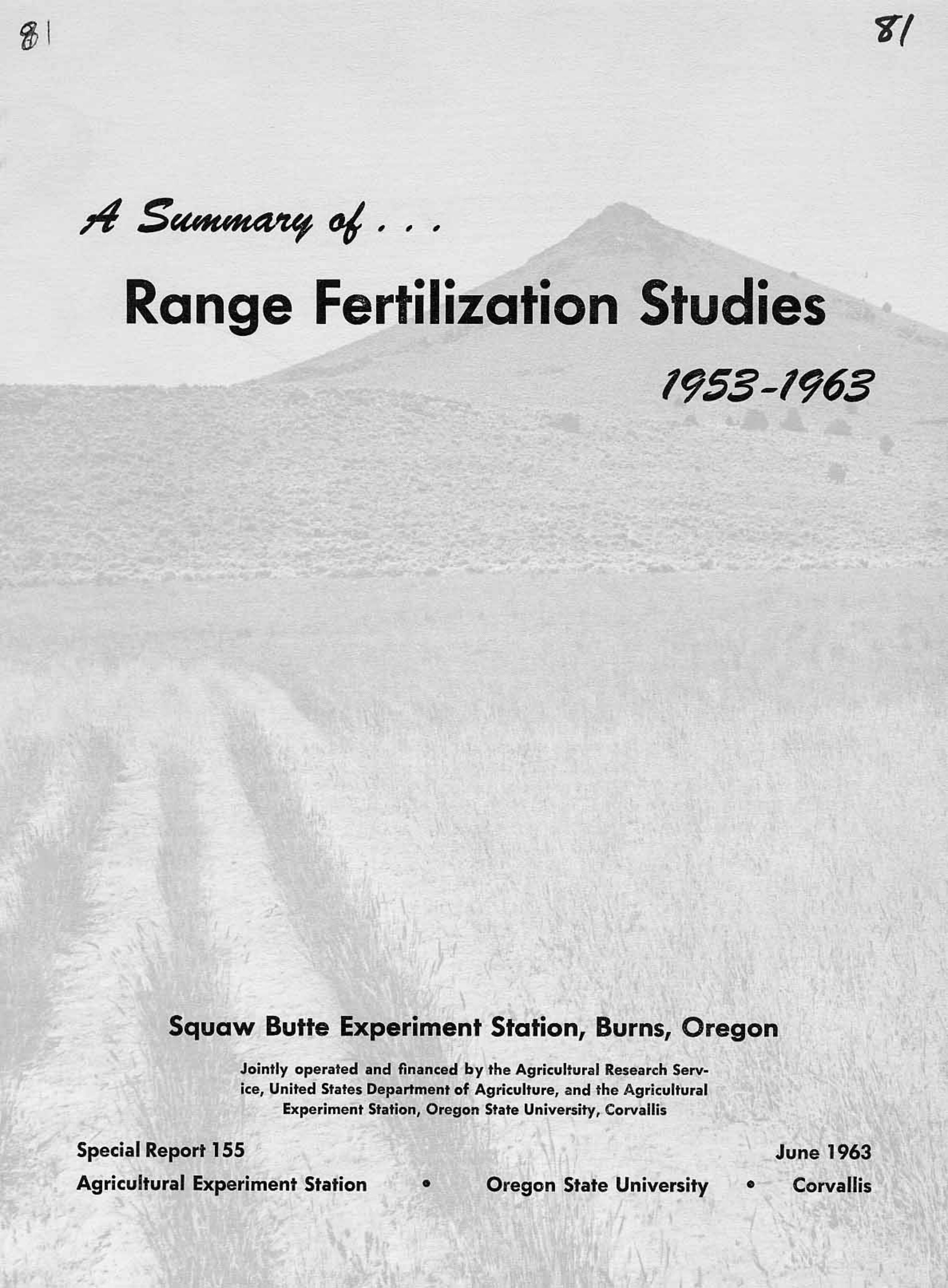

A Summary of . . .

