needed plant control work. Once the first two steps are accomplished, or perhaps concurrently with them, steps 3 and 4 could be carried out by other persons working under a coordinated scheme laid down by the central body. Here the utilization of master's degree or possibly doctorate assignments in one or more higher educational institutions in each state or province suggests itself as a logical means for an orderly attack under competent direction. Needed coordination would be mostly in terms of format for compilation, and standards for segregation of cultivated pastures and other areas not properly classifiable as range lands.

The possible benefits to chemical and equipment companies of having reliable information upon which to plan and direct their sales campaigns would seem to recommend this field as one rewarding for the financing of scholarships. State and Provincial legislatures also might see here ultimate tax savings to be had from more effective weed control campaigns, as well as tax gains from increased range production. In conclusion the author wishes to state his own conviction that accurate statistics on occurrence of undesirable plants in economic quantity are urgently needed as basic information for future range management planning and action. The determination of what per acre control costs are recoverable on any given range should not be neglected in defining economic quantity of undesirables.

Changes in Grazing Use and Herbage Moisture Content of Three Exotic Lovegrasses and Some Native Grasses

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Three introduced African lovegrasses, Lehmann lovegrass (Eragrostis lehmanniana), Boer lovegrass (E. chloromelas), and Wilman lovegrass (E. superba), are being planted in the drier parts of the West. Establishment of stands of these grasses on range areas raises certain questions regarding their management. At what season of the year are they most palatable? How do these grasses compare with native species in palatability? Is it possible to manage a range on which both seeded lovegrasses and native perennial grasses are growing so as to properly utilize both? Data recently collected on the Santa Rita Experimental Range in southern Arizona bear on these questions.

Methods

Seeded plots of the 3 lovegrasses were established on a 2.5 acre area in a 754 acre range in 1951. This range is grazed yearlong, and cattle have free access to the seeded area as well as to the native grasses at all times. Permanent water is available ½ mile from the seeded plots. Between September 5, 1956, and June 3, 1957, 10 observations were made of the percentage of plants grazed of each species of lovegrass. Each observation included 100 plants. A single sample of 100 native perennial grass plants, segregated by species, was also recorded at each observation. No observations were made during the summer growing period. A 100-gram sample of herbage of each of the 3 lovegrasses and of each of 4 native perennial grass species was collected to determine moisture content at each observation. The native grasses were: Arizona cottontop (Trichachne californica), hairy grama (Bouteloua hirsuta), side-oats grama (B. curtipendula), and tanglehead (Heteropogon contortus).

Growth Conditions During the Study Period

In southern Arizona most of the grass herbage is produced from summer rains during July, August, and September. However, there is a definite, though less reliable, cool-season rainy period, which sometimes produces a worthwhile amount of spring growth. Rainfall during the study period is indicated in Figure 1. The series of rains in January and continuing into March were sufficient for some perennial grasses and winter annuals to make considerable spring growth.

Utilization of Lovegrasses

By September 5, the date of the first observation, 47 percent
of the Wilman lovegrass plants had been grazed, compared with 16 percent of Lehmann, and 15 percent of Boer lovegrass plants (Figure 2). By October 5, the percentage of plants grazed had risen sharply to 75, 62, and 44, respectively, for Wilman, Boer, and Lehmann lovegrasses. Thus, Wilman lovegrass was grazed more intensively than Boer, and Boer lovegrass more than Lehmann while it was still green in the late summer and early fall. Most of the grazing of Wilman lovegrass occurred prior to October 5. It was grazed comparatively little during the remainder of the period. Boer and Lehmann lovegrass, however, showed a consistent increase in percentage of plants grazed as the season progressed, although utilization of Lehmann was always less than that of Boer. Use on Boer lovegrass was less than on Wilman lovegrass on October 5, but exceeded that on the Wilman in the early months of 1957. By June 3, 1957, percentages of plants grazed were 89, 95, and 84, respectively, for the Wilman, Boer, and Lehmann lovegrasses.

**Utilization of Native Grasses**

The native grasses studied were grazed throughout the period. Arizona cottontop appeared to be grazed most during the growing season. By October 5, 92 percent of Arizona cottontop plants had already been grazed. Very little additional use was recorded for this species during the remainder of the season. Use of Arizona cottontop was most nearly like that of Wilman lovegrass from October 5 to June 3, but total use on cottontop was higher. Use of hairy grama resembled that of Boer lovegrass throughout the period. Use on other native perennial grasses was variable, but fell generally between the extremes set by Arizona cottontop and hairy grama during the first part of the study.

**Moisture Content of Lovegrasses**

The September 5 samples of the 3 lovegrasses contained the maximum moisture content for the 10 months of record, varying from 34 to 49 percent on an oven-dry basis (Figure 3). Moisture content dropped rapidly during September as the herbage cured, and then decreased more slowly through November and December. From late January through early March the average moisture content of herbage increased as new growth developed. By May moisture content had dropped sharply to the low-

![Figure 1. Rainfall at the study area by storms.](image1)

![Figure 2. Percent of plants grazed by dates of observation.](image2)
Marked differences in moisture content among the 3 lovegrasses were recorded in all months except April, May, and June, the hottest and driest months during the period of study. In October, January, and March, the moisture content of Boer was more than twice that of Wilman. With minor exceptions, Wilman lovegrass maintained the lowest, and Boer the highest moisture content for the 10-month period. Lehmann lovegrass moisture content fluctuated between these two extremes. Average monthly moisture content for the 10 observations from September 5 to June 3 for the 3 species were: Wilman, 17.0 percent; Boer, 26.9 percent; and Lehmann, 22.6 percent. Average moisture content of Wilman lovegrass was significantly lower (5 per cent level of probability) than that of both Boer and Lehmann lovegrasses. The difference between Boer and Lehmann lovegrasses was not significant.

