Reprinted from JOURNAL OF RANGE MANAGEMENT
Vol. 7, No. 5, September, 1954
Printed in U.S.A.

A Study of Competition Between Whitesage and Halogeton in Nevada

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This study was initiated in June of 1952 by the Nevada Agricultural Experiment Station in cooperation with the Bureau of Land Management. The purpose of the study was to determine why halogeton (*Halogeton glomeratus*) is invading areas of whitesage (*Eurotia lanata*) winter ranges, and to suggest management practices which will halt this invasion and suppress the halogeton present.

Halogeton was first collected in the United States near Wells, Nevada in 1934. Since this time, the spread of this introduced poisonous range weed has been extremely rapid. Large areas of both spring-fall and winter ranges are now infested.

Three areas were chosen for this study: Clover and Independence valleys located near Wells, Nevada and Flanigan, north of Pyramid Lake in western Nevada. These three areas were chosen on the basis of differences in vegetation, in density of whitesage and halogeton, in soils and in past use. These areas are typical of arid valleys of the Northern Intermountain region. They are characterized by cold winters during which two-thirds of the precipitation falls, mostly in the form of snow. Summers are hot and dry. Effective showers seldom occur during July and August. The humidity is low and daily temperatures vary greatly. Some of the soils in the whitesage alternes have a hardpan, other similar soils lack a hardpan. The depth of this hardpan varies between 9 and 20 inches.

The whitesage in the study areas of Clover and Independence valleys occurs in pure types which ordinarily are bordered by the big sagebrush (*Artemisia tridentata*) type on the higher portions of the valley and by the shadscale (*Atriplex confertifolia*) type on the lower portions. In the Flanigan area, whitesage occurs in a mixed type with shadscale and bud sage (*Artemisia spinescens*).

Cattle and sheep expansion started in Clover and Independence valleys in 1870 and 1881, respectively. Grazing in both summer and winter was common, according to information obtained from Robert Steele, a Clover Valley rancher. Grazing is now almost entirely by sheep with a few cattle summer long.

With the completion of the Western Pacific Railroad in 1910, homesteaders moved into the Clover Valley area and attempted to dry farm. When their crops dried out, they moved on, leaving large denuded areas behind them. The sagebrush land which was cleared has reverted again to this type. Lands cleared of whitesage and shadscale are now covered with dense stands of halogeton.

Experimental Work

To determine why halogeton is invading whitesage areas, a series of six closely related experiments was conducted.

Expt. 1.—*Competitive growth of whitesage and halogeton seedlings.* Seeds of both species were planted in containers and after establishment, water was added only when the permanent wilting point of the soil was reached. Height measurements were taken on both species at weekly intervals throughout the summer, as were soil temperature and soil moisture readings. From the date of emergence, May 5, until the first week in July, the top growth of whitesage was 4 to 6 times as much as that of halogeton. From July until mid-August, the halogeton grew rapidly and by the end of the season had twice as much top growth as whitesage. On emergence and at intervals of 1, 3, 6, and 12 weeks after emergence, measurements of total root length were made on both species. Whitesage had a much larger root system than did halogeton until the first week in July, but from this time until the middle of August the roots of halogeton grew more rapidly and by the end of the season halogeton had 5 times the total root length of whitesage. Whitesage seedlings and older plants made their most rapid development at soil temperatures between 40 and 60°F. while halogeton made its most rapid developments at soil temperatures between 60 and 80°F.

This inability to grow either a large shoot or root system early in the season is an important factor in explaining the lack of establishment of halogeton on areas where a vigorous stand of competing vegetation is present.

