USE OF HERBICIDES IN COMPETITION STUDIES OF RANGE VEGETATION

The herbaceous vegetation on annual range frequently emerges in such extreme density that many of the plants fail to achieve normal size and vigor. It would be of considerable interest to know the effect of reduced plant numbers on the growth of these species in an otherwise undisturbed environment.

Reduction of plant density by hand thinning is not feasible on sizeable areas and mechanical thinning disturbs the site. If plants are established in a prepared seedbed by seeding at various rates to regulate the competition, or by transplanting at prescribed spacings, an unnatural condition for range species results. The application of herbicide to range vegetation permits a reduction in plant numbers by removing a component of the existing flora. When this is done in the seedling stage, surviving species are permitted to develop with little disturbance on the native site.

Such herbicide treatment was studied on annual grassland in which an abundant cover of broad-leaved herbs grew with the grasses. The most prevalent of these forbs commenced rapid spring growth earlier than the grasses, making it possible to spray during cool weather at a time when more leaf area of the forbs was exposed than of the grass.

It was found that a non-selective foliage contact spray could be applied at this stage of growth to kill most of the forbs, yet leave the grasses uninjured or at most with a moderate leaf tip-burn. A dinitro compound (Sinox General) was employed as the herbicide without oil or detergent at the rate of two quarts per acre in 100 gallons of water. The differential kill obtained would seem attributable to the lack of retention of the spray material by the grass.

The spray was applied between late January and early March to replicated plots 100 square feet in size. When the predominant grasses had reached full development in the late spring, square-foot samples of the forage were cut at random at one-quarter-inch above the soil. These samples were air-dried, separated into grass and non-grass components, and weighed. Botanical composition analyses were run on a portion of the samples.

Results and Discussion

In February 1956 the first spray treatments were applied to plots of resident vegetation at both the Hopland Field Station of the University of California and the San Joaquin Experimental Range of the U. S. Forest Service. Test areas had been selected for a uniform cover which contained relatively abundant broad-leaved herbs along with the grass. Spraying and harvesting dates for Hopland were February 2 and May 16 respectively, while at the San Joaquin Range the dates were February 6 and May 17.

In both areas the vegetation after spraying consisted predominantly of grasses (Table I). During the spring these grasses appeared more vigorous and taller than those in untreated plots, and more of the plants attained an increased size. The weight of grass in treated plots was greater by approximately 100 percent than in untreated plots.

A more extensive trial was conducted at the San Joaquin Experimental Range in 1957. Three dates of spraying were employed; namely, January 25, February 15, and March 7, and the number of replications was increased to eight. Samples were clipped on May 1 except for the March 7 treatment which was clipped June 1. A month of abnormally dry weather followed the March treatment, this delayed growth making the later harvest date desirable.

Table I. Effect of herbicide on total herbaceous vegetation and on relative amounts of grasses and forbs

Area	Rainfall 1955-56 season	Treatment	Total dry weight†	Grass dry weight fraction
	Inches		*Gms.*	%
Hopland.....	50.9	None	63.8	35.3
		Sprayed	52.0	86.0
San Joaquin.	26.5	None	23.3	38.4
		Sprayed	22.8	85.1

†Average of four replications, 3 square feet per sample.

The most prevalent grass in the plots was soft chess (*Bromus mollis* L.) and the most prevalent forb was broadleaf filaree (*Erodium botrys* Bertol.). Other grasses of frequent occurrence were foxtail fescue (*Festuca megalura* Nutt.), slender wild oat (*Avena barbata* Brot.), ripgut (*Bromus rigidus* Roth.), and red brome (*Bromus rubens* L.). Among the additional forbs were popcorn flower (*Plagiobothrys nothofulvus* Gray) and native clovers with numerous other species occasionally represented. A more detailed account of the vegetation of this area is given by Talbot and Biswell (1942).

The weight of plant material produced with the percent of that weight contributed by grasses and by forbs is shown in Figure 1. Whereas grasses comprised 25 percent of the weight of the herbaceous cover in the controls, they accounted for 90 percent following herbicidal treatment. The total production declined in the February and March treatments, but the January spray treatment equalled that of the control. This greater growth of the January treatment may reflect the earlier removal of competing broad-leaved herbs, and the subsequent longer period favorable for development. The later maturing grasses were stimulated more than were the earlier.

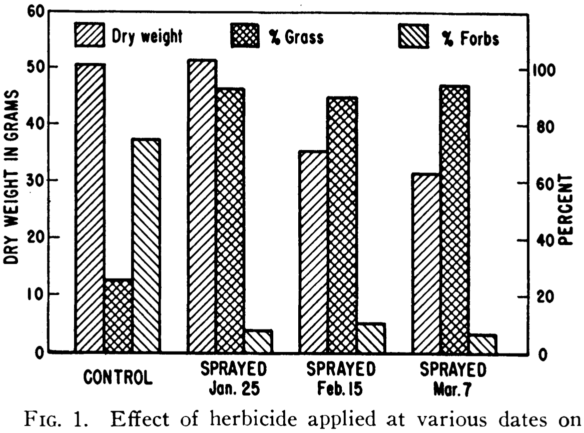

Fig. 1. Effect of herbicide applied at various dates on relative production of grasses and forbs.

