SURVIVAL OF SELECTED DESERT SHRUBS
under dry soil conditions

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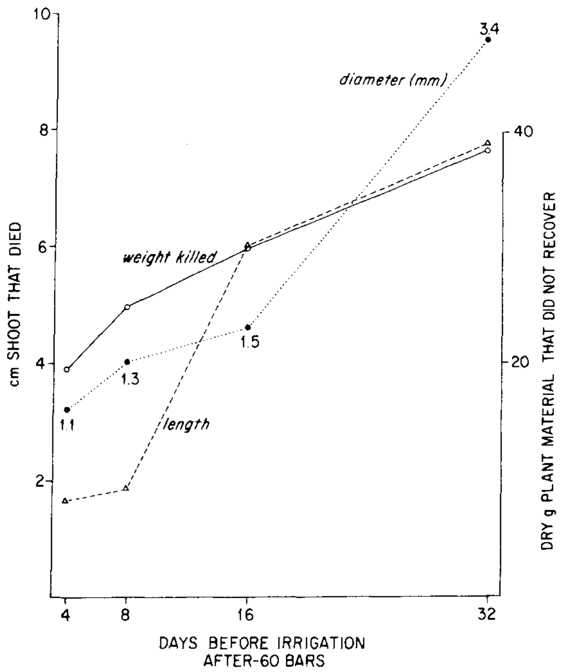
Four desert plants species were grown in plexiglass cylinders in which thermocouple psychrometers were placed so that soil moisture potential could be measured. After establishment the plants were allowed to extract the soil moisture to –60 bars. Different samples of each were then irrigated at different time intervals to measure recovery characteristics. Partial wilting of each occurred at much lower soil moisture potentials than agricultural crops and each recovered in varying degrees for irrigation 8 to 10 days after reaching the point of –60 bars soil moisture potential. These studies of drought resistant species help understand some responses of other plants to soil moisture variations.

THE RELATIONSHIP between field-grown desert shrubs and soil-water level is not well known, especially for plants with extensive root systems, where it is difficult to determine soil-water level in some portions of the root zone.



The longer the dry period following the point of –60 bars soil-moisture potential before irrigation of **A. dumosa**, the greater was the weight of plant material that did not recover, and the larger was the diameter and length of stems that died.

Glasshouse studies were conducted to determine the relationship between plant vigor and soil-water stress under conditions where the soil-water status of the entire root zone was known. The length of time a plant could go without water and still recover was also observed.

Studies were conducted on four species: *Atriplex hymenelytra* (Torr.) Wats. (desert holly), *Atriplex confertifolia* (Torr. & Frem.) Wats. (shadscale), *Ambrosia dumosa* (Gray) Payne (burro bush), and *Larrea tridentata* Ses. & Moc. (creosote bush). The plants were grown in cylindrical plexiglass containers, 10 cm in diameter and 30 cm long. Yolo silt loam soil, treated with krilium to maintain aggregate stability, was used as the growth medium. Seedlings of *L. tridentata* and rooted cuttings of the other three species were selected for uniformity and transplanted to the soil-filled containers. All containers were periodically watered to approximately 20% soil-water content until roots were fully established throughout the container, and watering was then discontinued.

Thermocouple psychrometers were installed in the soil containers at depths of 10, 20, and 30 cm to monitor soil-water potential. Plants were taken from the glasshouse into the headhouse early in the morning to prevent rapid increase in soil temperature which interferes with water potential measurements. Plants were allowed to stand in the headhouse for approximately one-half hour before measuring the water potential and then returned to the glasshouse after the measurement had been made. Measurements were usually made three times each week. The soil-water potential could be monitored by our psychrometers to about –60 bar potential.

The date on which the soil-water potential reached –60 bars was considered as zero day. Except for *L. tridentata*, the plants were watered at 4, 8, 16, or 32 days after the soil-water potential was –60 bars. *L. tridentata* plants were watered at 5, 10, 20, or 40 days following –60 bar potential. Plants were observed through both the drying phase and the period following watering.

The studies with *A. hymenelytra* were conducted during November and December. Soil-water potential remained relatively high for approximately 25 days and then decreased rapidly. It took approximately 12 days for the potential to drop from about –5 to –60 bars.