Expt. 2. *Root distribution in whitesage and halogeton.* Root distribution of mature whitesage and halogeton was determined on three sites: a non-invaded whitesage alterne, a moderately invaded whitesage alterne and an area of pure halogeton. These studies showed whitesage to have a generalized fibrous type of root system as described by Shantz and Piemeisel (1940). Halogeton plants in good vigor had a generalized type of root system which penetrated to a depth of 20 inches and had a radial spread of 18 inches. Plants in low vigor had a taproot system which penetrated to a depth of 9 inches and had a radial spread of 3 inches. Whitesage plants in low vigor had a radial root spread

of 26 inches. Those plants in moderate vigor had a radial root spread of 36 inches and those plants in good vigor had a radial root spread of 40 inches. Where a hardpan layer was present, the depth of root penetration was limited to the depth of this layer, while in areas where no hardpan was present, roots were traced to 57 inches. In such areas, the whitesage was much more vigorous and had a higher density than in hardpan areas and there was no halogeton present.

Expt. 3.—*Relationship between vigor of whitesage and the density and yield of halogeton.* To cause a change in the vigor of whitesage, a series of clipping studies was conducted for a period of 2 years. The intention was to decrease the vigor of whitesage and to observe the effects on the halogeton present. One set of plots was clipped at light (20%), moderate (50%) and heavy (80%) intensity during the summer. Another set of plots was clipped at light (35%), moderate (65%) and heavy (95%) intensity during the winter. Fifty percent is considered proper use during the summer, while 65 percent is considered proper use during the winter (Agr. Adjustment Admin., 1941).

Subsequent yields of whitesage from the summer-treated plots showed the largest increase from plots clipped at 50% intensity, while the greatest yields from the winter clip plots came from those utilized at 35%. In addition summer clipping at all intensities prevented seed production, while winter clipping at all intensities allowed some viable seed to be produced.

Results from summer and winter clipping also showed that there was no trend in respect to differences in density and yield of halogeton due to treatment following the clipping of the whitesage.

Expt. 4.—*Relationship between density of whitesage and of halogeton.* Treatments consisted of thinning each set of plots to one-fourth or one-half their original number of whitesage plants. In addition, a series of permanent transects was established in Clover and Independence valleys. Using the 3-step method (Parker, 1951), foliage densities were sampled in 1953 in both invaded and non-invaded whitesage stands and in areas of pure halogeton. Thinning plots gave inconclusive results because a poor stand of halogeton was produced in 1953 and because a large number of whitesage plants died, apparently from insect damage, in the Clover Valley study area during the winter of 1952–53. Results from the transect data showed that there was no halogeton present in stands which had a density of 22 per cent or greater of whitesage or of whitesage plus other perennial vegetation. At densities below 22 percent, halogeton was present in varying amounts, depending upon seed production the previous year and climatic conditions the present year.

Expt. 5.—*Effect of an increase in vigor of whitesage on halogeton.* Three treatments were used: (1) .9 of an inch of artificial precipitation applied during the summer. (2) 1 pound of krilium per 100 square feet plus water at the above rate and (3) 100 pounds of $(NH_4)_2SO_4$ per acre plus water and krilium at the above rates. Results showed that the treatments were much more effective in stimulating the vigor of halogeton than whitesage. This was due to 2 factors: (1) the depth of water penetration was not deep enough to benefit the deep-rooted whitesage plants but was sufficient to benefit the shallower rooted halogeton plants and (2) halogeton was growing more rapidly because of more favorable temperature conditions at the time of application and was better able to take advantage of the additional moisture and fertilizer. Limited observations have shown the vigor of whitesage can be increased if large amounts of moisture are available.

Expt. 6.—*Relationship of available soil moisture to growth and reproduction of whitesage and halogeton.* Fiberglas soil moisture units (Calif. For. & Range Expt. Sta., 1950) were buried at the various study areas at depths of 4, 10 and 20 inches. In most areas there was no available soil moisture after June 25 at 4 and 10 inches. Available moisture at 20 inches was depleted by July 16 in all areas except in Independence Valley where moisture was available all summer at 20 inches and below. No hardpan

