Management of Sown And Natural Lovegrass

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Highlight
In South Africa lovegrass yields liveweight cattle gains around 375 lb/acre, and it is easily managed by very heavy and continuous grazing during the growing period. Fertilizer boosts production, but it is not essential on grazed pasture. For reclamation of rangeland the chloromelas type appears more aggressive than the coarser curvula and robusta types. Feeding value of lovegrass hay is at least equal to that of teff hay.

Much of the South African Highveld is being or has been regrass abandoned fallows. On the sandy soils these fallows revert in two or three years to a seral grassland in which Eragrostis curvula (lovegrass) and Cynodon dactylon (Bermuda grass) are dominant (Davidson, 1962), but the woody subshrub Stoebe vulgaris (bankrupt bush) is frequently abundant (Hatt, 1959), and coarse grasses such as Eragrostis plana, E. gummiflua and Sporobolus pyramidalis may be locally abundant. Eventually Hyparrhenia hirta becomes dominant as succession advances, and together with bankrupt bush it forms wastelands.

The experimental site was one on which these species, including bankrupt bush, were abundant, the fertilized and unfertilized controls were composed of such range land. The reclamation of this land is an urgent necessity in South Africa.

Some twenty years ago L.C.C. Liebenberg suggested that lovegrass be sown to provide a ley in crop rotations. The Ermelo strain which he selected is now widely used for hay production and to a lesser extent for grazing. Selection of strains of Eragrostis curvula has been in progress at Frankenwald since 1950, based on small-plot trials with row-planting of about 100 strains by Poultney (1952), and small-plot trials with broadcast planting of twenty strains by Leigh (1960). On taxonomic grounds all these strains are included in the species E. curvula (Schrad.) Nees (De Winter, 1955), but it is suggested that for agricultural purposes five types be recognized, viz. curvula, chloromelas, robusta blue, robusta intermediate, and robusta green. The anatomy, morphology, chemical composition and herbage yield of these types are described by Leigh (1960). In a small scale palatability trial the curvula type was found to be less palatable than the others, and all the lovegrasses were markedly less palatable than Digitaria smutisi and Chloris gayana (Leigh 1961b).

Experimental Layout
Between 1952 and 1954 a series of units forming Block G was set out near Johannesburg on sandy soil derived from pre-Witwatersrand old granite, situated on a westerly slope of 8% with seasonally impeded drainage in patches. The area had been cultivated in the past, and was last ploughed about 90 years previously. The natural seral grassland was retained in G 5, 6 and 7, but the sown units G 1, 2, 3 and 8 were ploughed, planted to teff, reploughed and seeded to selected strains of lovegrass. The mean annual rainfall is 30 inches, falling mainly in summer, and the altitude is 4950 feet.

For convenience all areas are given in acres, although measured in morgen (1 morgen = 2.116 acres). Each unit (except the control G 5) consisted of four acres, of which two acres were grazed in summer by four Hereford grade cows and the calves born during the season. In all the units except G 5 the two-acre grazing paddock was grazed continuously without rotation for seven summers from 1955/56 onwards. In only two years was it necessary to mow some of the grazing camps to remove uneaten herbage. In G 5 the same number of animals was carried on six acres of unfertilized seral grassland divided into two paddocks and a rotation of about one month in each was employed.

The strains used in the experimental units are listed below, with the accession numbers of the Frankenwald Field Research Station:

G 1 Basutoland strain of weeping lovegrass, No. 91, curvula type.
G 2 Witbank strain No. 7, giant chloromelas type, with some No. 88, chloromelas type.
G 3 Grootfontein strain of robusta intermediate No. 104, and some robusta blue No. 4.
G 8 Frankenwald strain No. 134, chloromelas type, identical with the common strain in G 5, 6 and 7, planted 1958.
G 5, 6 and 7 natural seral grassland, lovegrass (mainly chloromelas type) and Bermuda grass co-dominant.

