Laboratory germination responses of 3 lovegrasses to temperature in relation to seedbed temperatures

BRUCE A. ROUNDY, JAMES A. YOUNG, LEE B. SUMRALL, AND MARGARET LIVINGSTON

Abstract

Laboratory tests are often conducted to determine seed germination responses to temperatures for seedbed ecology interpretations and revegetation seeding rate calculations. To determine the utility of laboratory germination tests for indicating seedbank germinability and revegetation seedling emergence, we measured seedbed temperatures and soil water on 2 semidesert grassland sites in the Southwest. We also tested germination of Lehmann lovegrass (Eragrostis lehmanniana Nees), 'Cochise' lovegrass (E. lehmanniana Nees × E. trichophora Coss & Dur.), and plains lovegrass (E. intermedia Hitch.) seed collections associated with natural or artificial revegetation studies on these 2 sites in relation to an array of constant and alternating temperatures. Germination responses to different temperatures varied with the year and source of collection and seed age and differed compared to those reported in the literature. Lehmann and Cochise lovegrass had high germination at temperature alternations similar to wet seedbed temperature extremes in December (20/25° C) and these species and plains lovegrass were germinable at moderate temperature alternations representative of wet seedbeds in April (20/30° C). Ability to germinate in laboratory tests at these temperatures is not necessarily indicative of germinability in the field for Lehmann lovegrass, which has been observed to germinate in April, not December, in wet seedbeds. All species had maximum or near maximum germination at a temperature alternation of 20/40° C, which is similar to wet seedbed temperature extremes during the summer rainy period when these species usually emerge. Because of the variability in germinability of different seed collections of lovegrass over time, specific collections should be tested at specific ages relevant to seedbed ecology and revegetation studies or projects. Laboratory germination tests which mimic actual wet seedbed temperature curves might be more predictive of seedbed germinability than the usual tests which expose the seeds to abrupt temperature alternations.

Keywords: range revegetation, seedbed ecology, Lehmann lovegrass, Cochise lovegrass, plains lovegrass, Southwest desert grassland, alternating temperatures

Lehmann lovegrass (Eragrostis lehmanniana Nees) and 'Cochise' lovegrass (E. lehmanniana Nees × E. trichophora Coss & Dur.) are native to South Africa but are adapted to the foothills of southern Arizona and New Mexico. These species have been seeded extensively for livestock forage (Cox et al. 1986), and Lehmann lovegrass has spread naturally on sandy soils from 800 to 1,500 m elevation (Cox and Kuyile 1986). Plains lovegrass (E. intermedia Hitch.) is a native perennial lovegrass that is adapted to higher

Manuscript accepted 20 May 1991.
limited by seedcoat dormancy, which decreases with seed age (Brauen 1967). Treatments which disrupt the seedcoat, such as alternating temperatures and scarification, would be expected to interact with the degree of original dormancy and seed age in enhancing germination (Brauen 1967). Alternating temperatures and other treatments might have the greatest effect on germination at some midpoint in seed age between highly dormant young seeds and highly germinable older seeds. The original degree of dormancy of Lehmann lovegrass seeds varies greatly among years of collection from the same mother-plant population and varies among different populations for the same year of collection (Brauen 1967). Therefore, specific collections and ages of Lehmann and possibly other lovegrasses should be tested for germination responses to temperature conditions to determine seeding rates and to interpret differences in field emergence.

Natural and artificial revegetation studies have prompted our interest in the germination responses of specific collections of these species to alternating temperatures. A Lehmann lovegrass population at the Santa Rita Experimental Range in southern Arizona produced high seedling emergence in association with increased diurnal seedbed temperature fluctuations when the grass canopy was opened by burning or mowing (Ruyen et al. 1988. Sumrall et al. 1991). Cochine lovegrass seeded at 1 million pure live seeds per hectare, as calculated from a germination percentage of 14 at a constant temperature of 25°C, produced extremely high emergence in 1987 in southern Arizona in a seedbed preparation study (Winkel and Roundy 1991). Plains lovegrass seed produced from irrigated plants and with a germination percentage of 43 at a 30°C constant temperature produced very limited emergence on an extremely wet year when seeded at the Santa Rita Experimental Range (Livingston and Roundy 1991).

Our purpose was to determine if germination responses to temperature are related to observed seedling emergence and seedbed temperatures for these specific collections of Lehmann, Cochine, and plains lovegrass. Our approach was to characterize diurnal temperature fluctuations of field seedbeds where seedling emergence of these collections has been observed and to test germination of these collections in relation to an array of constant and alternating temperatures in the laboratory.

