Lehmann Lovegrass on the Santa Rita Experimental Range, 1937-1968[1]

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Highlight

Thirty years' experience shows that Lehmann lovegrass readily establishes itself from seed under adverse conditions, reseeds itself quickly after fire or other disturbance, can withstand heavy continuous yearlong grazing, and can invade established stands of velvet mesquite. However, it is less palatable than native perennial grasses during the summer growing season, and has almost completely replaced the native perennial grasses on and adjacent to seeded areas within its preferred range.

Resumen[3]

El Zacate Lehmann Lovegrass en la Estacion Experimental de Santa Rita Durante los Años de 1937–68.

Los estudios se llevaron a cabo en la estación experimental de Santa Rita cerca de Tucson, Arizona, EUA. Se encontró después de 30 años de observaciones que el zacate Lehmann Lovegrass (*Eragrostis lehmanniana* Nees A-68) tiene buena adaptación a las zonas de 1,100 a 1,500 metros de altura y que tengan precipitación pluvial de 225 a 325 mm.

Las siguientes ventajas y desventajas fueron encontradas:

1) Existe menor palatabilidad del zacate en el verano y mayor en el invierno que los zacates nativos.
2) El forraje seco dura mas que los nativos de un año a otro por lo tanto su uso es ventajoso para sequías.
3) Es muy agresivo ya que puede reemplazar las especies nativas e invadir montes de mezquite y tierra quemada.
4) Puede resistir el pastoreo pesado y continuado por todo el año.

Lehmann lovegrass (*Eragrostis lehmanniana* Nees A-68) has been widely used to revegetate the drier portions of southwestern ranges and burned areas on national forests and other public and private lands since its introduction into the United States in the early 1930's (Crider, 1945). First planted on the Santa Rita Experimental Range, 30 miles south of Tucson, Arizona, in 1937, this species was used in numerous revegetation trials between 1945 and 1954 to determine its adaptability to varying soil and rainfall conditions and to various seeding methods. Most of these plantings were between 3,400 and 4,100 ft elevation, with annual rainfall from 13 to 17 inches (60% summer). A few areas were planted at elevations between 2,900 and 3,300 ft, with from 10 to 12 inches annual rainfall. Continuing observations and measurements of these plantings have revealed many of the strengths and weaknesses of Lehman lovegrass as a forage grass.

The usual objections to Lehmann lovegrass are: (1) it is less palatable than native perennial grasses during the summer growing season, and (2) on areas where it is well adapted, it eventually dominates the stand and reduces the native grasses over a period of years to a very minor component.

On the strong side: (1) Lehmann lovegrass readily becomes established from seed under adverse conditions, (2) it reseeds itself quickly after fire or other disturbance, (3) it can invade established stands of velvet mesquite (*Prosopis juliflora* var. *velutina* (Woot.) Sarg.) and produce relatively high yields of herbage, (4) its herbage carries over from one year to the next in better physical condition than that of natives for use as emergency forage, (5) it produces more green herbage during the winter and early spring than most native perennial grasses, and (6) it withstands repeated close grazing.

Although the above listing classifies the various attributes of Lehmann lovegrass as either strong or weak, most attributes have both desirable and undesirable implications for land managers.

Palatability

Cattle definitely prefer the predominant native perennial grasses to Lehmann lovegrass during the summer growing season. During the winter, however, the lovegrass remains greener than native grasses and is grazed readily. Cable and Bohning (1959) concluded that differences in palatability were as great among the several native perennials on the Santa Rita as between Lehmann lovegrass and native grasses. The relative palatability of lovegrass also changes following cultural treatment. In a high rainfall summer, Holt (1959) found that cattle grazed all grasses —native perennial grasses, Lehmann lovegrass, and annual grasses—indiscriminately, where 25 lb./acre or more of nitrogen was spread. More recently, the newly established lovegrass on an area accidently burned in April 1969 was grazed more closely in the following early fall than was mature lovegrass on adjacent unburned range. Thus, palatability of Lehmann lovegrass, while variable, is generally low, and this can be an advantage where grazed ranges are being seeded.