Moisture Content of Native Perennial Grasses

In general, moisture content of the 4 native perennial grasses exhibited the same seasonal fluctuations as the lovegrasses, but with somewhat smaller variation among species. Moisture content of the side-oats grama was the lowest of the 4 species for 7 of the 10 monthly samples and next lowest for the other 3 samples. Moisture content of Arizona cottontop and tanglehead averaged highest of the 4 species for most months. These two species also showed a sharper rise in moisture content between February 4 and March 4, which suggests that they made more spring growth in response to rains in January and February than did the two species of grama. Moisture content of hairy grama exhibited the widest variation among the 4 species, being lowest in 3 months, highest in 2 months, and intermediate in the other 5 months. Average moisture contents for the 10 monthly samples by species were: side-oats grama, 16.1 percent; hairy grama, 20.3 percent; Arizona cottontop, 23.7 percent; and tanglehead, 23.9 percent. Tests of significance showed that the average moisture content of side-oats grama was significantly lower than Arizona cottontop, tanglehead, and hairy grama, and that hairy grama was lower in moisture content than Arizona cottontop.

The monthly averages of moisture content for the 3 lovegrasses and the 4 native perennial grasses were similar throughout the study period.

Discussion

The data collected do not show a relationship between grazing use and moisture content of herbage for either the lovegrasses or native grasses studied. The numbers of plants grazed show large differences in apparent cattle preference both in the lovegrasses and in the native perennials. Arizona cottontop was used more closely earlier in the season than any of the lovegrasses. Utilization of Lehmann lovegrass lagged behind all other species until late in the spring. Otherwise, the general patterns of use of the native and introduced grasses were similar. These results suggest that management of a range with a mixture of native perennials and introduced lovegrasses should be no more difficult than managing for native perennials alone. However, on a seasonal range, the planned season of use should be
GRAZING USE OF LOVEGRASSES

considered in deciding which of the 3 lovegrasses to plant. It seems apparent that Wilman lovegrass would be the best choice for range that is used during the summer growing season and in the early fall. Either Boer or Lehmann lovegrass could be used for late fall, winter, and spring use. Since Boer is harder to establish and is preferred above Lehmann lovegrass by cattle, it should be planted on sites where conditions for establishment are good and where the new stand can be given some protection from grazing. Lehmann lovegrass is a better choice for less favorable sites or sites where protection from grazing is not practical.

TECHNICAL NOTES

A ROTARY LAWN MOWER FOR SAMPLING RANGE HERBAGE

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Workers in range research have long felt the need for rapid and accurate methods of obtaining herbage-yield samples from low-growing range vegetation. The sickle-bar mower has been used with some success, but it is better adapted to sampling higher-yielding pastures. Reel-type power lawn mowers have been tried but are generally unsatisfactory because of the bunchy nature of many range grasses and because they do a poor job of cutting the taller stems (Brown, 1954). Rotary mowers mounted on garden tractors have been adapted for harvesting forage plots by adding an herbage collection device; however, these were heavy, custom-made machines (Fortmann, 1956; Howell, 1956).

Of the various types of mowers, the rotary appears to be the best adapted to sampling range vegetation because it can effectively cut both low-growing leaves and tall stems. In 1958, a rotary mower equipped with a detachable grass catcher was announced. This note describes a test of this mower on seeded ranges.

The rotary mower tested is an 18-inch rotary lawn mower powered by a 2.25-hp 2-cycle gasoline engine. It is equipped with a rigid plastic grass catcher that attaches to the rear of the mower. For transporting, the handle and catcher can be removed and the entire mower carried in an automobile trunk. In operation, the rotor, which is equipped with 4 replaceable cutting blades, cuts and chops the herbage and then blows it into the plastic grass catcher. The grass catcher containing the herbage sample can be quickly removed and the two weighed together and then the clipped herbage can be easily dumped or sampled for moisture or chemical determinations.

Tests using a small sickle-bar mower, a type commonly used in agronomic herbage sampling, and the rotary mower were conducted on two stands of crested wheatgrass (Agropyron desertorum) located on the Colorado State University Foothills Range near Fort Collins, Colorado. Area 1 is a low-yielding stand planted in 1942, whereas, area 2 is a vigorous, high-yielding stand planted in 1956.

Ten sample plots 34 inches wide and 16½ feet long were mowed with each mower on each area. Plots of this size required one pass with the sickle-bar mower and two with the rotary mower. A border 3 feet wide was mowed around the sets of plots prior to actual sampling. The samples were taken by mowing from one border to the other (and back again in the case of the rotary mower). Two men took turns using the mowers so that each man mowed five plots on each area with each mower.

With the rotary mower, herbage samples were collected and weighed in the grass catcher, which will hold about 5 pounds of green herbage. Sample-plot size must be adapted to the capacity of the grass catcher. With the sickle-bar mower, the mowed

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1 Contribution from Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, in cooperation with the Forestry and Range Management Section, Colorado Agricultural Experiment Station, and Rocky Mountain Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture.

2 The rotary mower tested was the Deluxe Turbo-vac Grass Catching Rotary (model 75) made by the Jacobsen Manufacturing Company. The mention of commercial products and companies in this paper does not imply that they are endorsed or recommended by the Department of Agriculture over others of a similar nature not mentioned.