Vigor of Idaho Fescue Grazed under Rest–Rotation and Continuous Grazing

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Highlight: *The vigor of Idaho fescue in northeastern California was compared on plots grazed by two different approaches: one full 5-year cycle of rest-rotation grazing, at Harvey Valley; and repeated continuous grazing, at Grays Valley. Vegetative shoot lengths and numbers of flower stalks served as indicators of vigor. Vigor was higher on the Harvey Valley plots. The full-use treatments of rest-rotation grazing did not measurably reduce vigor, nor did the rest treatments improve it. Production of flower stalks appeared to depend on adequate spring precipitation and was not synchronized with the seed production phase of rest-rotation grazing. Continuous grazing at moderate intensity did not reduce plant vigor during the 5-year study period on the Grays Valley plot.*

The results suggest that moderate, continuous grazing permits Idaho fescue to maintain its vigor. But because rest-rotation grazing disrupts an apparent relationship between grazing use and precipitation, it may hold Idaho fescue vigor at a higher level than can continuous grazing.

At Harvey Valley, in northeastern California, a test of rest-rotation grazing has been underway since 1954. The grazing prescription is keyed to the growth and reproduction requirements of Idaho fescue (*Festuca idahoensis* Elmer), an important herbaceous component of range vegetation in the western United States. The species begins growing about April 1, shows flower stalks by the end of May, flowers and reaches full height growth in early July, and produces ripe seeds in early August.

The Harvey Valley allotment is divided into five range units. Each range unit receives each of five treatments in rotation over a 5-year period. As a whole, the allotment is stocked to obtain moderate use. The treatments and their intended purposes are (a) continuous full use (June 1 to October 31) to maximize livestock production, (b) rest the full season to permit recovery of plant vigor, (c) rest to mid-season to permit seed production followed by full use the second half of the season to plant seed, (d) season-long rest to permit seedling establishment, and (e) moderate use to mid-season followed by rest the second-half to aid establishment of new plants. "Full use" means 66% consumption of the current forage crop; "moderate use" means 33%.

Idaho fescue was expected to be more vigorous at Harvey Valley than on allotments where repeated continuous grazing was practiced. After 10 years of rest-rotation grazing, this expectation was confirmed (Ratliff et al., 1972).

But to understand more fully how rest-rotation grazing affects the vigor of Idaho fescue, we needed answers to such questions as: Is vigor maintained at a higher level with rest-rotation than with continuous grazing? Do the full-use treatments adversely affect vigor? Does season-long rest improve vigor? Is flower stalk production greatest during the seed production phase? And does additional continuous grazing adversely affect vigor? This paper reports a study that points to some answers.

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Methods

Three 1/2-acre plots were set up on sites that have the same basic potential to produce and sustain a given plant community. Therefore, we could logically expect any difference in plant vigor to reflect the effects of the grazing regime. One plot, on the Grays Valley allotment, was under moderate, continuous grazing; the other two plots, on the Harvey Valley allotment, were in different range units, in different sequences of rotation under rest-rotation grazing.

The three plots were on hair sedge (*Carex exserta* Mkze.)-bunchgrass sites, where Idaho fescue is a major component. Total basal cover of live plants and of Idaho fescue in 1966 was statistically equal on all three plots. The combined average, by point quadrat, was 13.2% for live plants and 2.9% for Idaho fescue. But basal cover of other grasses was statistically greater on both Harvey Valley plots (3.3% for 1 and 2.4% for plot 2) than on the Grays Valley plot (1.2%). While the amounts of grasslike plants (5.8%) were the same on the Grays Valley plot as on Harvey Valley plot 1, on Harvey Valley plot 2 basal cover of grasslike plants was 7.3%. A greater basal cover of forbs on the Grays

Table 1. Average length (ft) of vegetative shoots of Idaho fescue and overall means, northern California, by year of sampling and plot.

