

Juniper Root Competition Reduces Basal Area of Blue Grama¹

DONALD A. JAMESON

Principal Plant Physiologist,
Rocky Mountain Forest and Range
Experiment Station,² Flagstaff,
Arizona.

Highlight

Juniper root competition reduces the basal area of blue grama, but the effect is small enough that careful control of experimental error is necessary to detect the difference.

Juniper and pinyon increases in the Southwest have resulted in declining forage production. The reduction in forage could be caused by (1) shade, (2) rainfall interception, (3) litter, (4) phytotoxic root exudates, and (5) competition for water and nutrients. The influence of canopy and litter on blue grama (*Bouteloua gracilis* (H. B. K.) Lag.) has been reported earlier (Jameson, 1966). This paper reports additional results on the influence of root competition.

Review of Literature

In an earlier report (Jameson, 1966) multiple regression analyses of data from plots with the vegetation consisting mostly of pinyon-juniper and blue grama showed that tree litter was the major factor associated with reduction of blue grama. Tree cover either did not influence blue grama, or perhaps was beneficial. Other literature reviewed at that time provided background information for and supplemented these results. The study provided no data on the influence of tree root competition on blue grama, but other literature reviewed indicated that it was of minor importance.

Tree canopies influence light and rainfall interception. Juniper trees intercept about 40% of the precipita-

tion that falls on the crown (Skau, 1960) and up to 80% of the direct sunlight (Jameson, 1966). Reflected light, however, can greatly augment the total radiation received under the tree canopy. Although blue grama is sensitive to heavy shade (Benedict, 1941; Johnsen, 1962), Shirley (1945) in a review of the effect of light competition on plants concluded that juniper and pinyon trees rarely cast enough shadow to cause any harm to understory vegetation.

O'Rourke (1967) found that in higher precipitation areas there appeared to be a response of blue grama to juniper control, but in lower precipitation areas no response was detectable.

Methods

An area of nearly pure blue grama and associated one-seed juniper (*Juniperus monosperma* (Engelm.) Sarg.) was selected for study. Forty measurement locations were used in the study area; these were far enough removed from trees to be free of litter and appreciable shade, but close enough to be well within the effective root zone. A 50-point frame 1 m × 1 m with points spaced 1 dm × 2 dm was used to count basal area hits at each of the locations. Stakes were driven into the ground at each corner of the point frame to facilitate relocation. Total basal area hits both of blue grama and other species were recorded at each location.

Treatments were applied as follows:

Major plots:

1. Trees left intact (root activity present) (R₁).
2. All trees within 50 feet of the measurement locations cut (root activity not present) (R₀).

Minor plots:

1. Artificial tree crown added (C₁).
2. No artificial crown added (C₀).

These treatments were partially combined to provide 10 measurement locations for each of the combinations: C₀ R₀, C₀ R₁, C₁ R₀, C₁ R₁.

The artificial crown consisted of aluminum channel that carried off 40% of the rainfall and also intercepted 40% of the light. This channel was supplemented by intermediate strips that intercepted an additional 40% of the light (Fig. 1).

Results

Basal area hits from the first year of the study were subtracted from cor-

responding hits from the second year to represent change in hits on blue grama per 100 points due to root and shade-interception effects:

	No roots (R ₀)	Roots (R ₁)	Mean
No shade or interception (C ₀)	1.0	-6.4	-2.7
Shade and interception (C ₁)	4.8	-3.4	.7
Mean	2.9	-4.9	-1.0

Because analysis of variance showed no interaction between root activity and artificial canopy treatments, these two treatments could be compared independently. Plots without artificial crown lost an average of 2.7 basal area hits per hundred and plots with an artificial crown gained an average of 0.7 for a treatment effect of 3.4 hits per hundred. Compared to an average of 33.6 basal area hits per hundred before treatment, this represents about a 10% increase due to the artificial canopy. The direction of this treatment was the same as reported earlier (Jameson, 1966), but, as before, the difference was not statistically significant.