Methods

Soil Temperatures and Seed Collections

Lehmann lovegrass seeds were collected in fall of 1987 and 1988, and soil temperatures were measured for 2 years on a sandy loam upland site at 1,200-m elevation at the Santa Rita Experimental Range (SPER) 60 km south of Tucson, Ariz. Soil temperatures were measured in conjunction with a seedbed ecology study (Sumrall et al. 1991) on plots with an intact lovegrass canopy and on plots with the canopy removed by burning or mowing. Temperatures were measured during selected periods in fall, winter, spring, and just prior to and during the summer rainy season.

Soil temperatures were also measured in conjunction with a seedbed preparation study (Winkel and Roundy 1991) on a loamy upland site at 1,027-m elevation on the Anvil Ranch 65 km southwest of Tucson, Ariz. Measurements at that site were made just prior to and during the summer rainy season. Gypsum blocks and fiberglass soil cells (Colman and Hendrix 1949) were used to measure soil water availability for germination in relation to seedbed temperatures. Thermocouples or thermisters buried at 1 cm were used to sense temperatures. Temperature and moisture sensors were read every minute and 30-min. averages calculated using Campbell CR-10 dataloggers.

Cochise lovegrass seeds were obtained commercially from production fields in southeastern Arizona. The same seed lot used in the seedbed preparation study at the Anvil Ranch where soil temperatures were measured (Winkel and Roundy 1991) was used in germination tests. Plains lovegrass seeds were collected directly from plants growing at the Buenos Aires Wildlife Refuge, 90 km southwest of Tucson at 1,000-m elevation, as well as from irrigated transplants taken from the refuge and grown at the University of Arizona farm in Tucson.

Germination Tests

Germination tests were conducted using methods described by Young and Evans (1979). Seeds were placed on a single thickness of germination paper and kept moist with tap water. Seeds were considered germinated when the radical had emerged 2 mm.

Lehmann lovegrass seeds collected from the SRER in fall of 1987 were prechilled 12 months post harvest at 19 constant and alternating temperatures for 4 weeks, and germination recorded after 1, 2, and 4 weeks of subsequent exposure to a constant 35°C temperature. Prechilling included constant temperatures of 2, 5, and 10°C and alternating temperatures (cold 16 hours/warm 8 hours) of 0/2, 0/5, 0/10, 0/15, 0/20, 0/25, 2/5, 2/10, 2/15, 2/20/ 2/25, 5/10, 5/15, 5/20, and 5/25°C. Lehmann lovegrass seeds collected from the SRER in fall 1987 were also tested for germination 12 months after harvest in relation to 16 alternating temperatures including cold temperatures (16 hours) of 10, 15, 20, and 25°C Alternating with warm temperatures (8 hours) of 30, 40, 50 and 60°C. Seeds were incubated for 4 weeks and germination counts made after 1, 2, and 4 weeks.

Lehmann lovegrass, Cochine lovegrass and plains lovegrass seeds were tested for germination in relation to 78 constant and alternating temperatures. Constant temperatures were 0, 2, 5, 10, 15, 20, 25, 30, 35, 40, 45, and 50°C. Alternating temperature regimes consisted of 16 hours at each constant temperature and 8 hours at 1 of each possible higher temperature in each 24-hour period. For example, 0°C alternated with 2, 5, 10, 15, 20, 25, 30, 35, 40, 45, and 50°C but 45°C alternated with 50°C only. Lehmann lovegrass collected from the SRER in fall of 1987 and fall 1988 were tested in relation to these temperatures 18 months and 12 months after harvest, respectively. Cochine lovegrass and plains lovegrass were tested at 30 and 7 months after harvest, respectively.

All germination tests were done in dark germinations set at constant temperatures. Temperatures were alternated by moving petri dishes from 1 constant-temperature germinator to another. All treatments included 4 replications of 25 seeds each. Roundy et al. (1991) found that Lehmann lovegrass seeds initially imbibed in darkness had greatly increased germination in darkness after 1–5 min exposure to red light. Seeds in this study were exposed to light for periods greater than 5 min twice daily when seeds were changed from 1 germinator to another and also when petri dishes were removed for seed counts.

The arcsin of the square root of total germination percentages was analyzed by analysis of variance to determine significance of collections, temperature treatments, and interactions (P≤0.05). Least significant difference (P≤0.05) was used to separate germination means of collections, cold temperature treatments at specific warm temperatures, and warm temperature treatments at specific cold temperatures as appropriate based on analysis of variance.