Plot no. and allotment	1966	1967	1968	1969	1970	Means[1]
Harvey Valley-1	0.51	0.48	0.50	0.49	0.54	0.50 a
Harvey Valley-2	0.49	0.48	0.44	0.48	0.45	0.47 a
Grays Valley	0.38	0.38	0.36	0.33	0.40	0.37 b
Means[2]	0.46	0.44	0.43	0.43	0.46	

[1] F ratio from analysis of variance = 37.6 with (2, 8) degrees of freedom. Means followed by the same letter are not significantly different at the 5% level of probability, according to Duncan's multiple range test.
[2] F ratio from analysis of variance = 0.8 with (4,8) degrees of freedom; no significant differences.

Valley plot (2.8% as compared to 0.6 and 0.5 on Harvey Valley plots 1 and 2) largely offset its lower amounts of other grasses and grasslikes.

Twelve lines across the width of each plot were randomly selected with the imposed restriction that four fell on each third of the plot. Along each line, five sample points were randomly selected, providing 60 observations per plot per year. The nearest ungrazed Idaho fescue plant (with at least one flower stalk) to the sample point was the one measured. Each plot was sampled each year for 5 years, starting in 1966,—completing one rotation of treatment under rest-rotation grazing. At the start, two sets of lines and two sets of sample points were selected. Thereafter, the particular sets of lines and sampling points used for a plot were determined each year by chance.

Each year we recorded our vigor observations before any significant amount of grazing occurred on the plots. Rarely was the nearest plant to a sampling point grazed. Therefore, current grazing did not materially affect the vigor observations. The percentage of Idaho fescue plants grazed was estimated in October each year.

The hypothesis of equality among plot means and among year means was tested by standard analysis of variance procedures (Dixon and Massey, 1957). Duncan's multiple-range test (LeClerg, 1957) was used to detect differences among the means.

We studied two indicators of vigor: (a) length of vegetative shoots (basal leaf fascicles), and (b) number of flower stalks per plant. For ease in sampling, the longest vegetative shoot was the one measured, and each plant observed was required to have at least one flower stalk, thereby assuring mature plants for our study.

We consider vegetative shoot length to reflect vigor free of moisture stress caused by competition and, therefore, vigor as related to grazing. Mueggler (1970) found that "leaf length" was affected more by intensity of clipping than by reduction of competing vegetation. Therefore, if soil moisture is adequate, the effect of competition on vegetative shoot growth would be nil. Hurd (1959) also agrees on the value of basal leaf height as a reliable index to vigor of Idaho fescue plants – provided herbage weight is accepted as the combined vigor expression. He found that leaf height and herbage weight were closely correlated. Mueggler (1970) found that reducing competing vegetation around Idaho fescue plants increased the number of flower stalks and that clipping also affected the number of stalks, but not as drastically as Hormay and Talbot (1961) had reported.

For the 5 years of this study, we found a near-perfect correlation (r = 0.996) between spring precipitation and flower stalk numbers (Fig. 1). And from a number of precipitation gages in and around Harvey Valley, we know that the amounts and distributions of precipitation were similar on the three plots. Therefore, the number of flower stalks produced should reflect the effects of grazing and the relative amounts of competing vegetation on vigor of Idaho fescue.

Results

Vegetative Shoot Length

Vegetative shoots did not differ significantly in length between the two Harvey Valley plots, but they were longer than those on the Grays Valley plot (Table 1). Therefore, over the