Ease of Establishment

The ease with which Lehmann lovegrass becomes established is one expression of its aggressiveness. Characteristically, broadcast plantings on unprepared seedbeds produce sparse initial stands that thicken up to dense, almost pure,

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FIG. 1. Small-diameter lovegrass plants on area grazed heavily yearlong (25-cent piece for scale).

stands of lovegrass over a period of from 5 to 15 years. On the Santa Rita Lehmann lovegrass had been broadcast seeded successfully on unprepared seedbeds above about 3,500 feet elevation, and 13 to 14 inches annual rainfall. Establishment has been poor at 2,900 feet with under 10 inches annual rainfall. Stands established at elevations from 3,000 to 3,400 feet are thin and show little or no spread except along water courses.

The ability of Lehmann lovegrass to establish itself from seed after fire or heavy grazing is outstanding. A small fire in an exclosure in June 1963 burned a nearly pure stand of lovegrass and an adjacent area dominated by black grama (*Bouteloua eripoda* Torr.). The fire killed 98% of the lovegrass plants and 90% of the black grama plants (Cable, 1965). No black grama seedlings were established during the immediately following summer rainy season, but by fall, new lovegrass plants had not only reoccupied the lovegrass area (17 new plants/ft^2) but 13 new lovegrass plants/ft^2 had become established on the former black grama area in a nearly pure stand. Six years later, the former black grama area was still a nearly pure stand of fewer but much larger Lehmann lovegrass plants.

Lehmann lovegrass also has become established and is maintaining itself near stock water where it is grazed closely yearlong. Because of repeated close grazing, most lovegrass plants probably live only 1 or 2 years, but new plants become established each year to maintain a high density (5 to 20 plants/ft^2) of small-diameter plants (Fig. 1). The relatively low palatability of lovegrass during the growing season and its habit of producing seedstalks early in the summer enable it to maintain itself under heavier grazing than native perennial grasses can stand.

Natural Spread of Lovegrass

The spread of Lehmann lovegrass under natural conditions is well documented in the record of its occurrence on herbage production and utilization transects on the Santa Rita. From 10 to 20 of these transects (a total of 239) are located in each pasture and are visited at least twice yearly. Lovegrass was recorded on only four transects in 1955, compared to 14 transects in 1962 and 65 transects in 1968. Lovegrass plantings are as close as 0.1 mile to some transects, and as much as 3 miles from others. Lovegrass has spread most commonly onto transects at the higher elevations (4,000 ft +) and within 0.5 to 0.75 mile from a seed source.

The natural spread of Lehmann lovegrass is illustrated also by records from 1954 to 1968 in a 754-acre pasture having a sparse mesquite stand. The pasture varies from 3,700 to 4,100 ft elevation and receives 14 to 16 inches annual precipitation. Small plots of Lehmann lovegrass were planted in this pasture in 1950, 1951, and 1953. Lovegrass was first recorded on one of the herbage production transects in 1955. By 1968 it was reported on all 10 transects and as much as 0.4 mile from the nearest seeded plot. Average production of lovegrass between 1955 and 1960 ranged from 2 to 55 lb./acre for the pasture, and varied in response to summer rainfall. From 1960 to 1968, lovegrass production increased, independently of changes in summer rainfall, from 12 lb./acre to 331 lb./acre, a change from 3% of the total perennial grass production in 1960 to 66% in 1968 (Fig. 2). Native perennial grass yields also increased between 1961 and 1967, but would probably have been even higher had the lovegrass not been present. The relatively large drop in native perennial grass production in 1968, despite better-than-average rainfall, may represent the first step in declining native perennial grass production due to lovegrass competition.

Competition With Native Vegetation

Lehmann lovegrass has an unusual ability to invade existing stands of native perennial grasses and shrubs, and, in the process, to replace most of the native perennial grasses. Concern over this possibility, expressed by Humphrey (1958), appears to have been well founded. On the Santa Rita, production of associated native perennial grasses has declined drastically on areas where Lehmann lovegrass has formed dense stands.