Results

Seedbed Temperatures

Seedbed soil temperatures in the desert grassland at 1-cm deep fluctuated diurnally throughout the year (Table 1). Fluctuations were greater for a dry than wet seedbed and were greater for bare soil than that under a grass canopy. Differences between minimum
Table 1. Diurnal soil temperatures at 1 cm for 2 sites in the desert grassland in southern Arizona.

<table>
<thead>
<tr>
<th>Location and conditions</th>
<th>Minimum (°C)</th>
<th>Maximum (°C)</th>
<th>Maximum-Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Santa Rita Experimental Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>December-Soil dry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bare soil</td>
<td>2.6</td>
<td>31.1</td>
<td>28.5</td>
</tr>
<tr>
<td>Under grass canopy</td>
<td>6.4</td>
<td>21.4</td>
<td>15.0</td>
</tr>
<tr>
<td>December-Soil wet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bare soil</td>
<td>1.2</td>
<td>16.3</td>
<td>15.1</td>
</tr>
<tr>
<td>Under grass canopy</td>
<td>5.5</td>
<td>13.4</td>
<td>7.9</td>
</tr>
<tr>
<td>April-Soil dry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bare soil</td>
<td>10.5</td>
<td>32.3</td>
<td>21.8</td>
</tr>
<tr>
<td>Under grass canopy</td>
<td>12.2</td>
<td>20.7</td>
<td>8.5</td>
</tr>
<tr>
<td>April-Soil wet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bare soil</td>
<td>8.0</td>
<td>28.7</td>
<td>20.7</td>
</tr>
<tr>
<td>Under grass canopy</td>
<td>9.7</td>
<td>17.7</td>
<td>8.0</td>
</tr>
<tr>
<td>June-Soil dry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bare soil</td>
<td>17.3</td>
<td>54.1</td>
<td>36.8</td>
</tr>
<tr>
<td>Under grass canopy</td>
<td>19.2</td>
<td>47.0</td>
<td>27.8</td>
</tr>
<tr>
<td>July-Soil wet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bare soil</td>
<td>19.7</td>
<td>42.0</td>
<td>22.3</td>
</tr>
<tr>
<td>Under grass canopy</td>
<td>22.2</td>
<td>30.6</td>
<td>8.4</td>
</tr>
<tr>
<td>Anvil Ranch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June-Bare soil dry</td>
<td>21.8</td>
<td>59.9</td>
<td>38.1</td>
</tr>
<tr>
<td>July-Bare soil wet</td>
<td>21.5</td>
<td>41.1</td>
<td>19.6</td>
</tr>
</tbody>
</table>

1Wet = matric potential at 1-3 cm was ≥ -0.1 MPa.

and maximum temperatures were at least 20°C when the soil was wet during the rainy season in July when warm-season grass seeds usually germinate. Temperatures change continuously in a natural seedbed (Fig. 1) rather than abruptly as occurs in most laboratory tests of germination response to alternating temperatures.

**Fig. 1.** Average wet (matric potential ≥ -0.1 MPa) soil temperatures at 1 cm in a Lehmann lovegrass stand at the Santa Rita Experimental Range for 13-24 August 1989.

**Prechilling**

Germination of Lehmann lovegrass collected in fall 1987 and tested 12 months post harvest differed significantly among prechill temperature treatments ($P<0.05$). Constant prechill temperatures of 0, 2, 5, and 10°C produced limited germination but 0, 2, and 5°C cold-period temperatures alternating with warm-period temperatures greater than 10°C increased germination (Fig. 2). Generally, germination increased with increasing difference between cold and warm-period prechill temperatures. Prechill temperature alternations including 0 and 2°C cold-period temperatures resulted in higher germination than those with a 5°C cold-period temperature. Some of the seeds in this experiment germinated during the prechill period.

**Seed Age**

Germination of Lehmann lovegrass collected in the fall of 1987 and tested at 12 and 18 months post harvest was statistically compared for the 8 common cold and warm period-temperature alternations at which they were tested and produced some germination. No germination occurred at warm-period temperatures of 50 or 60°C. Cold period temperature, warm period temperature, seed age, and the 2 and 3-way interactions of these factors were all significant ($P<0.05$). Twelve-month-old seeds had very high germination when cold-period temperatures of 10, 15, and 20°C were alternated with a 40°C but not when alternated with a 30°C warm period temperature (Fig. 3). Eighteen-month-old seeds had a trend toward higher germination at a warm period temperature of 40°C compared to 30°C, but the differences were not significant.