Range Fertilization Studies

1953-1963

Squaw Butte Experiment Station, Burns, Oregon

Jointly operated and financed by the Agricultural Research Service, United States Department of Agriculture, and the Agricultural Experiment Station, Oregon State University, Corvallis

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A SUMMARY OF RANGE FERTILIZATION STUDIES

1953 - 1963

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INTRODUCTION

Most soils capable of producing agricultural crops require applied nitrogen if optimum production is to be maintained. It seems only logical to suspect nitrogen to be a limiting factor for improving the production of the sagebrush-bunchgrass range either in its native state or when seeded to improved grasses. These soils commonly have less than 1 percent organic matter content in the upper 6 inches of the soil surface. This alone is sufficient reason to suspect that nitrogen may be limiting.

There is a critical need for earlier spring range, higher yield in April and early May, and for better quality forage after grasses mature. It was felt that this need might be at least partially met by range fertilization. For the last 10 years, the Squaw Butte Experiment Station has carried numerous range fertility studies.

Most of the information presented in this special report is of a negative nature. The results are of interest and importance as a means of deciding whether or not to use nitrogen on range. Fertilizer application will produce a satisfactory yield increase when used on seeded range grazed after forage maturity. This is the only fertilizer practice that can be recommended under the conditions that exist at Squaw Butte.

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INCREASING SPRING YIELDS OF CRESTED WHEATGRASS

A major concern of the eastern Oregon rancher is early spring feed for his cattle. Earlier and more productive seeded pastures would alleviate hay feeding under flood conditions in some years and would also permit a delay in the turnout onto the native ranges, a most desirable objective. Nitrogen fertilization has been credited with causing an earlier and more rapid growth of grasses, and this is precisely what we would like to have.

Over a 3-year period, 1953 to 1955, the mean yield of crested wheatgrass was increased 84 percent by June 1 of each year, when fertilized with 20 pounds of nitrogen per acre in the previous fall. Although this is a favorable response, the yield increase amounted to approximately 230 pounds of herbage per acre and estimates an additional ton of herbage to cost about $24.00. However, grazing could not be expected to commence earlier than June 1 without drastically reducing the return. This, then, suggests that we have not gained much in the way of earlier spring feed.

Beginning in 1956, a new study to evaluate the influence of stand density and level of nitrogen fertilizer on the yields of crested wheatgrass by May 15 was initiated. Over a 6-year period, the mean yield response of grasses seeded in 6, 12, 24 and 36-inch rows to nitrogen was the same, and the mean response is shown in the accompanying chart. The mean yield increase (265 pounds per acre) on May 15 represents a 50 percent increase with 20 pounds of nitrogen per acre. The fertilizer cost of producing an additional ton of herbage in this study was estimated at $23.00.

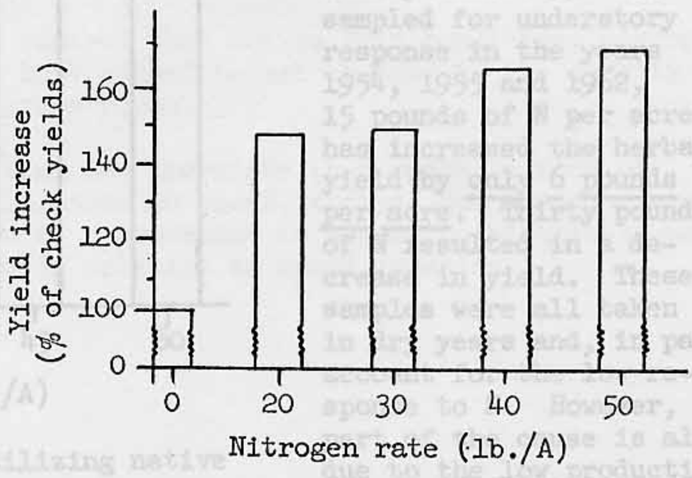

Figure 1. Percent yield increase from fertilizer on crested wheatgrass.

