Thermal Regulation of Water Uptake by Germinating Honey Mesquite Seeds

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Highlight

Ambient temperature regulated the rate and extent of water imbibition by germinating honey mesquite (Prosopis glandulosa Torr., var. glandulosa) seeds. Honey mesquite seeds required less water and less time for germination at 85 than at 100 or 70 F. Seeds at 70 F contained almost 3 times as much water as seeds at 85 F when germination first occurred although the rate of water uptake (mg/seed/hr) was reduced considerably. Decreasing moisture availability to 8 atm influenced the rate of water absorption by seeds more at 85 and 100 F than at 70 F.

Honey mesquite (Prosopis glandulosa Torr., var. glandulosa) occurs on some 80 of the 107 million acres of Texas rangelands. It is established in regions ranging from semiarid to sub-humid on a wide array of soils varying in origin, texture, nutrient level and moisture availability. Much research effort has been devoted toward development of control measures. However, less effort has been concentrated on factors determining the ecological range of honey mesquite. An understanding of germination, seedling establishment and plant growth may elucidate methods of controlling and preventing the reinvasion of honey mesquite. Since available moisture and temperature influence development of individual plants and vegetation communities, investigation of these climatic variables may facilitate understanding the ecological behavior of a plant species. This report emphasizes the role of temperature in rehydration of honey mesquite seeds from inactive embryonic tissues to emergence of the radicle from the testa.

Materials and Methods

Honey mesquite seeds for these studies were collected near Spur, Texas in 1967 and 1968. The seeds germinated in excess of 95% following scarification. The technique and apparatus used in these studies have been previously described by Scifres and Brock (1969). Honey mesquite seeds were germinated on cheesecloth saturated with distilled water in 90-ml glass vials. A glass tube, held in place with a plastic cap, was placed in the center of each vial to allow gas exchange. All openings, except the end of the glass tube, were sealed with lanolin paste. The vials were submerged in water baths at temperatures of 70, 85 or 100 F. One hour was allowed for equilibration of the vials.

The air-dry weight of 10 honey mesquite seeds was determined before the seeds were placed in each germination vial. Three vials were placed in each of the temperature regimes. For determination of weight change, the honey mesquite seeds were carefully removed from the vials and quickly and gently blotted dry with tissue paper. Weights were determined hourly for the initial 6 hr. Weights were also recorded at 8, 10, 12 and 24 hr after initiation of the study. Time lapse from removal to replacement in the water baths rarely exceeded 5 minutes. The seeds were also weighed at the first sign of germination (when the radicle extended 2-mm from the testa). The study was repeated four times and data averaged.

A similar study was conducted utilizing cheesecloth saturated with a mannitol solution in the vials. The mannitol solution was made to achieve a moisture tension of 8 atm as described by Powell and Pfeifer (1956). The experiment was conducted twice and the data averaged.

The increase in fresh weight over any time period t from the dry weight was assumed due to imbibition of water. Phillips (1968), in studies of water diffusivity of crop seeds, assumed the available moisture at the seed-water source interface to be constant throughout the germination period. In the present studies a similar assumption, that the volume of free space between the testa and embryo did not interact with temperature and influence water movement into the embryo, was made. Phillips (1968) discussed in detail the theory underlying manipulation of this type of data. The amount (mg) of water imbibed after a given time interval t is denoted A(t). The amount of water imbibed by the time of “first germination” is denoted A(tg). Imbibition curves were developed by considering the ratio A(t)/A(tg) as a function of time.

Results and Discussion

Only 11 hr were required for germination of honey mesquite seeds at 85 F in distilled water (Figs. 1 and 2). The average dry seed weight was about 42 mg and 44 mg of water had been imbibed at germination. The average rate of imbibition was about 4.0 mg/seed/hr.

There was no difference in imbibition rate of honey mesquite seeds at 85 and 100 F for the first 8 hr (Fig. 1). Germination occurred after 18 hr.

**FIG. 1.** Increase in weight of honey mesquite seeds in distilled water at 100, 85 and 70 F at various time intervals for the initial 24 hr following wetting.
Measurement of Seasonal Air Temperatures Near the Soil Surfaces

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1 Received July 5, 1970; accepted for publication September 8, 1970.
2 Central headquarters located in Portland, Oregon.

Highlight

A study of the maximum air temperature near the soil surface at 11 grassland locations was made during the summer of 1968 using a simple maximum temperature indicator. The maximum temperatures within the first centimeter above the soil were found to exceed 144°F on a number of these locations. Although the range of indicators was not large enough to include the extremes at all locations, a seasonal pattern was identifiable. Large local differences in near-surface temperatures were frequently observed. Presently, there is a lack of information describing the development and survival of forage plants in limiting environments. Temperature extremes are frequently recognized as an index for plant survival in these locations, but it is well known that many other factors (e.g., humidity, duration of exposure, plant age) influence the impact of temperature (Laude, 1964). It has been reported (Hallin, 1968; Gates et al., 1968) that maximum air temperatures near the soil surface in


Table 1. Ratio of water uptake at 2, 4 and 6 hr (At) to the amount of uptake at first germination (Atg) of honey mesquite seeds under 0 and 8 atm osmotic pressure at 70, 85 and 100 F.

<table>
<thead>
<tr>
<th>Germination temperature (F)</th>
<th>Osmotic pressure (Atm)</th>
<th>Water uptake ratios at various times (hr) after wetting</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>2</td>
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<tr>
<td>70</td>
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<td>0.03</td>
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<tr>
<td></td>
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<tr>
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<tr>
<td></td>
<td>8</td>
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1 Differences in mean ratios must exceed 0.13 for significance (P < 0.05).