**Fig. 2.** Germination (%) of Lehmann lovegrass seeds at 12 months post harvest in relation to cold period (16 hours) and warm period (8 hours) prechill temperatures. Seeds were prechilled at alternating temperatures for 4 weeks then germinated at a constant 35°C for 3 weeks. Similar letters above means for a warm-period temperature indicate no significant difference ($P>0.05$) among those corresponding means as determined by LSD.

**Fig. 3.** Germination (%) of Lehmann lovegrass seeds at 12 and 18 months post harvest in relation to 4 cold period (16 hours) and 2 warm period (8 hours) incubation temperatures. Similar letters relative to means at a cold period temperature indicate no significant difference ($P>0.05$) among those corresponding means as determined by LSD.
Germination was similar for both seed ages at a 30°C warm-period temperature for all cold-period temperatures. Germination did not differ greatly but slightly decreased with increasing cold-period temperature at a warm-period temperature of 30°C.

Seed Collections and Alternating Temperatures
Lehmann lovegrass seeds collected in fall 1988 and tested 12 months post harvest and plains lovegrass seed collected from unirrigated plants at the Buenos Aires Wildlife Refuge and tested at 7 months post harvest both had very low germination. The 1988 Lehmann lovegrass seed had a maximum germination of 12% at a temperature alternation of 0/20°C, while the Buenos Aires plains lovegrass had a maximum germination of 17% at an alternation of 2/30°C. Germination of these collections was generally less than 10% for different temperature alternations.

Germination of Lehmann lovegrass collected in 1987 and tested at 18 months post harvest, Cochise lovegrass tested at 30 months post harvest, and plains lovegrass from irrigated plants tested at 7 months post harvest was compared statistically for 78 temperature treatments. Collection, temperature treatment, and the interaction of these factors were highly significant (P<0.05) for total germination percentage. Only plains lovegrass germinated at a warm-period temperature of 45°C (25, 8, and 14% at temperature alternations of 25/45, 30/45, and 35/45°C, respectively). No germination occurred at a warm-period temperature of 50°C. Lehmann and Cochise lovegrass generally had a similar pattern of germination response to alternating temperatures (Fig. 4). Both collections had much higher germination than plains lovegrass at low cold-period temperatures alternating with 15 to 25°C warm-period temperatures. Germination of plains lovegrass generally increased with increasing warm-period temperatures for a given cold-period temperature. Germination of Lehmann and Cochise lovegrass increased with increasing warm-period temperatures for some cold-period temperatures and increased then decreased with increasing warm-period temperatures for other cold-period temperatures. Greater temperature alternations generally produced higher germination and germination was low at cold-period temperatures of 30°C or higher.

Constant and Alternating Temperatures
Germination of seeds of Lehmann lovegrass at 18 months post harvest, Cochise lovegrass at 30 months post harvest, and plains lovegrass from irrigated plants at 7 months post harvest was compared statistically for 4 constant and 6 alternating temperatures (Table 2). Those temperatures were of interest because they are commonly recommended for germination tests or are representative of seedbed temperature extremes during the summer rainy season. Collection, temperature, and the interaction of these fac-

Table 2. Germination (%) at 4 constant and 3 alternating temperatures for 3 lovegrasses.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Lehmann lovegrass</th>
<th>Cochise lovegrass</th>
<th>Plains lovegrass</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>38a</td>
<td>33b</td>
<td>16b</td>
</tr>
<tr>
<td>20</td>
<td>21bc</td>
<td>40ab</td>
<td>21b</td>
</tr>
<tr>
<td>25</td>
<td>10c</td>
<td>21cd</td>
<td>7c</td>
</tr>
<tr>
<td>30</td>
<td>7d</td>
<td>15d</td>
<td>16b</td>
</tr>
<tr>
<td>35</td>
<td>8cd</td>
<td>47ab</td>
<td>21b</td>
</tr>
<tr>
<td>40</td>
<td>14cd</td>
<td>45ab</td>
<td>28b</td>
</tr>
<tr>
<td>45</td>
<td>29ab</td>
<td>55a</td>
<td>47a</td>
</tr>
</tbody>
</table>

1Means in a column with the same letter are not significantly different by LSD (P>0.05).
Temperature alternations produced higher germination of Lehmann lovegrass than did constant temperatures, except at 20°C. Some constant temperatures produced similar germination of Lehmann and plains lovegrass as some alternating temperatures. The 20/40°C temperature alternation produced higher germination of plains lovegrass than the 20/35°C alternation recommended by Chirco and Turner (1986). The 20/30°C temperature alternation recommended for testing germination of Lehmann lovegrass (Chirco and Turner 1986) and many other grasses (Yaklich 1984) produced low germination of this collection of Lehmann lovegrass, compared to a constant 15°C or an alternation of 20/40°C.

