The Effect of Site on the Palatability and Nutritive Content of Seeded Wheatgrasses

C. WAYNE COOK[1]

Research Professor, Department of Range Management, Utah State University, Logan, Utah

It is generally acknowledged that plants growing on favorable sites have a greater tolerance to grazing than plants growing on unfavorable sites. This is a result of better growing conditions. Therefore, even moderate or light utilization may cause a decline in plant vigor on sites where moisture and nutrients are limited (Cook *et al.*, 1958). For this reason, poor sites frequently are expected to display poorer range condition than good sites under the same system of management.

A few studies indicate that palatability is influenced by the chemical content of the plant tissues, and since site influences chemical composition of plant tissue, it likewise influences palatability of plants (Albrecht, 1935, 1945; Plice, 1952; Edwards and Goff, 1935; Orr, 1929; and Watkins, 1940).

It was found by Albrecht (1935, 1945) that increased protein and phosphorus, as a result of fertilization, increased palatability. Studies by Plice (1952) found that increased carbohydrate content increased the preference shown for various plants.

It has been shown by many studies that soils which have developed under various site conditions affect the chemical composition of plants (Edwards and Goff, 1935; Orr, 1929; and Watkins, 1940).

It was found by Stoddart (1941) that favorable and less favorable sites within the same vegetation type on summer ranges in Utah significantly influenced the chemical content of plants. In another study on summer ranges of Utah, by Cook and Harris (1950), it was found that forage plants growing on favorable and unfavorable sites within aspen and within sagebrush types differed in chemical content in the various plant parts and in stem-leaf ratios.

Results and Discussion

During the years 1949 to 1957, an extensive area of sagebrush and juniper in central Utah (figure 1) was converted to introduced wheatgrass pastures. The soils on the juniper sites were light, chalky-gray in color, with a shallow "A" horizon of only a few inches depth. In many cases, a calcium carbonate horizon beneath was exposed. The soil was a clay loam. Many rocks, varying from 6 to 12 inches in diameter were exposed on the surface. The adjacent sagebrush soils were a brown, sandy loam of loessial origin and were comparatively deep, with a calcium carbonate hardpan at about two-foot depth.

Effect of site on palatability

At the start of the investigation, all study areas supported a good stand of a seeded grass mixture, namely, crested, intermediate, and tall wheatgrass. In managing these seeded wheatgrass ranges for spring grazing, it was noted that utilization was always severe on the less productive knobs where juniper had previously dominated, compared to moderate utilization on adjacent favorable sites where sagebrush was formerly dominant.

After only three years of grazing, more than 70 percent of the plants had been killed on the poor sites and less than 13 percent on the favorable sites.

All three wheatgrasses were reduced about the same percentage on unfavorable sites, but tall wheatgrass suffered the greatest loss and crested wheatgrass suffered the least on favorable sites.

During one of the three years, the area received only about one-third of the long-time average of annual precipitation.