Digitaria smutisi, Chloris gayana (Katambora strain), Panicum coloratum, Sorghum almum and Euchlaena parennis were included in the original layout, but these species were discarded because of their inability to persist in the face of weed enroachment.

All units except G 5 received annually 40 lb. P2O5/acre, reduced to 20 lb. from 1960. Nitrogenous fertilizer was applied in the form of ammonium nitrate, two-thirds in spring and the remainder in summer. The grazing paddocks of G 1 to 3 and G 6 received 60 lb. N/acre, reduced to 30 lb. N from 1960 onwards in G 1 to 3 to study the residual response to fertilizer and excretal N. The grazed paddock of G 7 received 120 lb. N/acre in 1955/56, then for two seasons 20 lb. N, increased in all subsequent seasons to 30 lb. N/acre. The hypothesis
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Results of Grazing Trials

Grazing began as early as possible in spring, varying between the last week of September and the first week in November, except in the drought year 1961/62, when grazing began in December. The animals usually continued to gain weight until the end of March, but in two seasons grazing continued until May when some of the groups were still gaining weight. The seasonal liveweight gains in each group are given in Table 1.

The liveweight gains on the curvula, chloromelas and robusta pastures were almost identical. All three types were evenly grazed, and these pastures had a short, dense sward in contrast to the tussocky appearance of ungrazed lovegrass pasture. During spells of dry weather there was a marked tendency for the curvula type to be pulled out by the roots (Figure 1). This never occurred in the chloromelas or robusta types. The percentage basal cover in all units in 1964 is shown in Figure 2. There was a general invasion of Bermuda grass into all the sown units. Bankrupt bush did not appear in any of the sown units, although it soon became abundant in the discarded units planted to species other than lovegrass. The small perennial Walafreda densiflora invaded G 2 and in 1960 it was fairly common, but a year later the plants had decreased in size and number. In the grazed units Hyparrhenia did not encroach at all, although it was abundant outside along the fences.

The natural seral grassland in G 5 provided a measure of the productivity of these areas without reseeding or fertilizing. With one-third the stocking rate employed in the fertilized units, this control group gave a mean seasonal liveweight gain slightly more than one-third the gain in the fertilized units. From the lowest gain per head in the first two seasons, G 5 yielded the highest gain in four of the last five seasons. The response of the sward to dung and urine was noticeable over the years, and it is probable that the stocking rate could be increased. The botanical

Table 1. Seasonal liveweight gains (summer grazing only) in lb. per acre and mean gain per cow-calf unit 1955 to 1962.

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</tr>
</thead>
<tbody>
<tr>
<td>G 1</td>
<td>518</td>
<td>226</td>
<td>405</td>
<td>297</td>
<td>624</td>
<td>302</td>
<td>182</td>
<td>378</td>
</tr>
<tr>
<td>G 2</td>
<td>468</td>
<td>195</td>
<td>371</td>
<td>317</td>
<td>578</td>
<td>486</td>
<td>229</td>
<td>371</td>
</tr>
<tr>
<td>G 3</td>
<td>463</td>
<td>238</td>
<td>412</td>
<td>316</td>
<td>441</td>
<td>401</td>
<td>338</td>
<td>376</td>
</tr>
<tr>
<td>Mean G 1-3</td>
<td>483</td>
<td>226</td>
<td>396</td>
<td>309</td>
<td>548</td>
<td>410</td>
<td>250</td>
<td>375</td>
</tr>
<tr>
<td>G 5</td>
<td>145</td>
<td>65</td>
<td>145</td>
<td>149</td>
<td>158</td>
<td>170</td>
<td>123</td>
<td>136</td>
</tr>
<tr>
<td>G 6</td>
<td>526</td>
<td>165</td>
<td>296</td>
<td>299</td>
<td>619</td>
<td>448</td>
<td>248</td>
<td>363</td>
</tr>
<tr>
<td>G 7</td>
<td>671</td>
<td>598</td>
<td>276</td>
<td>257</td>
<td>533</td>
<td>290</td>
<td>145</td>
<td>396</td>
</tr>
<tr>
<td>G 8</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>500</td>
<td>448</td>
<td>294</td>
<td>—</td>
</tr>
</tbody>
</table>

1 Fertilizer reduced to 30 lb. N/acre on G 1-3 in 1960/61. Animals in G 6 and 8 inadvertently grazed in hay paddocks during part of this season.