**Discussion**

Use of laboratory germination tests to indicate germinability of lovegrass seeds under actual seedbed temperature conditions in natural and artificial revegetation studies may have a number of limitations.

**Field Seedbed Temperatures Prior to Germination**

Seeds in field seedbeds are exposed to a variety of temperature and moisture conditions that may stimulate or reduce germinability. Seeds of warm-season grasses in the Southwest are usually seeded prior to the summer rainy season and are exposed to wide temperature extremes in dry seedbeds (Table 1). Seeds of lovegrass in the field generally fall in September or October and are exposed to an array of temperature extremes in dry and wet seedbeds prior to summer rains, when they usually germinate. Natural pretreatments may reduce dormancy of Lehmann lovegrass seeds suggested by the increased germinability of seeds in the laboratory after prechilling (Fig. 2), and after various wet and dry heat treatments (Haferkamp and Jordan 1977, Haferkamp et al. 1977). Germinability of Lehmann lovegrass seeds in the seedbank, as indicated by bioassay, increased with time after seed rain and was highest prior to the summer rainy season (Ruyle et al. 1988, Sumrall et al. 1991). Besides afterripening with time during the winter and spring, seeds in field seedbeds may lose dormancy as they are exposed to widely fluctuating temperature and moisture conditions.

Just how much field seedbed conditions throughout the year affect germinability of lovegrass seeds during the summer rainy season is unclear. Emergence of Lehmann lovegrass from bioassay samples collected after seed rain in fall of 1988, stored dry in the laboratory and tested in June 1989, was as high as emergence from samples collected and tested in June 1989 (Sumrall et al. 1991). This suggests that environmental seedbed conditions did not increase germinability of Lehmann lovegrass or that, if they did, there was also a loss in viability or germinability of some seeds during the winter and spring.

**Laboratory and Field Temperatures during Germination**

Seeds in field seedbeds are exposed to temperatures which change gradually and continuously between the minimum and maximum (Fig. 1), while those in most laboratory studies are exposed to abrupt alternations, generally being at one temperature for 16 hours and at another for 8 hours (Yaklich 1986). Because abrupt temperature alternations may break dormancy of some species (Yaklich 1986), sharp temperature alternations in laboratory tests could overestimate germinability of seeds under field conditions.

Lehmann and Cochise lovegrass had high germination under low cold-period temperatures (0-2°C) alternating with high warm-period temperatures (20-30°C, Fig. 4). These temperature extremes rarely occur in the semidesert grassland (Table 1). However, these lovegrass species had at least 28 to 45% germination at temperature alternations similar to those that occur in a wet seedbed in December (0/15, 2/15°C, Table 1). Lehmann, Cochise and plains lovegrass had 28, 61, and 14% germination, respectively, at a temperature alternation of 10/30°C, which is similar to wet seedbed temperature extremes in April (Table 1). However, these species usually emerge during the summer rainy period in July and August, not during winter or spring rains. In the case of low cold-period, moderate and high warm-period temperature alternations, laboratory germination results do not appear to be very representative of germinability in the field for these lovegrasses.

Totterdell and Roberts (1980), Roberts and Totterdell (1981) and Probert et al. (1986) have shown that germination of some seeds is sensitive to the time spent at a particular temperature in a temperature alternation treatment, as well as the rate and amplitude of temperature change. Low temperatures are effective in breaking dormancy of many species which will then germinate at higher temperatures (Bewley and Black 1982). The relatively long warm period of laboratory temperature alternations may allow germination to proceed while the low cold-period temperature helps to break dormancy for Lehmann and Cochise lovegrass. However, the minimum temperature requirement for germination of Lehmann lovegrass does not appear to be satisfied by field seedbed temperatures in winter or spring.