No visible symptoms occurred at potentials of –15 bars (the soil-water potential commonly considered to be permanent wilting point for many plant species). Nevertheless, placing a hand around the plant indicated that the plant at –15 bars potential was somewhat less turgid than before. Visible signs of wilt occurred at approximately –25 bars. Severe wilt was observed at –40 bars. Leaf necrosis or desiccation did not occur until several days after the potential reached –60 bars and could no longer be monitored.

Recovery

The plant irrigated at four days after the zero point showed no symptoms of necrosis at the time of irrigation. Recovery after irrigation was quite rapid. New root development was observed four days following irrigation.

The plant irrigated at eight days following –60 bar potential had some necrosis (not severe) at the leaf edges on the lower part of the plant. The plant recovered after irrigation, but less rapidly compared with the 4-day irrigation treatment. Very little permanent damage to the plant appeared from this drying treatment.

The plant allowed to go 16 days after –60 bar potential without watering was in a severe state of desiccation. The plant did not recover upon watering. The plant allowed to go 32 days without watering following –60 bar potential did not recover either.

The studies on *A. confertifolia* were conducted during July and August. Soil-water potential remained high for about 19 days following irrigation and about 10 more days were required to reach –60 bar potential following a rather rapid decline in soil-water potential.

No visible signs of stress occurred until the potential reached about –30 bars, at which time loss of turgor was observed. Lower stems dropped, leaves turned dark, and dehydrated. There was,

Ambrosia dumosa plant irrigated (from right to left) 4, 8, 16 and 32 days after reaching –60 bars soil moisture potential. The plant watered at 32 days is dead. New foliage is growing from near the base of the plant watered at 16 days, but most of the foliage is dead.

however, no severe desiccation when the water potential was below –40 bars.

Erratic results were observed in recovery after irrigation. The plant irrigated four days after –60 bar potential recovered completely and rapidly. The plant irrigated eight days following –60 bars did not recover. On the other hand, the plant irrigated 16 days after –60 bar potential did recover. The plant irrigated at 32 days did not recover. The plant which received the 16-day treatment behaved differently from the others throughout the course of the study. Soil-water potential decreased much more slowly on this plant compared with the others. However there is no clear-cut explanation for the difference between the 8- and 16-day treatments.

The study on *A. dumosa* was conducted during May and June. A sharp decrease in soil-water potential was observed approximately five days after irrigation. Approximately eight days were required following this period for the potential to reach –60 bars. *A. dumosa* apparently used water more rapidly than *A. confertifolia* or *A. hymenelytra*. The difference in rate of water use could not be completely attributed to difference in plant size. The *Atriplex* species appear to have a lower transpiration rate as compared to *A. dumosa*.

The plants showed no wilt at potential of –15 bars, although the leaves appeared grayer. Severe chlorosis on all but the leaves toward the growing tip occurred when the potential was about –38 bars. Most of the leaves were completely necrotic when soil-water potential was –60 bars.

Plants watered at 4, 8, and 16 days after –60 bars recovered. The plant irrigated 32 days after –60 bar potential did not recover (see photo). The plants irrigated at the 4- and 8-day intervals recovered quite quickly. The plant irrigated at 16 days was much slower to show signs of recovery. First recovery of all time periods was on the older, harder stems. Buds then appeared gradually towards the terminal shoot until dead tissue was reached.

The graph indicates that stems of *A. dumosa* died from the tip back as time progressed after irrigation. Note that the average length of dead shoot increased as the time for irrigation after –60 bar potential increased. This effect is also observed by an increase in the largest diameter of killed stem. The total weight of dried material which did not recover also increased as the time before rewatering was lengthened.

Studies on *L. tridentata* were conducted during October and November. The soil-water potential decreased quite rapidly in the container only three days after irrigation. Soil-water potential reached –60 bars approximately nine days after the decrease in soil-water potential. *L. tridentata* appeared to transpire somewhat more rapidly than *A. dumosa* and much more rapidly than the *Atriplex* species.

L. tridentata plants varied considerably, possibly because of the use of seedlings rather than rooted cuttings. In general, the plants became chlorotic and lost some leaves as the soil dried. The plant watered five days after –60 bar potential recovered rapidly. The lower third of the plant had defoliated, but this was not a permanent effect.

Ten days after –60 bar potential, defoliation occurred on about 80% to 90% of the plant. Some leaves on the tips remained green, but most of the remaining leaves were partially necrotic. Following irrigation, new buds developed on stems where lateral shoots took off. There was no sign of die-back on the plant, and complete recovery occurred. Plants watered 20 and 40 days after –60 bar potential did not recover.

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