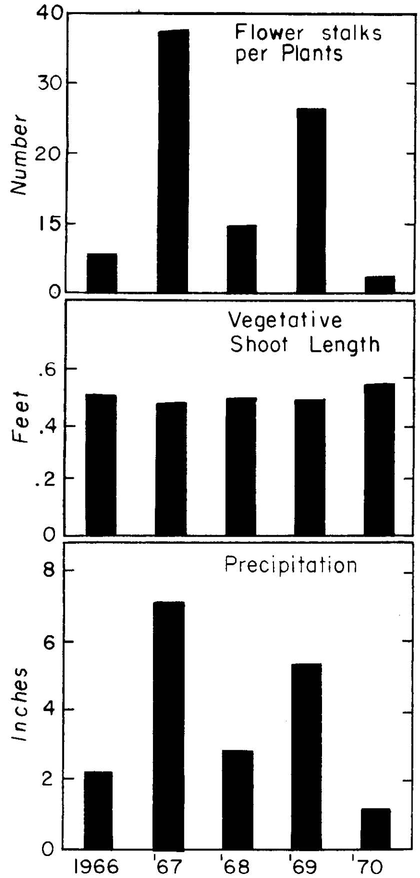

Fig. 1. *High production of Idaho fescue flower stalks depends upon adequate spring precipitation, but vegetative shoot production shows no such dependence.*

5-year period, vigor of Idaho fescue fared better under rest-rotation than under continuous grazing, but the treatments did not measurably affect vigor on the Harvey Valley plots. Nor did additional continuous grazing cause plants to lose vigor on the Grays Valley plot.

Flower Stalk Numbers

Plots did not differ significantly in number of flower stalks produced per plant (Table 2), but differences in flower-stalk numbers between years

Table 2. Average number of flower stalks per Idaho fescue plant and overall means, northern California, by year of sampling and plot.

Plot no. and allotment	1966	1967	1968	1969	1970	Means[1]
Harvey Valley-1	5.5	37.2	9.5	26.2	2.7	16.2
Harvey Valley-2	18.9	18.9	9.0	31.4	3.1	16.3
Grays Valley	9.1	9.5	9.1	30.0	4.0	12.3
Means[2]	11.2 bc	21.5 ab	9.2 bc	29.2 a	3.3 c	

[1] F ratio from analysis of variance = 0.44 with (2, 8) degrees of freedom; no significant differences.
[2] F ratio from analysis of variance = 5.70 with (4, 8) degrees of freedom. Yearly means followed by one or more like letters are not significantly different at the 5% level of probability, according to Duncan's multiple range test.

Table 3. Percent of Idaho fescue plants grazed and scheduled grazing treatment for season preceding measurement of vigor indicators, northern California, by year of measurement and plot.

Plot no. and allotment	1965 % use	1965 T[1]	1966 % use	1966 T	1967 % use	1967 T	1968 % use	1968 T	1969 % use	1969 T
Harvey Valley-1	20	A	82	B	0	C	24	D	0	E
Harvey Valley-2	0	C	92	D	0	E	28	A	94	B
Grays Valley	76	F	92	F	57	F	81	F	31	F

[1] Treatments: A = moderate use first half, rest second half; B = continuous full use; C = season-long rest; D = rest first half, full use second half; E = season-long rest; F = moderate, continuous use (Grays Valley).

were significant. Some within-plot variation was probably related to grazing use the previous year, but most of it was caused by differences in spring precipitation. These differences masked the effects of grazing to the extent that we could find no clear relationship between grazing use and flower stalk numbers for any of the plots.

On the basis of this single indicator—flower stalk numbers—it would appear that Idaho fescue plants on the Harvey Valley plots did not differ in vigor from those on the Grays Valley plot. However, pussytoes (*Antennaria dimorpha* Nutt.) comprised all the forb cover on the Grays Valley plot. Because it occurs in rather compact patches and precedes most grass and grasslike plants in the succession, pussytoes does not compete with Idaho fescue as much as the other grasses and grasslikes. Further, the basal covers of other grasses and grasslikes were greater on the Harvey Valley plots. Competition was, therefore, probably greater on the plots under rest-rotation. And because as many flower stalks were produced there as where competition was likely less, vigor of Idaho fescue plants could be considered relatively greater on the plots under rest-rotation grazing.