As was observed the previous year, the grasses in sprayed plots were taller, and had more plants in the larger size classes. The increased weight of grass following a spray treatment appears attributable in part to the greater development of seedlings previously suppressed by competition with other species. Chippindale

(1932) has demonstrated that grass seedlings may persist for long periods under conditions rendered unfavorable for their growth by the competition of other plants, yet recover rapidly upon release from this competition.

The results of these trials suggest that herbicides may be useful in controlling the density of natural vegetation. Other formulations should be tried to determine their effectiveness in removing plants without exerting damage on the remaining vegetation. With increase in the number and selectivity of herbicides, it is conceivable that the competition afforded by a single species may one day be studied through herbicidal removal of that species from the herbaceous cover.

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SOME CHANGES IN THE SOIL ENVIRONMENT OF A GRAZED-PRAIRIE COMMUNITY IN CENTRAL MISSOURI

INTRODUCTION

In an earlier paper changes in species composition due to grazing of tallgrass prairie in Missouri were reported (Kucera, 1956). It was shown that severe deterioration of the native vegetation results from heavy use over a short period of time. The study area is a 160 acre tract of unbroken prairie located 17 miles east of Columbia, Missouri, in Callaway county, T48N, R10W, Sec. 12, SW 1/4. It is a relic example of physiographic subclimax prairie, extensive areas of which occurred formerly on the poorly-drained flat lands of east-central Missouri, and in other sections of the Prairie Peninsula. The soil, designated as Putnam silt loam, is of loessial origin and is characterized by strong profile development and slow permeability. The surface horizon is dark gray underlain by a lighter subsurface zone and a dense clay subsoil (Frieze, 1950). *Andropogon scoparious* and *A. Gerardi* are the principal components of plant cover. The floristic details of this tract are presented by Drew (1947). Beginning in 1941, the area was partitioned, a part of which was utilized as pasture, the remainder as hayland. This procedure continued for approximately the last 15 years, and thus has provided ample opportunity for evaluation of the grazing factor on native prairie vegetation. With such changes as have occurred in floristic composition according to the earlier study, the question arises whether or not moisture relationships and physical structure of the soil profile have been altered. Therefore, the present investigation attempts evaluation of any changes in moisture patterns and structural features viewed as concomitant results of the grazing factor.

PROCEDURES

Field and laboratory studies were conducted during the 1957 season. The grazed and ungrazed sections of the prairie tract were sampled monthly for soil moisture from April to October inclusive. Soil samples were taken from duplicate borings at 1, 6, 15, 20, 36, and 60 inches. A characteristic feature of the profile, particularly on the flat ground, is a dense claypan. Care was taken to reduce the relief variable as much as possible by selecting comparably flat terrain in both grazed and ungrazed sections of the prairie. Variations in root concentrations, clay content, and organic matter caused vertical differences in soil moisture within the profile. Samples were oven-dried at 110° C. for 24 hours in making moisture calculations.

Core samples were obtained for the purpose of determining volume weight, or apparent specific gravity, and total porosity. A LaMotte tube sampler was used. One-inch cores were taken successively at 1, 2, 3, 4, 5, and 6 inch depths, and two-inch cores at the 7-8, 9-10, 14-15, and 19-20 inch depths. Twenty-five cores were sampled from each level within each of the grazed and ungrazed sections. The volume weight is represented by the oven-dried weight of undisturbed soil mass per unit core volume. Since weighings were expressed in grams, volume dimensions of the core were calculated in the metric system. Thus, volume weight (V. W.) = g./c.c. on a unit basis, and is a measure of structural conditions.

Total porosity values expressed as the percentage air space of the total core volume (soil plus air space) were calculated from the volume weights and a specific gravity of 2.65, as follows:

$$\text{Total porosity (\% of total volume)} = 1 - \frac{\text{V.W.}}{2.65} \times 100$$

In addition to total porosity, capillary porosity was determined. This value is a measure of air space occupied by water held under capillary tension, and is an approximation of the field capacity under natural conditions. Capillary capacity was determined in the laboratory using air-dried samples passing a one mm. mesh, and from which root fragments and other plant particles were removed. Approximately 200 grams of soil were packed uniformly in glass cylinders to which was added an amount of water sufficient to wet three-fourths of the column. After the wet zone had ceased downward movement, and incipient drying appeared on the surface, a 60—70 gram sample was taken for oven-drying.

Losses on ignition were determined in triplicate from successive one-inch layers of soil in the top six inches of the profile. The three samples were obtained from a composite of the 25 cores used in determining volume weights. Oven-dried samples were screened to eliminate root fragments and ashed at 400° C. Loss on ignition was calculated as per cent organic matter in the soil.

RESULTS

The soil profile under ungrazed prairie showed consistently higher moisture values from the beginning of the growing season into summer, after which a reverse was measured. This reversed trend began first in the subsoil and occurred progressively higher in the profile with subsequent samplings. Percentage differences in moisture are presented in Table I. These differences are attributed to variations in floristic composition and to the corresponding differences in utilization between the two tracts. The ungrazed portion has an intact cover of