Plots with root activity lost an average of 4.9 basal area hits per hundred and plots without root activity gained an average of 2.9. The main effect due to removal of root activity was 7.8 or an average increase of 23% over the pretreatment. This difference was significant (P = 0.01).

Concurrent observations on the litter-covered areas of the cut trees showed no increases in blue grama in juniper litter during the time of the study.

Discussion and Summary

It was hypothesized in an earlier report (Jameson, 1966) that juniper crowns probably had a beneficial effect on growth of blue grama, and that tree litter was the predominant factor responsible for reduction of this species in juniper stands. The lack of response to shade was substantiated in the study reported here. Results reported by other works suggested that root activity probably had little effect. This study, however, indicated that, with no litter present, basal area increased 23% the first year following removal of root activity. With random sampling of a juniper-blue grama community, this effect probably could not be shown, but with careful control of the experimental variance this difference

¹ Received April 14, 1969; accepted for publication May 26, 1969.

² Forest Service, U.S. Department of Agriculture, with central headquarters maintained at Fort Collins in cooperation with Colorado State University; research reported here was conducted at Flagstaff in cooperation with Northern Arizona University. Jameson is now Assoc. Professor of Range Science at Colorado State University.

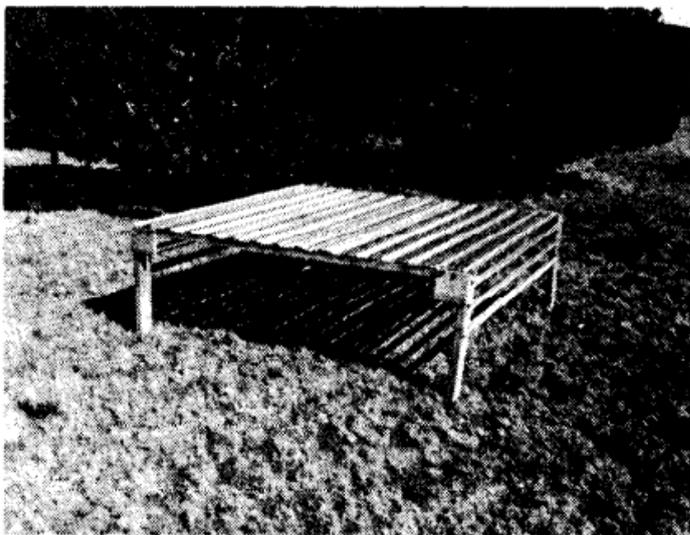


FIG. 1. Artificial canopy devised to duplicate shade and interception effects of juniper.

was found to be statistically significant.

These relationships are important

in managing pinyon-juniper ranges. Where the litter covers only a small part of the area, the blue grama response expected from juniper control should be about the same magnitude as the effect of root competition shown in this study. Where there is more litter, production of blue grama will be less, and although the increase may eventually be greater, it may be delayed until the litter at least partially decomposes.

Literature Cited

- BENEDICT, H. M. 1941. Growth of some range grasses in reduced light. *Bot. Gaz.* 102:582-589.
- JAMESON, DONALD A. 1966. Pinyon-juniper litter reduces growth of blue

grama. *J. Range Manage.* 19:214-217.

JOHNSON, THOMAS N., JR. 1962. One-seed juniper invasion of northern Arizona grasslands. *Ecol. Monogr.* 32:187-207.

O'ROURKE, JAMES T. 1967. Edaphic conditions influencing vegetative response following pinyon-juniper control in north-central Arizona. MS. Thesis, Univ. Arizona, Tucson.

SHIRLEY, HARDY L. 1945. Light as an ecological factor and its measurement, II. *Bot. Rev.* 11:497-532.

SKAU, CLARENCE McCLELLAN. 1960. Some hydrologic characteristics in the Utah juniper type of northern Arizona. Ph.D. Thesis, Mich. State Univ., East Lansing.