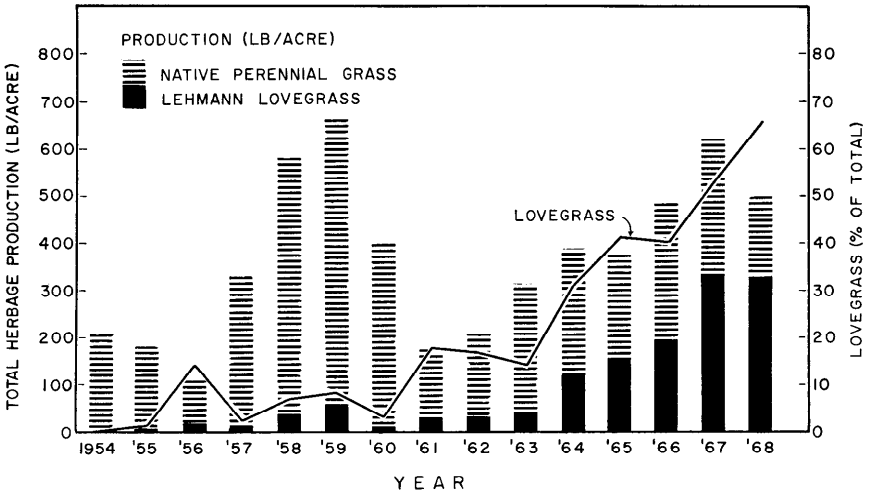

FIG. 2. Changes in production of native perennial grasses and Lehmann lovegrass in a 754-acre pasture, 1954–1968.

One study involves four sites at elevations from 3,150 ft to 4,100 ft established to study the influence of mesquite density on perennial grass production. At each site, one 2-acre plot was left with an undisturbed stand of mesquite, and four adjacent plots were thinned to leave 25, 16, 9, and 0 mesquites/acre (mesquite density on the check plots varied from 44 trees/acre at the lowest elevation to 358 at the highest). A narrow strip across one end of each plot was seeded to Lehmann lovegrass in 1945. Herbage production was measured annually from 1946 to 1950, and in 1958 and 1968.

Lovegrass spread over the plots most quickly at the highest elevation, where growing conditions were most favorable, and more slowly at each successively lower elevation. The lovegrass remained within the seeded strips until some time after 1950. By 1958 it had spread to the opposite end (400 ft away) of some plots at all four elevations. In 1968, the abundance of lovegrass at the lowest elevation was still too low to interfere with native grasses, but its abundance at the other elevations had seriously reduced the production of native perennial grasses (Fig. 3).

Lovegrass is much better able to compete or co-exist with mesquite than are the native perennial

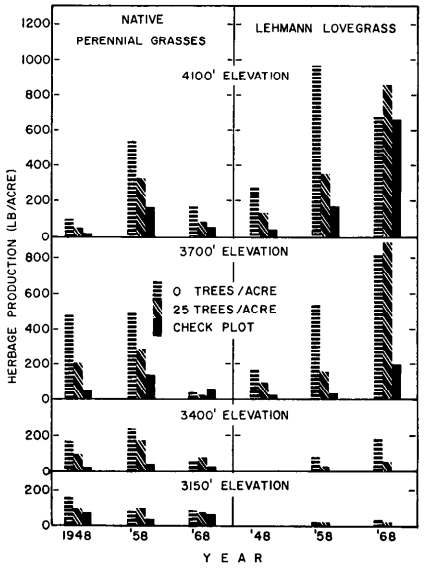

FIG. 3. Changes in production of Lehmann lovegrass and native perennial grasses on 2-acre plots with three mesquite densities, at four elevations, 1948–1968 (lovegrass production for 1948 is for seeded strip only).

grasses, whose yields typically vary inversely with mesquite density. In 1968, for example, lovegrass at the highest elevation produced essentially as well on the check plot, with 358 mesquites/acre, as on any of the other plots. At 3,700 ft, with lower rainfall, lovegrass yields were about the same on plots with up to 25 mesquites/acre, but significantly lower on the check plot with 138 trees/acre. The decline in native perennial grass production between 1958 and 1968 at the two higher elevations suggests that the lovegrass was depressing the native perennial grass yields in 1968 as much or more than the mesquite did before thinning.

At the two lower elevations competitive relationships between lovegrass, mesquite, and native perennial grasses are less clear.