2 30 lb. N/acre on all treatments except control in 1961/62 (driest season in 40 years).
composition has not swung as markedly towards lovegrass and Bermuda grass as in the fertilized units (Figure 2), and bankrupt bush is still present.

The rapid improvement of seral grassland when fertilized at the same rate as the sown pasture is demonstrated in G 6. Without reseeding this grassland provided liveweight gains equal to the sown pastures at the same stocking rate. Originally the pasture was infested with bankrupt bush which decreased until it was virtually absent, confirming earlier conclusions about the weed (Krupko and Davidson, 1961). Clearly such grassland can be converted to useful pasture simply by an improvement in soil fertility. The botanical composition is similar in the sown pastures and the fertilized seral grassland.

In the G 7 unit 120 lb. N/acre was applied in the first season, followed by annual dressings of 20 or 30 lb. N/acre. The sward was evenly grazed at all times, and there were no weeds in the pasture. Eragrostis plana (a tough tussock species) was pulled out by the roots by the grazing animals, and the percentage basal cover of this species decreased from 12% in 1956 to 7% in 1961 to 1.5% in 1964. Other coarse species such as Sporobolus, Heteropogon and Hyparrhenia also decreased. The mean liveweight gain, with the same stocking rate as the other fertilized units, but only two-thirds the nitrogenous fertilizer over the seven years, was equal to the gains on the heavily fertilized units. Economically G 7 provided a better return on fertilizer investment than the other fertilized units. The marked residual effect of fertilizer was also evident in the units G 1 to 3 in the 1960/61 season, when only 30 lb. N/acre were applied and the gains were about the same as the mean gain in previous seasons.

Over the seven years the application of adequate fertilizer to seral grassland gave a 167% increase in productivity. Reseeding plus the same fertilizer gave only an additional 3% increase. The similarity of the gains per animal suggests that stocking rates have not differentially influenced the liveweight gains per acre, except possibly in the control G 5, in which gains per head were higher in the later years, suggesting that it might be understocked.

**Winter Feeding Trials**

For the feeding trials hay was mown twice each season, and the animals used were Hereford cows and calves of medium grade. Other experiments at Frankenwald (Davidson and Purchase, 1961) have indicated that lovegrass hay supplemented with silage is sufficient to maintain the weight of beef steers and dry cows, but not cows which are suckling calves. The addition of urea and molasses provides a ration which gives gains of up to half a pound per day in steers and dry stock. In the trials under discussion urea and molasses (at the rate of approximately 3 ounces of urea and 1 pint molasses per animal per day) were sprayed on the hay daily.

During the winter of 1955 the hay from G 1 to 3 was used for a feeding trial lasting 63 days to compare the gains of two groups of Hereford heifers, one of which received a Vitamin A-D preparation. No silage was fed, but the hay was sprayed with urea and molasses. There was no significant difference between the groups, the control animals having gained 0.72 lb. per day and the others 0.76 lb.

The hay used in the feeding trials in the winter of 1956 was of poor quality, having been mown after seed was harvested in January, with a second cut a month later. No silage was fed, but urea and molasses were sprayed on the hay. The liveweight gains are given in Table 2. Half the cows were suckling calves, and in most cases these cows lost weight, while the dry cows gained slightly. In spite of the poor quality of the lovegrass hay from mixed stands used for seed production, the hay which was fortified only with urea and molasses provided a maintenance ration.

