranges indicates the vital importance of relating range and livestock improvement problems to other land uses. In order to provide for the continuing best use of the range resource, it is essential that improvement

programs for livestock and range be integrated with those in game, forestry, and recreation, in order to serve the best interests of all citizens.

In summary, range research is an essential segment of a beef-improvement program in range areas. Attention must be paid to feed quantity and quality if breeding potential is to be realized. Coordinated programs in both areas—livestock breeding and management and forage improvement—must be followed if maximum results are to be obtained.

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Vitamin A Problems in Beef Production

D. C. CHURCH

Since isolation and identification of vitamin A as a required nutrient for most animal species, a tremendous amount of research effort has been spent to determine animal needs and the nature of this vitamin's physiological function. Although some of the mystery has been cleared up, information still is needed on requirements, and knowledge still is relatively vague regarding physiological function other than the one specific reaction connected with night vision.

Vitamin A maintains tissues

It is known that vitamin A is concerned with maintenance of epithelial tissues—those cells and tissues which cover body surfaces and line body cavities—concerned with protection of underlying tissue, absorption from the gut, vision and reproduction, and so forth. It is also involved in bone growth to some extent. Vitamin A as such is not found in plants, but chemically related orange-colored compounds called carotenes are present. Many different carotenes, all differing slightly in their chemistry, are found in plants, but some of them are of little or no use to animals. In general, bright green grass, hay, or silage will contain large quantities of carotenes. Excess exposure to sunlight, moist heat in presence of air, or long storage periods result in rapid destruction of these compounds. When herbivorous animals eat plants containing these carotenes, the most potent one being beta-carotene, some of them are converted to vitamin A in the wall of the small gut. Blood carries the vitamin A to various tissues and the excess not required is stored in the liver, kidney, spleen, and to some extent in fat. In some ruminant species such as sheep and goats, carotenes are not found in blood or other tissues while breeds of cattle such as Guernsey and Jersey have large quantities in blood and liver and the highly pigmented fat or milk color is due largely to these compounds. There are indications, however, that carotenes stored in fat or liver may not be of much value to an animal as a potential source of vitamin A.

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Deficiency symptoms

Deficiency symptoms, as a rule, occur more rapidly and are more severe in young calves. This is due partly to the fact that a calf is born with very low reserves of vitamin A in its tissues, since only a limited amount of the vitamin is capable of passing across the placental membranes. Visual (clinical) symptoms which easily can be seen in a calf are due to a combination of factors. One of the earliest symptoms is bulging and excessive watering of the eye accompanied by some incoordination when walking. This is due to an increased pressure that develops on the optic nerve and blood vessels and also on the brain and spine by the cerebral-spinal fluid which bathes the brain and spinal column. The calf will also become night blind during this stage. At about the same time a very loose diarrhea will develop due to cellular changes in the gut. Hair will tend to become dry and rough and skin dry

and scaly. Convulsions will be seen occasionally. If this condition prevails, the calf will become permanently blind due to bone growth which closes off the opening in the skull through which the optic nerve and vessels pass. The cornea will rupture and the eye may become infected or necrotic. Pink eye is sometimes confused with vitamin A deficiency.

Symptoms in feedlot cattle

Symptoms in feedlot cattle are the same for hair and skin. Little or no change takes place in the eye except for excess watering. Convulsions are frequently noted. Diarrhea is not as severe as in young calves. Anasarca, which is a swelling of legs and brisket, sometimes occurs. Less severe deficiencies may result in a slower rate of growth or less resistance to various stresses.

Clinical symptoms are not very obvious in mature animals unless the deficiency is quite severe. Other than a dry, scaly skin and rough, dull hair, no particular symptoms will be obvious. Examination of the eye with the proper instrument, measurement of the cerebral-spinal fluid pressure, or analysis of blood or liver vitamin A (plus tests for night blindness) are required for conclusive proof of deficiency. In breeding stock, vitamin A deficiencies may impair fertility of males. Deficiency must be relatively severe to cause any marked interference in conception rates of females. Very severe deficiencies may result in abortion. There is some indication that stillborn deaths of full-term calves may result although evidence is not conclusive. Most research evidence indicates that vitamin A deficiency is not as much of a problem with brood cows as is commonly believed by many producers.

In the past, laboratory analysis of blood samples for vitamin A content has been the most common means of confirming suspected deficiencies. However, there are a number of situations which may confuse results and lead people to believe that a deficiency exists when, in all probability, such is not the case. For example, operations such as dehorning and castration, wounds, infections, or conditions such as mastitis have been shown to cause a marked drop in blood vitamin A levels, with the result that blood analysis may point to a deficiency that does not exist. Even normal parturition causes a sudden drop in blood vitamin A levels, partly due, no doubt, to secretion of vitamin A into the colostrum. Analysis of samples of liver taken by biopsy procedures is believed to be more indicative of true vitamin A status of an animal since liver reserves are relatively large and do not fluctuate as much or as rapidly as do blood levels.