Use of Idaho Fescue

On the Grays Valley plot, an average of 67.4% of the Idaho fescue plants were grazed by October (Table 3). Averages for Harvey Valley plots 1 and 2 were only 25.2 and 42.8%, respectively. A comparison of use on the Grays Valley plot with precipitation (Fig. 1) indicates that the percentage of plants grazed under continuous grazing is negatively correlated with spring precipitation. There is also an indication that use of Idaho fescue occurs earlier when spring precipitation is low. For example, 86% of the Idaho fescue plants in 1966 but only 16% in 1967 were grazed by mid-August on the Grays Valley plot.

Discussion and Conclusions

Continuous grazing did not further reduce Idaho fescue vigor on the Grays Valley plot. Basal cover measurements of Idaho fescue on the three plots were equal in 1966, and Idaho fescue took more use without deteriorating on the Grays Valley plot than it received on the Harvey Valley plots. Continuous grazing, therefore, appears to be more effective in controlling competing vegetation than it is damaging to Idaho fescue.

Fullest use of Idaho fescue plants on the Grays Valley plot appears to occur when spring precipitation is low and grazing most damaging. Conversely, use appears lighter (also later) when spring precipitation is high and conditions are most favorable for plant growth, seed production, and seedling establishment. Thus, given reduced competition and "rest periods" afforded by favorable moisture, Idaho fescue can apparently maintain its vigor and reproduce under moderate, continuous grazing.

However, our results suggest that rest-rotation grazing has some advantages over continuous grazing. Vigor of Idaho fescue was significantly higher on both Harvey Valley plots than on the Grays Valley plot. Idaho fescue plants on the Harvey Valley plots received rest independent of precipitation. Rest-rotation grazing thus disturbs the relationship between grazing use and precipitation, which may be an important factor on continuously grazed allotments; and, therefore, may hold Idaho fescue vigor at a higher level than can continuous grazing.

It appears, however, that range managers cannot key seed production into a set program of rest-rotation grazing. Flower stalk production on the Harvey Valley plots was not synchronized with the seed production phase of rotation—except by chance. Rather, flower stalk production depends on spring precipitation. Further, the full use treatments did not reduce nor did full-season rest improve Idaho fescue vigor on the Harvey Valley plots.

These results lead to two suggestions; First, by 1966 when this study was started, Idaho fescue plants at Harvey Valley may have already reached their maximum vigor. If vigor was at a maximum, the effects of a later rotation would be less obvious. Second, the range manager can capitalize on the high vigor of Idaho fescue and the relationship between spring precipitation and flower stalk production. During years of adequate precipitation, most range units at Harvey Valley could be lightly stocked until seeds ripen, thereby assuring ample seed on units scheduled for full use. Concentrating livestock in these units after seed ripens should result in more seed being trampled into the soil, more seedlings the following year, and more rapid improvement in range conditions.

Literature Cited

Dixon, Wilfrid J., and Frank J. Massey, Jr. 1957. Introduction to statistical analysis. 2nd ed. McGraw-Hill Book Co., Inc., New York, p. 139-177.

Hormay, A. L., and M. W. Talbot. 1961. Rest-rotation grazing—a new management system for perennial bunchgrass ranges. U.S. Dep. Agr., Forest Serv. Prod. Res. Report 51. 43 p.

Hurd, Richard M. 1959. Factors influencing herbage weight of Idaho fescue plants. J. Range Manage. 12:61-63.

LeClerg, E. L. 1957. Mean separation by the functional analysis of variance and multiple comparisons. U. S. Dep. Agr. ARS-20-3, p. 23-29.

Mueggler, W. F. 1970. Influence of competition on the response of Idaho fescue to clipping. U.S. Dep. Agr. Forest Serv. Res. Paper INT-73, 10 p.

Ratliff, Raymond D., Jack N. Reppert, and Richard J. McConnen. 1972. Rest-rotation grazing at Harvey Valley—range health, cattle gains, costs. U.S. Dep. Agr. Forest Serv. Res. Paper PSW-77, 24 p.

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NATIVE SEEDS

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