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Canopy Cover and Phytomass Comparisons of Steep Slopes Planted to Cheatgrass[1]

Abstract

Steep north- and south-facing slopes on an artificially formed earth mound were seeded with cheatgrass in the autumn of 1971 and left unattended. In 1978, canopy cover and phytomass measurements were made on both slopes. The vegetative cover on the north-facing slope provided more canopy cover and more live phytomass than the south-facing slope. Live aboveground phytomass was measured at 830 g/m^2 on the north-facing slope and 163 g/m^2 on the south-facing slope.

The large amount of primary production on the north-facing slope is attributed to temperature-water relationships rather than to soil nutrient differences because the mound was composed of the same homogeneous mix of soil of common origin.

Introduction

Plants that comprise native steppe communities provide a more or less continuous ground cover, but the amount of cover and its species composition vary greatly from place to place according to the rooting substrate and to variations in microclimate as influenced by major and minor topographic features of the land.

Sauer and Rickard (1979) examined species composition and canopy cover on natural north- and south-facing slopes. They found that steep north-facing slopes supported more species and more canopy cover than contrasting south-facing slopes, but the rooting substrates on the contrasting slopes were also markedly different, with the north-facing slopes having a rooting substrate more favorable to plant growth. In field investigations it is usually not possible to separate substrate variables and those variables caused by slope exposure in terms of plant growth.

Hinds (1975) examined energy and soil water relationships and was able to control the rooting substrate by raising plants in small weighing lysimeters filled with the same kind of soil and then exposing the lysimeters to the contrasting microclimates of north- and south-facing slopes. In this way, differences in plant productivity and phenology could be attributed to microclimatic rather than soil variables.

Methods and Materials

An artificial earth mound 100 m long and about 2 m in height was constructed by scraping the surface soil of the surrounding ground into shape with a bulldozer. The long axis of the mound extended in an east-west direction forming steep (40°) north- and south-facing slopes. The slopes were seeded with cheatgrass by hand sowing in early autumn and left unattended (Hinds, 1974).

Canopy cover by species was determined twice during the growing season of

[1]Prepared for the U.S. Department of Energy under Contract No. EY-76-C-06-1830.

1978 on 10 March and again on 17 April. One line, 25 m long, was located at mid-slope and parallel to the long axis of the mound on the north slope; another line was placed along the south slope. Canopy-cover was estimated visually on 50 plots placed systematically at ½ m intervals along each line (Daubenmire, 1959). The same lines were used in March and April.

Aboveground plant parts were harvested by hand picking all live plants within circular plots placed along but not on the line used for canopy cover estimates. Small plots 0.032 m^2 were used during the winter and early spring harvests, but 0.5 m^2 plots were used when plants were mature at the end of the growing season. Only five plots were harvested on each slope early in the growing season, but ten plots were harvested at the end of the growing season. Live plant material was separated from any dead plant material by hand sorting. The live material was air dried in the laboratory and weighed. Results are presented as grams dry weight per square meter. Dead plant material (litter) was hand picked from each plot harvested for aboveground phytomass, air dried, and weighed in the same way employed for live phytomass.

Results and Discussion

Only a few taxa grew on the earth mound. All were self-established following the initial seeding of cheatgrass. Cheatgrass, *Bromus tectorum*, and tumble mustard, *Sisymbrium altissimum*, were the most abundant species. Other taxa were Russian thistle, *Salsola kali*, spring draba, *Draba verna*, tansy mustard, *Descurainia pinnata*, willow herb, *Epilobium paniculatum*, bluebunch wheatgrass, *Agropyron spicatum*, Sandberg bluegrass, *Poa sandbergii*, Cusick bluegrass, *Poa cusickii*, hawks' beard, *Crepis atrabarba*, yellow salsify, *Tragopogon dubius*, fleabane, *Erigeron filifolius*, and big sagebrush, *Artemisia tridentata*. Plants provided more canopy cover on the north-facing slope than the south-facing slope (Table 1).

Phytomass harvests show the north-facing slope to be more productive from the initiation of growth in the fall to senescence in late spring (Fig. 1). The growing season was also longer on the north-facing slope. The poor showing of early fall plant growth in the south-facing slope is probably due to more intense solar radiation which results in evaporative loss of soil water.

The accumulation of dead plants (litter) was not clearly favored on one slope or the other (Table 2). The variation among samples taken from either slope was large, as indicated by the size of the standard error associated with the mean. Variation was probably induced by the heterogeneity of the litter mat on the slope due to a tendency of litter to accumulate in microdepressions. However, it is also possible that litter decomposition is faster on the north-facing slope due to a more favorable moisture regime.

Plant growth was initiated for the 1978 season with the onset of rains in the autumn of 1977. Growth was arrested during the cold winter months and resumed with the onset of warming temperatures and increasing day length in spring (Fig. 1). Plants matured on the south-facing slope in mid-April, but maturation and senescence on the north-facing slope was delayed until mid-May. At the termination of the growing season, the north-facing slope had produced 830 g of dry matter per m^2 compared to only 163 g/m^2 on the south-facing slope. Cheatgrass was the major contributor to productivity on the north-facing slope, but tumble mustard was almost

TABLE 1. Summary of canopy cover (percent) on steep slopes of an artificial earth mound in the spring of 1978.