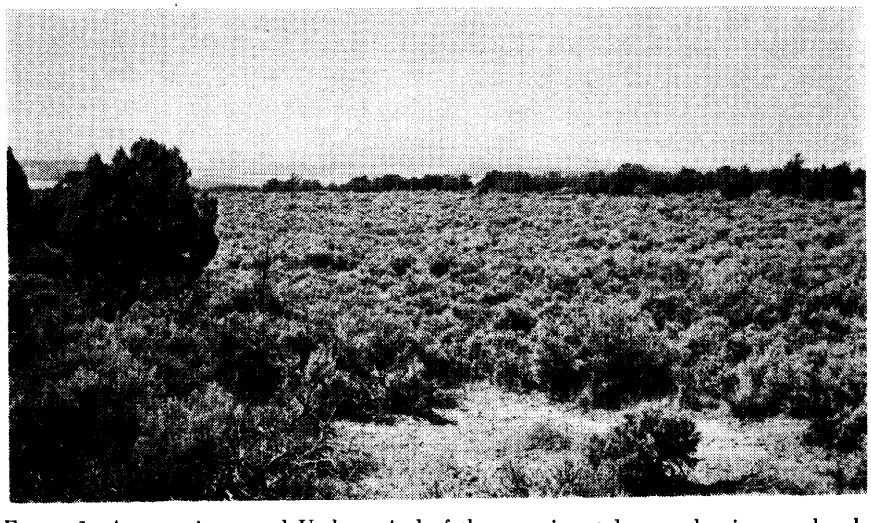

FIGURE 1. An area in central Utah, typical of the experimental area, showing sagebrush in the lower drainage areas and juniper on the adjacent ridges.

[1] *The author is indebted to the Bureau of Land Management for their aid in preparing and seeding the areas, and to David Williamson for chemical analysis of the plant material.*

Table 1. Average stem-leaf ratio, stem and leaf measurements, and degree of utilization at the end of the spring grazing season for three introduced wheatgrasses on favorable and unfavorable sites adjacent to each other.

Site and species	Stem/leaf ratio	Seed culms per plant	Height of seed culm (inches)	Length of leaf (inches)	Width of leaf (mm)	Percent utilization
Favorable						
Crested wheatgrass	2.46	71.1	24.1	5.1	4.4	35
Intermediate wheatgrass	1.15	32.6	26.6	6.4	5.9	63
Tall wheatgrass	1.12	29.3	33.3	11.4	5.1	31
Average	1.58	44.3	28.0	7.6	5.1	43
Unfavorable						
Crested wheatgrass	1.67	60.7	19.8	4.6	3.1	80
Intermediate wheatgrass	0.71	15.9	23.7	6.3	4.3	96
Tall wheatgrass	0.45	12.8	28.2	8.6	4.0	66
Average	0.94	29.8	23.9	6.5	3.8	81

Percent utilization was significantly greater on all unfavorable sites for all species (Table 1). This was believed to be a result of the physical character of the plant, since plants on unfavorable sites were more leafy, and both leaves and stems were smaller and less coarse in structure than those on favorable sites (Figure 2). The plants from the more favorable sites had about 50 percent more stems than leaves by weight, and plants on the poor sites had about equal portions of leaves and stems (Table 1).

Effect of site on chemical content

At the time of the study, crested wheatgrass was in the preanthesis stage of development; intermediate wheatgrass was in the early head stage; and tall wheatgrass was in the boot stage. There was no discernible difference in the stage of plant growth between the two sites.

There were some significant differences in chemical content of plants growing upon the two sites. Protein and ash content of the entire plant were significantly higher on the unfavorable sites than on favorable sites. This was largely a result of the differences in stem-leaf ratio. Both the leaves and stems of crested and intermediate wheatgrass were higher in lignin on the favorable sites, compared to the unfavorable sites. This would be expected, since both leaves and stems were somewhat larger structurally and gave the general appearance of being coarser than those on the poorer sites. These differences in lignin content were not present for tall wheatgrass, even though the physical stature of the plant appeared somewhat coarser on the favorable site. However, tall wheatgrass was not as mature as the other wheatgrasses and, no doubt, would have displayed these same differences with advanced stages of maturity.

Cellulose in the entire plant was significantly higher on favorable sites than on unfavorable sites. Other carbohydrates and gross energy values were about the same on both sites. Since protein was higher on unfavorable sites, and cellulose was higher on the favorable sites, they had compensatory effects upon the gross energy values.

Conclusions

There are two apparent reasons why poorer range sites may show range deterioration before the more favorable sites. First, the utilization is markedly greater on the poorer sites; second, plants on poorer sites cannot withstand the degree of herbage removal or trampling that can be withstood on favorable sites because of poorer growing conditions. In the experimental pastures where these studies were conducted, it was concluded that these poor sites would have to be sacrificed if the favorable sites were to be utilized even at a conservative degree of 35 percent of the current production. If, however, the unfavorable sites are to be maintained in good condition, the capacity of the pasture must be based largely upon the amount of usable forage on these sites.