Supplementation may be advisable

Research done in various states indicates supplementation of brood cows with vitamin A or carotene-containing feeds may be advisable during periods of drought or when green feed intake in desert range areas is limited to a few weeks in the year. Otherwise, normally recommended husbandry practices of providing a good quality hay 30 to 60 days prior to and after calving would seem adequate. Where practical, it is much cheaper to provide good quality hay or vitamin A supplementation to calves via a creep than to feed it to the cow and get it to the calf via milk. The critical period for most calves is from birth to about 8 weeks of age or until the calf has access to new grass or good quality hay. The milk supply that most calves receive will not provide sufficient vitamin A to meet their needs, especially if the colostrum is de-

ficient in quantity or low in vitamin A.

The vitamin A problem with feeder cattle appears to be a different situation. Weanling calves have not had time to build up appreciable reserves and many will show deficiency symptoms after 100 to 200 days on feed when intake of carotene is low. Current investigations indicate that nitrate compounds found in plants may contribute to this problem. Other work indicates that high environmental temperatures increase vitamin A requirements. Present recommendations would be about 15,000 to 20,000 units per head per day of dry vitamin A, although some people recommend more. In many cases it is cheaper to add a dry, synthetic vitamin A to a ration than to depend on carotenes from plants.

High Concentrate Diets

A. T. RALSTON

The goal of each beef producer is a greater share of the consumers' red meat dollar by 1) decreasing costs of production so that beef can compete successfully, and 2) improving quality so consumers will continue to choose beef as their favorite meat. Any new feed additive management technique, or pool of genetic material is of great interest because of the hope that it will help beef cattle become more efficient.

Cooperative trials at the Malheur and Milton-Freewater branch stations and at Corvallis were conducted to answer some questions facing feedlot operators.

Malheur

The Malheur station has explored the possibility that fiber from other grains or combinations of grains might also serve as built-in roughages. Combinations of steam rolled barley, dried molasses, beet pulp, ground ear corn, and a protein supplement were compared to standard ground ear corn-alfalfa hay ration in 1961. High concentrate diets resulted in a 15% increase in average daily gain and an 18% reduction in feed required per pound of gain. The ration giving the best results contained 50% steam rolled barley, 25% ground ear corn, and 25% dried molasses beet pulp plus 2 pounds of protein supplement. Higher levels of corn resulted in somewhat poorer performance. Although gains were excellent, health problems, including urinary calculi, wooden tongue, infected salivary glands, and rectal mucosal edema, indicated that vitamin A levels might be critical. This was later verified by low liver levels of vitamin A at slaughter time.

In 1962, steam rolled milo in combination with dried molasses beet pulp and ground ear corn resulted in performance equal to a similar dry rolled barley combination, but inferior to the optimum ration of 1961 consisting of

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45% steam rolled barley, 22.5% dried molasses beet pulp, 22.5% ground ear corn, and 10% protein concentrate (Table 1). Vitamin A supplementation of approximately 10,000 IU per day improved the health problem with the exception of urinary calculi. From the chemical composition of these high concentrate diets, it is apparent that the usual calcium : phosphorus ratio has been altered from the conventional 3:1 to 1:3. When calcium carbonate and salt were force fed, incidence of urinary calculi ceased. High concentrate diets again excelled the standard ration by 8% for average daily gain and 14% in feed efficiency.

In the first trial approximately 3 pounds of protein were fed per day in all rations resulting in a conversion of .95 pounds of protein per pound of gain.

In the following trial, daily intake of protein was reduced to about 2 pounds resulting in a conversion of .71 pounds of protein per pound of gain.

In the standard ration, protein intake was 2.85 pounds per day resulting in a conversion of 1.03 pounds of protein per pound of gain. This seems to indicate that during this finishing period a large amount of feed protein is being used for energy, and that energy is the limiting factor rather than protein.

Table 1. Malheur steer performance

Treatment	Initial weight	Final weight	Ave. daily gain	Feed/lb. gain	USDA grade
	lbs.	*lbs.*	*lbs.*	*lbs.*	
1960-61					
75% RB*, 25% BP	806	1,249	3.16	7.19	16.4
50% RB, 25% BP	806	1,269	3.30	7.41	16.3
25% RB, 50% GEC, 25% BP	824	1,248	3.02	7.98	16.1
75% GEC, 25% BP	813	1,229	2.97	8.45	16.0
Ad lib. GEC + alfalfa	809	1,190	2.71	9.55	15.4
Average	812	1,237	3.03	8.12	16.0
1961-62					
45% RB, 45% BP	767	1,215	2.90	8.07	14.7
45% DRB, 22.5% GEC, 22.5% BP	757	1,208	2.92	8.05	13.9
45% RB, 22.5% GEC, 22.5% BP	765	1,256	3.18	7.51	15.0
45% RM, 22.5% GEC, 22.5% BP	763	1,213	2.92	8.46	14.5
Ad lib. GEC + alfalfa	749	1,175	2.76	9.39	13.8
Average	760	1,213	2.94	8.30	14.0

* RB = steam rolled barley; DRB = dry rolled barley; GEC = ground ear corn; BP = dried molasses beet pulp; 1960 = 2 lbs. protein supplement; 1961 = 10% protein supplement.