Dominance of Lehmann lovegrass in 1968 increased generally with elevation. Lovegrass made up only 21% of the perennial grass production at 3,150 ft, 49% at 3,400 ft, and 95% and 88%, respectively, at 3,700 and 4,100 ft (Table 1). Arizona cottontop (*Trichachne californica* (Benth.) Chase) and threeawn grasses (*Aristida* spp.) sustained most of the loss in native perennial grass production during the study period at the 3,700 ft-site (Fig. 4). Slender grama (*B. filiformis* (Fourn.) Griffiths), sprucetop grama (*B. chondrosioides* (H.B.K.) Benth.), side-oats grama (*B. curtipendula* (Michx.) Torr.), and Arizona cottontop sustained most of the loss at the 4,100-ft. site.

Lehmann lovegrass has also increased rapidly in a 150-acre pas-

Table 1. Percentage of total perennial grass production contributed by Lehmann lovegrass in 1968.

Mesquite Density (trees/acre)	Percent production by elevation (feet)			
	3150	3400	3700	4100
0	14.0	73.9	96.0	80.5
9	40.7	46.2	94.8	89.0
16	23.0	35.8	98.2	88.0
25	8.2	42.9	98.8	90.9
Check	6.7	0	76.1	92.8
Mean	20.8	48.8	95.4	88.2

FIG. 4. Change in grass composition on plot with 9 mesquites/acre at 3,700 ft elevation. Left: In 1946, two growing seasons after mesquites were thinned, Arizona cottontop formed a thick stand. Right: In 1969, a nearly pure stand of Lehmann lovegrass.

ture at about 3,800 feet elevation on the Santa Rita. The mesquite on 100 acres of the pasture were controlled by aerial spray of 2,4,5-T in 1954 and 1955, and 1 lb./acre of lovegrass seed was broadcast over the entire pasture from the air in 1954. In 1955, total perennial grass production on the sprayed area was 914 lb./acre, of which lovegrass made up 110 lb., or 12% (Fig. 5). In the ensuing 13 years, native perennial grass production decreased an average of 62 lb./acre for every 100 lb./acre increase in lovegrass production, until in 1967 lovegrass produced 978 lb./acre and native grasses only 130 lb./acre (below pre-spray yields). The native perennial grasses that sustained most of this loss were Arizona cottontop and plains bristlegrass (*Setaria macrostachya* H.B.K.).

On the unsprayed part of the pasture lovegrass spread much more slowly, but from the 11th year (1964) on the native grasses produced about 175 lb./acre (not greatly different from the level of production before lovegrass was seeded), and lovegrass about 600 lb./acre. In this situation lovegrass yields provided a forage bonus by filling a niche that native perennial grasses did not fill in competition with mesquite.

Yearlong stocking in this pasture averaged 2.3 head during the 10 year period before seeding and mesquite control. From 1955 to 1965, after spraying and seeding, stocking averaged 6.3 head. The nearly threefold increase in average stocking is attributed mainly to increased forage production resulting from mesquite control, although in later years increases in lovegrass on the unsprayed part of the pasture have provided an extra increment of carrying capacity.

Grazing and soil appear to have had little influence on the spread of Lehmann lovegrass on the Santa Rita. Lovegrass has replaced native perennial grasses on areas continuously protected from livestock, on areas grazed heavily yearlong, and on areas grazed at various seasons and intensities between these extremes. Likewise, Lehmann love-