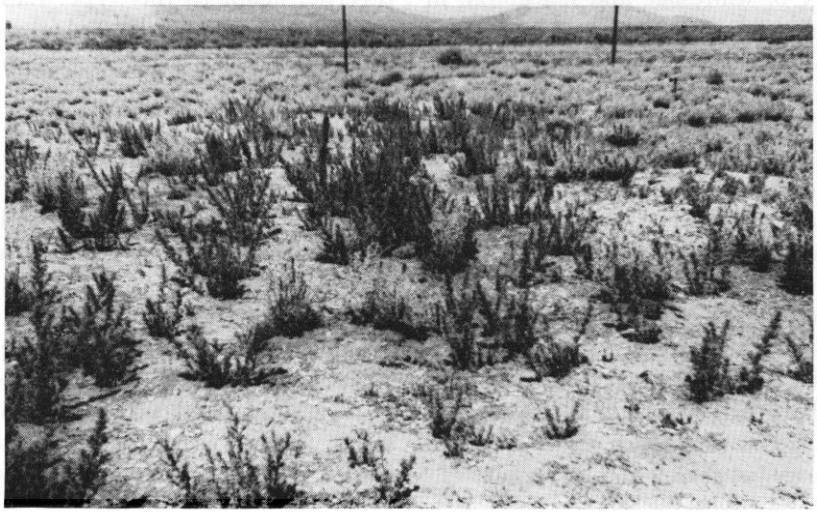

FIGURE 1. Whitesage alterne in Clover Valley showing the vigorous stand of halogeton which develops on vacated ant hills.

occurred here in contrast to the other study areas. Under these drought conditions, whitesage and halogeton grew well and produced seed only in and around disturbed areas (Fig. 1). The halogeton in the whitesage alterne was stunted and produced only a limited seed crop. Halogeton growing in a pure stand produced an abundant seed crop in spite of the lack of available moisture, during the period of blooming and seed development.

Discussion

The results obtained during the first two years of this study show that the invasion of whitesage by halogeton is associated with a low density of whitesage. The absence of whitesage plants under 15 years of age in Clover Valley indicates that recent reproduction has been inadequate to replace the older plants which have died. The plant cover in Independence Valley is made up of whitesage plants in all age groups including very young ones. With this satisfactory reproduction, the stand is being maintained at suitable density and there is no halogeton present. This poor reproduction in Clover Valley during 1953 seems to be due to at least three factors. These are: (1) overgrazing by livestock and improper season of use as shown by clipping studies, (2) deficient moisture as shown by soil moisture studies and observations on disturbed areas and (3) utilization of whitesage by rabbits.

Overgrazing of whitesage by either stock or rabbits during the winter or spring results in low vigor as reflected by scanty regrowth. This type of regrowth is characterized by having less transpiring leaf surface than plants in moderate or good vigor. Less soil moisture is absorbed and less competition is exerted against halogeton. Late spring and summer grazing appears to be the primary factor originally responsible for opening up whitesage stands for invasion by halogeton by reducing vigor and reproduction and thereby causing a decrease in the density of the stand.

Competition for moisture appeared to be the factor which was responsible for the lack of reproduction in 1953 since adequate control of grazing existed. However, drought together with any degree of utilization, especially overuse, can reduce seed production more than can drought alone. Competition for moisture is greatly increased by the presence of a hardpan layer which restricts all roots to the upper 20 inches of soil.

Suggested management practices for halting this invasion and suppressing the halogeton present are: (1) reduced grazing pressure and (2) rabbit control.

Reduced grazing pressure involves balancing the available forage with livestock numbers, shortening the period of use, especially toward the end of the winter grazing season, and discontinuing summer use. In general livestock numbers should be reduced in order to allow whitesage to regain its vigor. The season of use should be shortened toward the end of the season in order that whitesage can make good regrowth and produce some seed before moisture becomes limited. Although summer grazing of whitesage is limited, it should be discontinued because of its adverse effect on seed production.

A general rabbit control program would be beneficial to the whitesage since herbage removal would be reduced with a resulting increase in competitive ability and reproduction. Such a program would also be of benefit in reducing the amount of halogeton seed being spread by this mammal.

During this study, three problems were revealed which are deserving of further research. These are: (1) use of whitesage for revegetating denuded areas and for artificial seeding in the shadscale and sagebrush types, (2) identification, life history and control of a buprestid beeetle which appears to be attacking and killing whitesage plants in large areas, and (3) possibility of water spreading as a means of increasing the moisture available to whitesage.

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