In some pastures, these unfavorable sites made up as much as

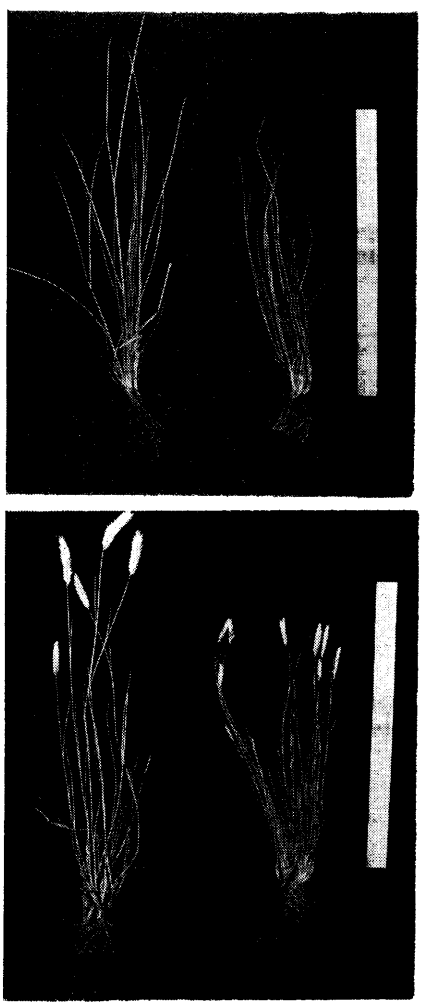

FIGURE 2. Tall wheatgrass *(top)* and crested wheatgrass *(bottom)*. Plants on the left in each photo are from favorable sites, and are much taller and coarser than plants on the right, which are from unfavorable sites.

30 percent of the area and, in others, less than 5 percent. Regardless of size or proportion of the area composed of unfavorable sites, the same relative use between sites prevailed. For most effective use of larger favorable sites, this sacrifice might involve almost a complete loss of palatable species on the unfavorable sites.

It is, therefore, concluded that where favorable and unfavorable sites exist side by side on the range, either the condition of the range on the unfavorable site must be sacrificed, or the forage on the favorable sites underutilized. These factors, perhaps, explain why so many juniper areas are denuded and a fair stand of forage still persists on adjacent gentle slopes and valley bottoms.

Summary

During the spring grazing season from 1949 to 1957, an investigation was conducted in central Utah on seeded foothill range to determine the effect of site on palatability and chemical content of forage.

After only three years of grazing, more than 70 percent of the plants had been killed on poor sites, and less than 13 percent on favorable sites.

All wheatgrasses suffered about the same loss on unfavorable sites, but tall wheatgrass suffered the greatest loss and crested wheatgrass the least on favorable sites.

Palatability of all species was significantly greater on all unfavorable sites, compared to favorable sites.

Plants on favorable sites had about 50 percent more stems than leaves by weight, and plants on poorer sites had about equal portions of leaves and stems.

Both protein and ash were significantly higher in the entire plant on unfavorable sites, and cellulose was significantly higher on favorable sites. Both leaves and stems of crested and intermediate wheatgrasses were higher in lignin on favorable sites compared to unfavorable sites.

It was concluded that unfavorable sites deteriorate more rapidly than favorable sites when grazed together because: (1) the plants are more preferred and, consequently, are utilized more intensively on the unfavorable sites, and (2) these plants are not as tolerant to heavy use as plants on favorable sites because of the generally poorer growing conditions.

LITERATURE CITED

ALBRECHT, W. A. 1935. Discrimination in food selection by animals. Sci. Month. 60:347-352.

———. 1945. The story of four

Table 2. Average chemical content of three introduced wheatgrasses collected from favorable and unfavorable sites at the end of the spring grazing season, June 15.