Germinability of seeds at laboratory temperature alternations within the range of seedbed temperatures measured during the summer rainy season appears to be associated with germinability in the seedbed. Temperatures in wet seedbeds in July when warm-season grasses usually germinate and emerge ranged from 20 to 42°C at 1-cm deep in bare soil (Table 1). Lehmann lovegrass seeds collected in 1987 and tested at 12 months post harvest had much higher germination at a temperature alternation of 20/40°C than 20/30°C (Fig. 3). This corresponds to the much higher emergence of Lehmann lovegrass from bare soil than from under a lovegrass canopy where temperature ranged from 22 to 31°C on the site where this site was collected (Table 1, Sumrall et al. 1991). The lack of field emergence of Lehmann lovegrass under the canopy may have been due to less temperature alternation and also due to lack of red light (Koundy et al. 1991).

Cochise lovegrass seeded at the rate of 1 million pure live seeds per hectare as calculated from a germination percentage of 14 at a constant temperature of 25°C had unusually high emergence during a wet summer (Winkel and Roundy 1991). This same lot of Cochise lovegrass in the current study had 21% germination at a constant temperature of 25°C and 55% germination at a temperature alternation similar to that of a wet seedbed in July (20/40°C). The bulk seeding rate of Cochise lovegrass could have been overestimated by using a constant-temperature germination percentage to calculate the pure live seed percentage.

Plains lovegrass seeds tested in this study had 47% germination at a temperature alternation of 20/40°C and at least 18% germination at other moderate, mid-range temperature alternations (15-20°C cold periods alternating with 25-40°C warm periods). Germination responses to temperature do not appear to be responsible for why help explain lack of emergence of this seed lot when seeded on a wet year (Livingston and Roundy 1991).

**Seed Age and Collection**

Because Lehmann lovegrass seed dormancy can vary so much with collection and age (Brauen 1967), laboratory germination tests may or may not indicate germinability in the seedbank at a different time than when the laboratory tests are conducted. Leh-
mannon lovegrass harvested in fall 1987 and tested at 12 months post harvest had much higher germination at temperature alternations of 10/40, 15/40, and 20/40°C than the same seed tested at 18 months post harvest (Fig. 3). Thirty-month-old seeds of Cochise lovegrass, 18-month-old seeds of Lehmann lovegrass, and 7-month-old seeds of plains lovegrass had highest, intermediate and lowest germination, respectively, over an array of germination temperatures. Because seed age and species are confounded, higher germination cannot conclusively be attributed only to greater seed age. In fact, year of collection, as probably reflecting the environment of the mother plants, had the greatest effect on overall germinability of seeds in this study. Lehmann lovegrass seeds collected from the SRER in fall of 1988 had much lower germination when 12 months old than seeds collected in 1987 at 12 and 18 months of age. Plains lovegrass seeds from irrigated plants had much lower germination than those of the same age from irrigated plants taken from the same population.

Difference in germinability of different lovegrass collections may be due in part to differences in degree of seed coat permeability as related to environmental conditions under which the seed was produced. Brauen (1967) found 14 to 18 collections of Lehmann lovegrass seed to be highly dormant (<10% germination), depending on the year of collection, while 18 to 22 others were not. Scarification increased germination rate and percentage of 10 collections of Lehmann lovegrass tested by Hardegree and Emmerich (1991). Variability among these collections in germination rate was decreased by scarification but not variability in total germination percentage. This indicates that differential germinability of different collections of Lehmann lovegrass may be only partly due to differences in seedcoat permeability.

Germination responses of different Lehmann lovegrass collections to temperature are also highly variable as indicated by the literature and the current study. Temperature alternations recommended for plains and Lehmann lovegrass by Chirco and Turner (1986) and those that produced maximum germination of Lehmann lovegrass in other studies (Knipe 1967, Wright 1973) did not produce the highest germination in this study.

This study and data from the literature indicate the difficulty in determining laboratory temperature treatments to indicate germinability of lovegrasses in field seedbeds. The high degree of variability in germination of different collections and ages of seed in relation to temperature make it difficult to state a temperature alternation that could be used to determine maximum germinability of all collections. The 20/40°C alternation in this study produced maximum germination in all collections and is similar to wet seedbed temperature extremes during the summer rainy season when lovegrass usually germinate. Laboratory germination tests which mimic actual wet seedbed temperature curves could be most useful in understanding natural recruitment and in making more accurate pure live seed and bulk seedling rate calculations for revegetation with lovegrasses. Seed age is an important consideration in testing germinability of lovegrasses for ecological interpretations and for seed rate calculations for revegetation.

Literature Cited


Curtis and Curtis, Inc. 1989. Southwest plants. Star Rt. Box 8A, Clovis, N.M.


