

Rainfall Interception by Cool-desert Shrubs

NEIL E. WEST AND GERALD F. GIFFORD

Highlight: *Interception patterns of big sagebrush (Artemisia tridentata Nutt.) and shadscale (Atriplex confertifolia (Torr.) Wats.) were measured under two simulated rainfall intensities during three different seasons. Mean rainfall interception rate of individual plants of both species was 0.15 cm when averaged over all sampling dates and rainfall intensities. Interception during individual storms of at least 0.15 cm size by entire plant communities, based on measured vegetal cover, was calculated at 0.028 cm or less. On the average, about 4% of the total annual rainfall (not snowfall) would be intercepted by these plant communities.*

Interception of precipitation by plants of the cool deserts or shrub steppes of the Intermountain Region has been little studied. One obvious reason for this is simply that interception rates are assumed to be minor because many of the plant species are small in size and total vegetal cover is often less than 50%. Although Wallace and Romney (1972) indicate the possibility of desert plants channeling rainfall into the soil near the base of their stems, the only studies we could find that report actual interception rates of an American semiarid shrub species is that of Hull (1972) and Hull and Klomp (1974). They studied big sagebrush (*Artemisia tridentata* Nutt.) using small, 10-centimeter diameter gauges in dense (2.2 plants per m²) stands near Holbrook and Twin Falls, Idaho. A comparison between gauges on heavy brush and in brush-free areas showed that the heavy brush intercepted 31% of the rain which fell between April 1 and October 30 at Holbrook and 30% at Twin Falls. Snow interception averaged 37% on plots at Holbrook. Potential interception per rainfall event as determined by spraying 10 individual plants with water was 0.11 centimeters.

The objective of this study was to examine interception patterns of big sagebrush and shadscale (*Atriplex confertifolia* (Torr.) Wats.) under two simulated rainfall intensities during three different seasons for improved understanding of this phenomenon in hydrologic and mineral nutrient cycling processes.

Authors are associate professors of range ecology and rangeland hydrology, respectively, Dept. of Range Science, Utah State University, Logan, 84322. The technical assistance of Mr. Lee Camp is gratefully acknowledged. The loan of a rainfall simulator by R. O. Meeuwig, Intermountain Forest and Range Experiment Station, Reno, Nev., was much appreciated. Work on which this report is based was carried out as part of the US/IBP Desert Biome and was supported by National Science Foundation Grant GB-15886.

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Methods

The interception studies were carried out in Curlew Valley near Snowville, in northern Utah, at a study site previously described by Mitchell et al. (1966). A representative sample of mature big sagebrush and shadscale (*Atriplex confertifolia* (Torr.) Wats.) plants was collected during spring (late April), summer (late July), and fall (early October) of 1973 and subjected to simulated rainfall at two intensities, 1 cm/hour and 5 cm/hour using a device designed by Meeuwig (1971). The shadscale plants varied in height from 13 to 35 cm and the big sagebrush plants varied in height from 18 to 44 cm. All plants were cut off at their stem bases, placed in a holding device on a direct reading balance, and weight gains under simulated rainfall recorded at the end of 30, 60, 120, 300, 600, and 900-second intervals. For replications 30 plants were used in the spring, 20 in the summer, and 10 during the fall run. Data on total interception for each brush species, as indicated by total weight gained after 900 seconds, in each season were subjected to analysis of variance.

Canopy coverage of the treated shrubs was determined by taking the east-west and north-south diameters through the center of the fullest part of the crown and calculating the area of a paraboloid.

The average canopy coverage of the community as a whole was determined by placement of a 200-m line intercept tape at crown level through the community in the vicinity where the treated plants were taken. From these data interception per unit area could be calculated.

Results

Mean rainfall interception rates of individual plants used in this study amounted to 0.15 cm for both shadscale and big sagebrush, when averaged over all sampling dates and rainfall intensities. Given a storm of sufficient size to wet each individual plant, actual interception of entire plant communities on this site would amount to approximately 0.025 cm and 0.028 cm, respectively, for shadscale and big sagebrush based on measured vegetal cover of 16.8% for shadscale and 19.1% for big sagebrush.

The analysis of variance indicated a significant species by date by rainfall intensity interaction. Since the species by date interaction was also significant, the implication was that the species by date interaction differs with the level of rainfall intensity. Examination of this two-way interaction indicated

the problem was tied to species interception differences during the fall sampling date. Looking then to the species by rainfall intensity interaction for the fall sampling date revealed that there were no significant differences in interception between species at the 1 cm/hour rainfall intensity (0.13 cm vs 0.14 cm); but at the 5 cm/hour intensity the interception for shadscale was 0.13 cm and the interception for big sagebrush was 0.22 cm, the difference being highly significant. This difference is explained by the greater non-growing season retention of leaves by the more evergreen big sagebrush (West and Gunn, 1974).

Interception rates of the two plant species showed no significant differences when averaged over both rainfall intensities for the spring and summer sampling dates.

The average length of time until start of leaf drip and/or stemflow for shadscale and big sagebrush plants was 3.8 minutes under the 5 cm/hour rainfall intensity. Hull and Klomp (1974) mention that they observed leaf drip from big sagebrush in Idaho during heavy storms but stemflow was never observed. A storm of enough intensity (5 cm/hour) to bring leaf drip or stemflow can be expected to recur only about once each 25 years at Snowville, Utah (Richardson, 1971).

We would expect intercepted precipitation to be held above the soil surface in proportion to vegetal cover and be available for evaporative losses of an increased rate over that on soil surfaces. In this respect, about 21 rain storms greater than 0.15 cm are expected between the period April 1 and

November 31 of each year at Snowville, based on analysis of U.S. Weather Service records for 1950-1970. Ignoring those storms of less than 0.15 cm, an average of about 0.59 cm of rain is intercepted yearly by the sagebrush and shadscale plant communities. This amounts to about 4% of the total annual precipitation which falls as rain. These results will be utilized in modelling of water and mineral nutrient cycles in these ecosystems.

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