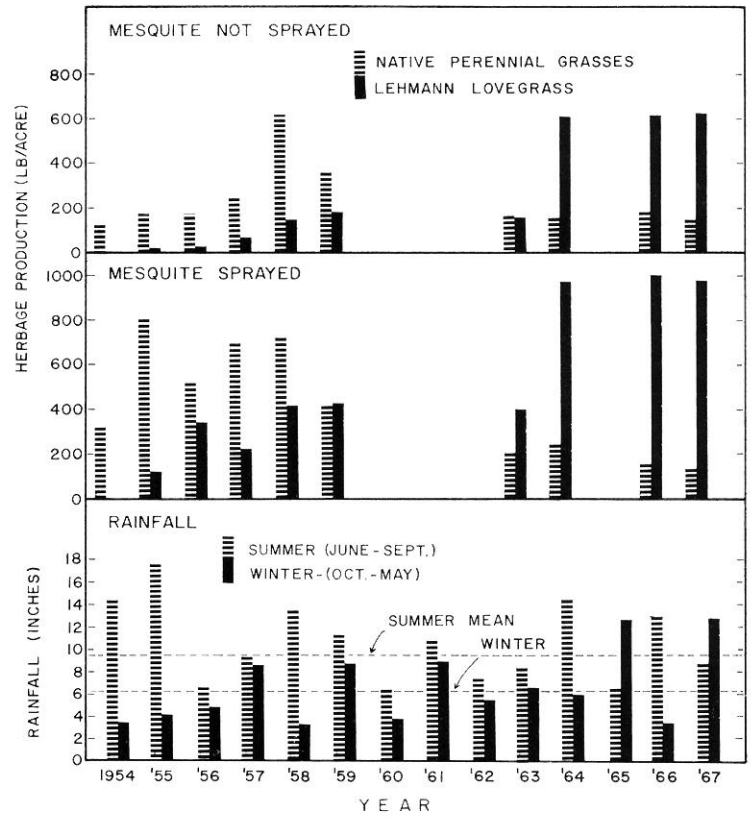

FIG. 5. Changes in herbage production of native perennial grasses and Lehmann lovegrass on sprayed and unsprayed range seeded in 1954.

grass has developed into dense stands on a variety of soils including sandy loams, gravelly loams, and stony loams of the Continental, Comora, Sonoita, Tumacacori, and White House series (Youngs et al., 1936).

Carry Over Herbage

The value of Lehmann lovegrass as an emergency forage was demonstrated in 1965, when summer rains on the Santa Rita were light. For the want of forage, the 58 cattle from a 4,900-acre pasture, where annual grasses normally produce most of the forage, were moved August 10 into the 150-acre sprayed and reseeded pasture mentioned previously. Herbage production in 1965 was relatively low, but there was an accumulation of old growth on the lovegrass clumps, and lovegrass made up over 80% of the available grass herbage. The cattle were kept in the pasture for 2.5 months, during which time they grazed the lovegrass to a relatively uniform stubble height of about 2 inches. The mature cattle did well during this period of intensive use, although the rancher felt that the calves were a little lighter in the fall than calves on adjacent native range. No harmful effects of the heavy use were apparent in the lovegrass growth the following summer.

Ungrazed lovegrass plants are particularly conspicuous in years of high forage production because of their low palatability during summer, and the consequent tendency for old growth to accumulate. This ungrazed herbage can provide drought insurance for the rancher, however, and should be a source of comfort rather than a cause for alarm.

Cool-Season Herbage

The green lovegrass foliage produced in the winter, although present in much smaller volume than in summer, probably provides grazing animals with a more nutritious diet than is provided by native grasses alone at this season. Not only is the volume of green lovegrass herbage greater than that of the natives in winter, but its crude protein content averages from 11% to 38% higher than that of Arizona cottontop, the dominant associated native perennial grass (Cable and Shumway, 1956).

Summary and Conclusions

Records of the occurrence and spread of Lehmann lovegrass on the Santa Rita Experimental Range between 1937 and 1968 indicate that:

1. Lehmann lovegrass is well adapted to semidesert ranges between about 3,500 and 4,500 ft elevation, and 13 to 17 inches of annual rainfall; it often develops into almost pure stands, and crowds out the more palatable native perennial grasses.

2. At lower elevations, and 13 inches or less rainfall, lovegrass persists in scattered stands, spreads very slowly, and appears to be no great threat to native perennial grasses.

3. Within its preferred range, Lehmann lovegrass establishes itself fastest on areas with little or no competition from native perennial grasses or mesquite. It will establish itself from seed broadcast into stands of mesquite, however, although it may take 10 to 25 years to reach a production of 200 lb./acre, compared to as few as 2 years where mesquite is controlled.

4. Lehmann lovegrass plants are easily killed by fire, but new plants become established quickly from seed already in the soil.

5. Lehmann lovegrass becomes established more quickly on semidesert ranges than any other perennial grass species that has been tried on the Santa Rita, and is the only perennial grass that has demonstrated the ability to establish itself in a mesquite stand or on heavily grazed areas.

6. In the final analysis, the decision whether or not to plant Lehmann lovegrass must be based on an evaluation of its strengths and weaknesses in relation to the local situation. If it is planted, it should be with the expectation that it will eventually develop into a nearly pure stand, and will spread to adjacent range.

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