The hay camps G 2 and 3 were reseeded in March 1956 to chloromelas No. 7 and robusta No. 4 respectively. A more comprehensive trial was conducted in the winter of 1959, using hay from two seasons in G 1 to 3, and hay from four acres of newly established chloromelas (a fine strain which is abundant at Frankenwald) in G 8. Only one season's hay was available in G 6 and 7. During this winter, when a little silage was fed in addition to spraying the hay with urea and molasses, the cows suckling calves maintained their weight while dry cows gained. The mean gains per day over comparable periods indicated that on the whole, lovegrass hay was as good as teff hay which...
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**Table 2. Mean liveweight gains in lb. of four cows and their calves per group over two winters.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Type of hay</th>
<th>Winter 1956—urea and molasses on hay</th>
<th>Winter 1959—silage, urea and molasses</th>
<th>Mean</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Duration days</td>
<td>Gain¹</td>
<td>Duration days</td>
<td>Gain¹</td>
</tr>
<tr>
<td>G 1</td>
<td>curvula</td>
<td>100</td>
<td>0.01 ± 0.04</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>chloromelas</td>
<td>100</td>
<td>0.00 ± 0.07</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>robusta</td>
<td>100</td>
<td>0.01 ± 0.08</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>teff</td>
<td>100</td>
<td>0.62 ± 0.06</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>seral grassland</td>
<td>100</td>
<td>0.05 ± 0.09</td>
<td>59</td>
</tr>
<tr>
<td>7</td>
<td>seral grassland</td>
<td>100</td>
<td>0.27 ± 0.13</td>
<td>31</td>
</tr>
<tr>
<td>8</td>
<td>chloromelas</td>
<td>—</td>
<td>—</td>
<td>73</td>
</tr>
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</table>

¹Mean cow-calf gain per/day.

was also fertilized with N and P, only the robusta type being significantly better. The fine strain of chloromelas which is dominant in the seral grassland in G 6 and 7, and which was planted in G 8, gave good liveweight gains over a shorter period. It is known to be a lower-yielding strain, but it is of importance because of its abundance on falls in South Africa.

**Summary and Conclusions**

There appears to be no justification for the view held by some farmers that lovegrass is so unpalatable that it is unsatisfactory as a hay and pasture grass. While it is no doubt less palatable than most exotic species, the latter deteriorate rapidly in this region. For complete utilization lovegrass should be very heavily grazed. Continuous grazing during the growing period, with a stocking rate slightly in excess of two beef cows per acre, proved a workable system of management on fertilized sown and natural lovegrass. After seven years weed encroachment was negligible, except for Bermuda grass and volunteer lovegrass. The persistence of these two species is clearly dependent upon heavy grazing, witness the deterioration of mown plots elsewhere (Leigh 1961a) and the discarded units in the experimental block. The gradual improvement of the unfertilized control conforms to this ecological hypothesis. The botanical changes confirm earlier conclusions that lovegrass and Bermuda grass form a biotic subclimax maintained by heavy grazing (van Rensburg, 1939), partly through the mobilization of nutrients by rapid cycling of nitrogen and phosphorus (Davidson, 1964; Gillard, 1963). According to this interpretation the encroachment of Bermuda grass is inevitable. Its value as a pasture and in the control of erosion makes it a desirable constituent of permanent pastures on soils not suitable for cultivation. In this region, home of so many strains in the apomorphic species E. curvula, reseeding is less important than fertilization and heavy grazing, and fertilization is more important in the early years than later.

At the heavy stocking rates advocated for easy management of lovegrass pastures, the curvula type appears to be less stable than the chloromelas and robusta types. For reclamation of rangeland, the chloromelas type appears to be more aggressive than the others, and its finer habit makes it more easily managed than the coarser curvula and robusta types, especially on soils of low fertility. For intensive grazing robusta appears to be the most promising type, being more palatable and more persistent than the others.

The feeding value of lovegrass hay equals or exceeds teff hay. It has the advantage of being a vigorous perennial, which is easily ploughed out, and it is suitable as a grass ley. The nitrogen and phosphorus requirements, however, are high in grassland used exclusively for hay production.