It can therefore be concluded that fertilizing stands of crested wheatgrass to provide for earlier and more productive spring pastures will rarely be an economical practice on eastern Oregon sagebrush ranges.

YIELDS OF NATIVE RANGE GRASSES AT MATURITY

There are few ranchers who can say that they would not be able to make use of more summer feed from their native ranges. Nitrogen is again a natural suspect as a factor which may be limited in quantity.

In the presented chart, the 4-year mean yield increases from an improved native range (sprayed range) in good condition at 4 levels of applied nitrogen are shown. The increase of 77 pounds per acre with 30 pounds of N needs no further elaboration to indicate the excessive cost of obtaining additional forage from this method.

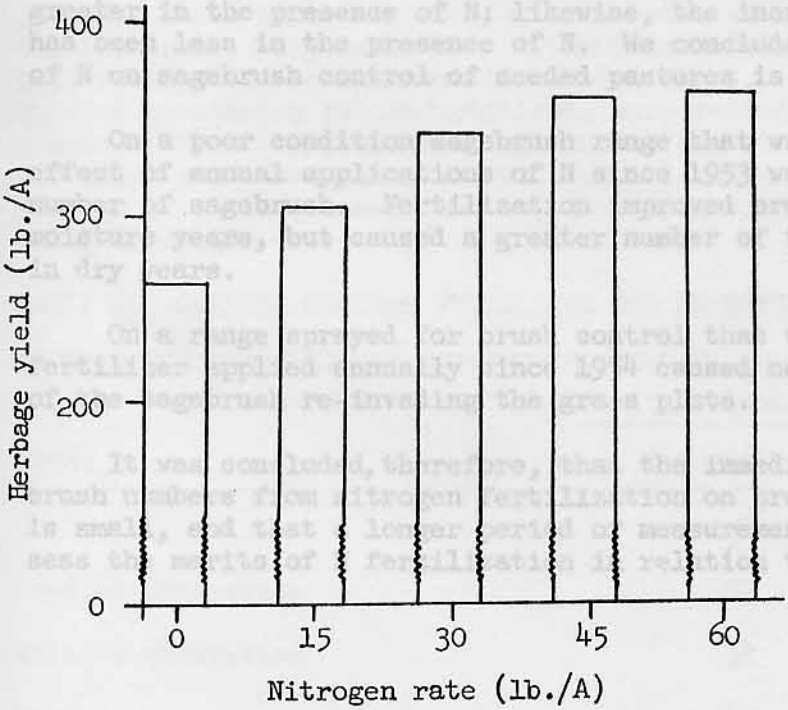

Figure 2. Yield increase from fertilizing native range.

On a sagebrush site in poor condition, which has been fertilized annually since 1954 and sampled for understory response in the years 1954, 1955 and 1962, 15 pounds of N per acre has increased the herbage yield by only <u>6 pounds per acre</u>. Thirty pounds of N resulted in a decrease in yield. These samples were all taken in dry years and, in part, account for the low response to N. However, part of the cause is also due to the low production already present on these plots.

It is also important to note that N caused changes in the plant composition. On the improved native range site, the composition of cheatgrass was increased on all fertilized plots at the expense of the perennial plants.

Nitrogen fertilization of our native ranges for increasing the production of late summer feed does not appear to be economical, and preliminary trends suggest that the composition of the range may change under a continued fertility practice; this change may also be to the detriment of perennial grasses.

SAGEBRUSH AND NITROGEN

When we talk about improving the production of seeded or native ranges, we are nearly always concerned as to what happens to the brush, either how fast it goes or how fast it comes back. Nitrogen fertilization affects this pattern because sagebrush, too, responds to nitrogen as well as being influenced indirectly by the response of the grass.

On a spring-grazed crested wheatgrass pasture, annually fertilized with nitrogen since 1953, the decrease in the number of young sagebrush has been greater in the presence of N; likewise, the increase in the number of old brush has been less in the presence of N. We conclude, therefore, that the net effect of N on sagebrush control of seeded pastures is positive but rather small.