	North-facing slope		South-facing slope	
	Mar 10	Apr 17	Mar 12	Apr 17
Annual Grasses				
Cheatgrass[a]	63	84	24	30
Annual Forbs				
Tumble mustard[a]	12	26	22	65
Tansy mustard	1	1	1	1
Willow herb	0	1	0	0
Spring draba[a]	0	1	0	0
Russian thistle[a]*	0	0	0	1
Perennial Grasses				
Bluebunch wheatgrass	1	1	0	0
Sandberg bluegrass	0	1	0	0
Cusick bluegrass	0	1	0	0
Perennial Forbs				
Hawks' beard	0	1	0	0
Fleabane	0	0	0	1
Yellow salsify[a]	0	1	0	0
Shrubs				
Big Sagebrush*	0	0	0	1
Total Canopy Cover %	77	118	47	99
Total Taxa	4	10	3	6

* = seedlings
[a] = naturalized immigrant

TABLE 2. Dead phytomass on north and south slopes of an artificial earth mound.

Date	North g/m² ± SE	South g/m² ± SE
Dec 15	449 ± 80	308 ± 52
Feb 10	443 ± 84	357 ± 50
Feb 22	244 ± 77	335 ± 84
Mar 24	243 ± 45	114 ± 43
Apr 18	216 ± 50	182 ± 82
May 17	124 ± 52	

as important as cheatgrass on the south-facing slope.

More taxa were present on the north-facing slope than on the south-facing slope. Some of these—bluebunch wheatgrass, Sandberg bluegrass, and Cusick's bluegrass—are constituents of climax plant communities. This finding suggests that the cooler-wetter microclimate of the north-facing slope is more suited to the self-establishment and growth of these species. Similar findings have been reported from the steep slopes of earth fills elsewhere in Washington (Dillon, 1967).

Cheatgrass swards are able to exclude other plant species to a high degree (Daubenmire, 1975). One of the few plants that appears to be at all competitive with cheatgrass is tumble mustard. It is especially competitive on the south-facing slope.

Artificial earth mounds provide a way to change experimentally the microclimate experienced by plants while keeping the physical-chemical features of the rooting substrate closely similar. The slopes are large enough to allow the investigation of species interrelationships, a feature not available in greenhouse or controlled growth chamber experiments.

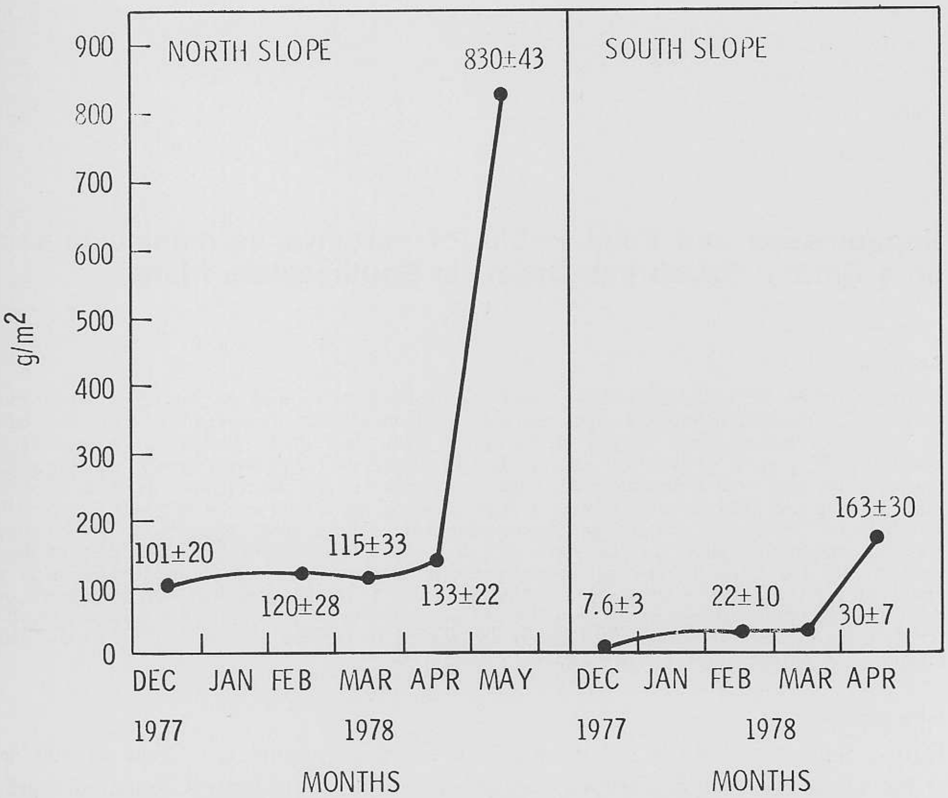

Figure 1. Seasonal changes in live phytomass on north- and south-facing slopes during the 1977-1978 growing season. Average values ± standard error.

Since its introduction to North America from Europe, cheatgrass has invaded and persisted on thousands of acres of dry rangelands. It apparently has little competition from the native plants on disturbed ground. Although cheatgrass is held in low esteem by livestock raisers, it can provide a self-sustaining ground cover that inhibits soil erosion. In arid lands where land is not intended for livestock grazing, such as shallow land burial sites for chemical wastes, cheatgrass would seem to offer a quick and effective way to establish a self-sustaining plant cover capable of resisting soil erosion.

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Received July 15, 1979
Accepted for publication November 16, 1979