Further work on the response of these distinctive types to differential grazing intensity and fertilization is necessary for a final assessment of the value of lovegrass in extensive range reclamation and intensive agriculture. Without this it is likely to be condemned as a pasture for want of appropriate management, taking into account its ability to withstand heavy grazing continuously throughout the growing season, and the rapid decline in palatability as it matures. The performance of lovegrass in the absence of Bermuda grass has not been assessed.

**LITERATURE CITED**


**KRUTHO, IRENA, AND R. L. DAVIDSON. 1961.** An experimental study of *Stoebe vulgaris* in relation to graz...
Response of Major Plant Species to Elk and Cattle Grazing in Northwestern Wyoming

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Highlight
Grazed elk ranges differ from grazed cattle ranges. Composition changes were detected for 18 plant species occurring on both types of range.

In northwestern Wyoming, large elk populations in addition to domestic livestock have created a serious range situation. It therefore seemed reasonable to conduct a study to determine which plant species respond significantly to grazing by elk and cattle. This study was accomplished during the summer of 1963 with the use of protected range exclosures. Undisturbed areas of natural vegetation provide an ideal check or norm for studies on the effects of various grazing treatments. Without them it becomes impossible to evaluate the significance of change.

Exclosures are included in the broad classification of relict areas which derive protection from some physical feature such as fences, cliffs, and other similar objects (Clements, 1934). According to Daubenmire (1940), the implied purpose of the exclosure is to control the animal influence in the plant environment, therefore it has been used to obtain important information concerning the activities of livestock, wildlife, rodents and birds.

Area Studied
This study involved an inventory through sampling of 24 big game and nine livestock exclosures located on four National Forests of northwestern Wyoming. The study area is located east and south of Yellowstone National Park on four major river drainages (South Fork of the Snake River, Shoshoni River, Greybull River and the Wind River) and four mountain ranges (Hoback Range, Teton Range, Wind River Range and the Absaroka Range). Elevations in this area range from 4,600 to 13,785 feet. However the exclosures studied ranged between 6,000 to 8,000 feet. The precipitation ranges between 15 and 20 inches per year, most of which falls in the form of snow during the winter. Sandy soils, grey alkaline soils and volcanic soils are common in the area and are generally derived in place from the local parent material. The vegetation consists of rather clear-cut grass, shrub, coniferous forest, and deciduous forest types; however only the grass and shrub communities were sampled. Cattle, sheep, and horses graze portions of this area during the summer months while elk and other species of big game use various parts of the range during the entire year.

Methods and Procedures
Two general types of exclosures were used, the paired unit (figure 1, bottom) and the single unit (figure 1, top). The paired type was located on range used by both cattle and elk. It was composed of a complete enclosure, which excluded both cattle and elk; and a partial enclosure, which excluded cattle but allowed elk to enter. The single unit was located on elk range and consisted of one complete enclosure. At the paired units, samples were taken inside of both exclosures. Differences here were attributed to elk use. Samples were also taken on the inside of the partial enclosure and on comparable areas grazed by cattle and elk on the outside. This difference was attributed to use by cattle. Because the single units were located on elk range a sample was taken on the inside and the outside and the change, if any, attributed to elk use.

The sample consisted of vegetative cover and composition estimates which were measured by means of the "Percentage Area Estimation" method as first described by Armstrong (1907). This method involves the random throwing of a square foot metal frame. At the point of impact, each species was recorded and percentage estimate was given to each. This value indicated the portion of the square foot occupied by that species. After ten samples were throw in a line through the sample area, the average composition percentage for each species was computed.

1 This paper was developed from a thesis (Jones, 1964. A study of some livestock and big game exclosures in northwestern Wyoming) submitted to the Graduate School of the University of Wyoming in partial fulfillment of the requirements for the degree of Master of Science. Special acknowledgment is made to Dr. Alan A. Beetle, head of the Range Management Section of the University of Wyoming.