On a poor condition sagebrush range that was protected from grazing, the effect of annual applications of N since 1953 was a slight increase in the number of sagebrush. Fertilization improved brush establishment in favorable moisture years, but caused a greater number of the young brush plants to die in dry years.

On a range sprayed for brush control that was in fair condition, nitrogen fertilizer applied annually since 1954 caused no net changes in the density of the sagebrush re-invading the grass plots.

It was concluded, therefore, that the immediate (6-8 years) effect on brush numbers from nitrogen fertilization on brush, sprayed and seeded ranges is small, and that a longer period of measurement is needed to adequately assess the merits of N fertilization in relation to brush invasion.

SEEDED INTRODUCED GRASSES AND NITROGEN

Seeding of burned rangelands and depleted areas is a continual aspect of range management. The success of those seedings can generally be attributed to (1) the amount of plant competition at the time of seeding, and (2) the rapidity by which the seeded grasses close the community. In some areas, the addition of certain commercial amendments have facilitated this latter factor.

In conjunction with a study to evaluate other factors, 30 pounds of N per acre was applied to new plots in the years 1956, 1957 and 1958. Subsequently, these plots were seeded to crested wheatgrass, Whitmar wheatgrass and big bluegrass, singularly and in combination with Canby bluegrass and streambank wheatgrass, which were also seeded alone. Other plots, with the same seeding treatments but unfertilized, were seeded at the same time. In the late summer of each year, the seeding success was evaluated. The results averaged for the 3 years are shown below. Fertilization failed to improve the seeding success of those grasses that were seeded on plots previously plowed out of a big sagebrush site.

TABLE 1. SEEDING SUCCESS FERTILIZED AND UNFERTILIZED.

Grass	Plant Frequency in 6 x 6-inch Quadrats: Unfertilized	Plant Frequency in 6 x 6-inch Quadrats: Fertilized
	%	%
Crested wheatgrass	52	53
Whitmar wheatgrass	33	34
Big bluegrass	40	39
Canby bluegrass	41	40
Streambank wheatgrass	57	57
Mean	45	45

YIELDS OF INTRODUCED GRASSES AT MATURITY

Up to this point of this report, the prospect of obtaining an economic return from the use of nitrogen on the sagebrush-bunchgrass range has looked pretty slim; but, there is still an opportunity existing.

One of the primary reasons why most of our native ranges do not yield any economic return is that the production from them is too low to begin with. An economic return, then, requires an extremely high response to N. One way to offset the need for a high N response is to begin with a higher production base. This, of course, can be achieved in part by seeding introduced grasses. Two grasses that produce a good late season forage are Whitmar wheatgrass and big bluegrass; the former has been a recommended species for a number of years, and the latter is a hopeful potential.

The yields of big bluegrass and Whitmar wheatgrass, in the absence and presence (30 pounds per acre) of nitrogen applied annually in each of 5 years, are shown in the following tabulation.

TABLE 2. NITROGEN INFLUENCE ON YIELD OF TWO INTRODUCED RANGE GRASSES HARVESTED AT MATURITY.

Species	Nitrogen rate	Year 1957	1958	1959	1960	1961	Mean
		lb/A	lb/A	lb/A	lb/A	lb/A	lb/A
Big bluegrass	0	1394	1106	732	993	635	972
	30	3319	3339	1311	1957	666	2118
Whitmar wheatgrass	0	912	811	690	543	469	685
	30	2239	2639	1083	1455	754	1634
Crop-year precipitation in inches		13.1	16.2	6.1	9.7	7.2	10.4

With N valued at 15¢ per pound and a ton of forage valued at $20.00, these returns estimate the cost of an additional ton of forage produced through fertilization at $8.00 and $9.50 for big bluegrass and Whitmar wheatgrass, respectively. Such costs can be viewed favorably, but whether or not they are the most economic practice for a rancher depends upon cost and return from his alternative practices.

The results speak for themselves - nitrogen fertilization is most apt to return profits from sagebrush-bunchgrass range when it is used on high yielding stands of introduced grasses harvested at maturity.