Milton-Freewater

This station has investigated the effect of limited roughages fed at a level of 2 pounds per head daily with high amounts of concentrates. Roughage sources from pea vine silage, dehydrated pea vine silage pellets, and alfalfa pellets and no outside roughage source have been compared. All additional roughages were fed at a 2 pound per head per day level. Early gains in the initial trial were excellent, but due to an increasing mud problem gains finally ceased and the trial was terminated before the expected time. Addition of pea vine silage to such diets kept cattle on feed longer and resulted in higher feedlot performance. Addition of an outside roughage source had a depressing effect upon the marbling score even though this was not reflected in average daily gain or feed efficiency. Addition of alfalfa pellets to the ration resulted in performance comparable with that of barley and protein supplement, while dehydrated pea vine silage pellets resulted in still lower gains (Table 2).

The next trial continued comparison of roughage sources and dry versus steam rolling of barley. Dry rolling of barley resulted in slightly reduced performance, but all gains were excellent averaging 3.17 pounds per day. Dehydrated pea vine silage pellets resulted

Table 2. Milton-Freewater steer performance

Treatment	Initial weight	Final weight	Ave. daily gain	Feed/lb. gain	USDA grade
	lbs.	*lbs.*	*lbs.*	*lbs.*	
1960-61					
RB*, 2 lbs. A. pel., OSU	760	994	2.13	9.24	13.3
RB, 2 lbs. DPVSP, OSU	761	969	1.89	10.82	13.3
RB-BP, OSU	761	999	2.16	9.31	13.6
RB, 6 lbs. PS, OSU	761	1,023	2.38	8.59	13.5
RB, OSU	761	971	1.91	9.73	14.1
RB, Commercial	761	955	1.77	10.66	13.5
Average	761	985	2.04	9.72	13.6
1961					
RB, 6 lbs. PS, Commercial	652	1,014	2.99	6.58	14.1
RB, 2 lbs. DPVSP, OSU	652	1,054	3.32	8.08	13.6
RB, 6 lbs. PS, OSU	652	1,040	3.22	6.95	13.4
RB-BP, 6 lbs. PS, OSU	652	1,043	3.23	6.67	13.9
DRB, 6 lbs. PS, OSU	652	1,032	3.14	6.85	14.5
RB, 2 lbs. A. pel., OSU	652	1,028	3.11	7.10	13.8
Average	652	1,035	3.17	7.04	13.9

* RB = steam rolled barley + 15% dried molasses beet pulp; PS = pea vine silage; DPVSP = dehydrated pea vine silage pellets; A. pel. = alfalfa pellets; BP = dried molasses beet pulp: Commercial and OSU = 40% protein supplements.

in greatest gains. However, these pellets were of different composition than those used in the preceding trial.

In both trials a protein supplement was fed that would supply each animal 15,000 IU of vitamin A per day, together with enough limestone and bone meal to bring the calcium : phosphorus ratio back in balance. With this supplementation, no health problems occurred.

Corvallis

The trial conducted at this station was designed to compare feeding various quantities of steam rolled barley, to determine response of cattle fed high barley rations for various periods of time, and to compare steam rolled to ground barley under these conditions. Results showed little advantage of continuous high concentrate diets over a long period of time. Animals receiving high barley rations for the last 128 days made gains equal to those continuously fed high barley for 183 days. Animals on ground barley and alfalfa pellets free choice made gains equal to those on steam rolled barley. There was a greater incidence of bloat in ground barley treatments. Steers on ground barley ate about 12% more alfalfa pellets than the lots on steam rolled barley. Only minor differences were noted as to carcass grades.

Table 3. Corvallis steer calf performance

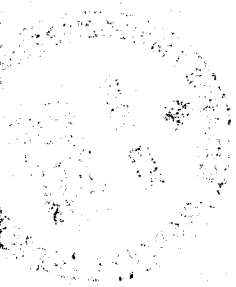
Treatment	Initial weight	Final weight	Ave. daily gain	feed/lb. gain	USDA grade
	lbs.	*lbs.*	*lbs.*	*lbs.*	
1 1/2% of body weight, 212 days	476	946	2.22	8.01	14.2
Hi barley last 183 days*	478	998	2.41	7.10	15.2
Hi barley last 72 days*	471	972	2.24	8.38	14.2
Hi barley last 128 days*	489	1,021	2.42	7.43	15.2
Average	479	984	2.32	7.73	14.7

* Plus 2 lbs. of alfalfa pellets per day.
** Remainder of 212 day period 1 1/2% body weight steam rolled barley plus alfalfa pellets ad lib.

Conclusions

The following conclusions can be drawn from these trials:

- High concentrate diets resulted in greater average daily gains and greater feed efficiency.
- Vitamin A supplementation in excess of 10,000 IU per day was required to eliminate health problems.
- Calcium supplementation is necessary for optimum results.
- Many roughages gave satisfactory results in supplementing such diets but generally tended to reduce the amount of marbling.
- Economic success will depend upon feed prices.
- Animals could be finished in a shorter period of time.



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