Site and species	Portion of plant	Ether extract	Protein	Ash	Lignin	Cellulose	Other carbohydrates	Phosphorus	Gross energy
				(percent)					(Cal/kg.)
Favorable									
Crested wheatgrass	Leaves	5.4	12.2	13.6	5.8	25.0	38.0	.16	4436
	Stems	2.4	8.1	6.4	8.4	32.8	41.9	.16	4351
	Whole plant	3.3	9.3	8.5	7.7	30.5	40.7	.16	4374
Intermediate wheatgrass	Leaves	5.8	10.7	12.5	5.1	27.9	38.0	.16	4499
	Stems	1.2	8.0	7.6	6.2	34.4	42.6	.17	4354
	Whole plant	3.3	9.3	9.9	5.7	31.4	40.4	.16	4420
Tall wheatgrass	Leaves	2.8	13.4	14.4	6.6	29.3	33.5	.14	4266
	Stems	1.2	8.4	8.2	6.8	33.2	42.2	.16	4205
	Whole plant	2.0	10.7	11.1	6.3	31.3	38.6	.15	4227
Average	Leaves	4.7	12.1	13.5	5.8	27.4	36.5	.15	4415
	Stems	1.6	8.1	7.4	6.9	33.6	42.4	.16	4304
	Whole plant	2.8	9.6	9.7	6.5	31.2	40.2	.15	4340
Unfavorable									
Crested wheatgrass	Leaves	5.6	14.5	13.6	5.2	25.2	35.9	.15	4489
	Stems	2.3	10.9	6.6	7.8	32.4	40.0	.17	4410
	Whole plant	3.5	12.2	9.2	6.8	29.7	38.6	.16	4433
Intermediate wheatgrass	Leaves	3.0	12.2	13.0	5.2	27.4	39.2	.16	4410
	Stems	1.4	8.2	7.8	6.0	30.9	45.7	.16	4298
	Whole plant	2.3	10.5	10.8	5.5	28.8	42.1	.16	4357
Tall wheatgrass	Leaves	2.8	10.7	16.4	6.1	25.2	38.8	.14	4262
	Stems	1.4	7.4	8.0	5.8	33.4	44.0	.16	4253
	Whole plant	2.4	9.6	13.8	6.0	27.6	40.6	.14	4255
Average	Leaves	3.8	12.5	14.3	5.5	25.9	38.0	.15	4387
	Stems	1.5	8.9	7.5	6.5	32.2	43.4	.16	4320
	Whole plant	2.6	10.8	11.0	6.0	28.7	40.8	.15	4351

haystacks. The Land 4:228-232.

COOK, C. WAYNE AND LORIN E. HARRIS. 1950. The nutritive value of range forage as affected by vegetation type, site, and stage of maturity. Utah Agr. Exp. Sta. Bul. 344. 45 pp.

————, L. A. STODDART AND FLOYD E. KINSINGER. 1958. Responses of crested wheatgrass to various clipping treatments. Ecol. Mono. 28: 237-272.

EDWARDS, D. W. AND R. A. GOFF. 1935. Factors affecting the chemical composition of pasture grasses. Hawaii Agr. Exp. Sta. Bul. 76.

FRAPS, G. S. AND J. F. FUDGE. 1940. The chemical composition of forage grasses of the east Texas timber country. Texas Agr. Exp. Sta. Bul. 582. 35 pp.

ORR, J. B. 1929. Minerals in pastures and their relation to animal nutrition. H. K. Lewis & Co., Ltd., London.

PLICE, MAX J. 1952. Sugar versus the intuitive choice of foods by livestock. Jour. Range Mangt. 5:69-75.

STODDART, L. A. 1941. Chemical composition of *Symphoricarpos rotundifolius* as influenced by soil, site, and date of collection. Jour. Agr. Res. 63:727-739.

WATKINS, J. M. 1940. The growth habits and chemical composition of bromegrass (*Bromus inermis* Leyss), as affected by different environmental conditions. Jour. Am. Soc. Agron. 32:527-538.