Germination of Texas Persimmon Seed

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Abstract

Seed of Texas persimmon germinated in excess of 90% at constant temperatures from 20 to 30° C, and in an alternating temperature regime of 20–30° C. Seeds germinated equally well in light and dark. No seed dormancy mechanisms were observed, and viability was not reduced after storage at room conditions for 2 years. Germination percentages of seeds collected from 2 contrasting range sites did not differ. Germination did not differ over a broad range of pH values (4 to 11), but radicle elongation was inhibited at pH 11. Germination and radicle length were sensitive to osmotic potentials of 0.2 MPa or more, and no seed germinated at 1.2 MPa. Germination was restricted in a 5 g/l NaCl solution and nearly ceased at 10 g/l NaCl. Radicle length was more sensitive to NaCl solutions than was germination. Ion toxicity of salt solutions appeared to be more detrimental to germination and radicle growth than the osmotic potential of salt solutions. Seeds were not dependent on soil cover for seedling establishment, but the highest emergence occurred when seeds were covered with 1 cm of soil. Percent of germination was not reduced by passage through the digestive tracts of coyotes.

Texas persimmon *(Diospyros texana),* also called "black" and "Mexican" persimmon is a native shrub or small tree found in rocky open woodlands, open slopes, arroyos, and other such places throughout the western two-thirds of Texas (Correll and Johnston 1970). Highest densities occur in a group of 13 counties in south-central Texas from the southern edge of the Edwards Plateau into the northern South Texas Plains (Scifres 1975). It is usually 2 to 3 m tall, but may attain a height in excess of 6 m. Texas persimmon fruits are an important wildlife food (Vines 1960, Arnold and Drawe 1979), but this species is often a deterrent to effective range management. Although usually considered a minor component of range vegetation, Texas persimmon may become one of the primary problems following use of mechanical brush control methods such as chaining and root plowing (Scifres 1975, 1980). Moreover, it is a hard-to-kill species that is essentially resistant to conventional herbicides applied as broadcast sprays. Because its roots extend laterally a great distance from the parent plant, it is also resistant to most mechanical control methods (Scifres 1980).

Little is known of the life history or biology of Texas persimmon. The major objective of this study was to determine the germination response of Texas persimmon seeds in the laboratory to certain environmental factors encountered in the seedbed. The effect on seed germination after passing through a coyote digestive tract was also studied.

Materials and Methods

Texas persimmon seeds were collected in August 1980 from several plant populations growing on a gray sandy loam range site (Aridic Ustochrepts) near La Joya in Hidalgo County, Texas. Only fully developed, undamaged seeds were used for germination experiments. Prior to use in experiments, seeds were stored at room conditions (20 to 27°C, and 50 to 75% relative humidity). With the exception of periodic determination of germination over a 2-year period, the various experiments were conducted when the seeds were less than 1 year old.

All experiments were conducted in small growth chambers with automatic temperature and fluorescent light (200 $\mu E/m^2/s$) controls. Unless otherwise stated, experiments were conducted at a constant temperature of 25° C (optimum) with an 8-hr light period. An experimental unit was 10 seeds in a 15-cm petri dish that had 2 filter papers wetted with 20 ml of distilled water or an appropriate test solution. Experiments were designed as randomized complete blocks unless otherwise stated. Treatments were replicated 10 times, and each experiment was conducted twice. Seeds with 2-mm long radicles were considered as germinated. Germination was recorded 14 days after the initiation of each experiment. Radicle lengths were recorded in selected experiments.

Seeds were germinated under continuous temperatures of 15, 17.5, 20, 22.5, 25, 27.5, 30, 32.5, 35, and 40°C (8-hr light period, 16-hr darkness) and alternating temperatures of 10–20, 15–25, 20–30, and 25–35°C (16-hr low temperature in darkness, 8-hr high temperature with light) (Mayeux and Scifres 1978, Mayeux 1982, Everitt 1983a).

The effects of simulated moisture stress on seed germination were evaluated by adding polyethylene glycol (PEG-6000) to distilled water for the substrata—PEG-6000 concentrations required to give osmotic potentials over a wide range of temperatures are given by Michel and Kaufman (1973). Their results were used to prepare solutions ranging from 0 to 1.2 MPa at 25°C (1 MPa = 10 bars). The pH of these PEG solutions was 6.7.

Tolerance to salinity during germination was evaluated with aqueous solutions of NaCl at concentrations of 0, .25, .5, .75, 1, 2.5, 5, and 10 g/l. The influence of substrate pH on germination was investigated by adjusting the pH of distilled water with HCl and KOH (Mayeux and Scifres 1978). Percent germination was evaluated at pH values of 2, 3, 4, 5, 6, 7, 8, 9, 11, and 12.

Light requirements for seed germination was investigated by comparing germination in petri dishes covered with aluminum foil with germination in uncovered dishes. The effect of age on germination was investigated by comparing germination at 1, 6, 12, 15, 18, 21, and 24 months after seed collection.

The influence of planting depth on seed germination was studied in the greenhouse. Temperatures in the greenhouse ranged from 21 to 28°C. Ten seeds were planted in soil in large pots (16 cm diameter × 16 cm height). A potting mixture of 3 parts sandy loam :1 part peat moss: 1 part perlite was used to prevent crusting. Seeds were placed on the soil surface and also covered to depths of 1, 2, 4, 5, and 7 cm. Seedling emergence and height were recorded after 60 days.

Seeds were also collected from several plant populations growing on a shallow sandy loam range site (Ustollic Paleorthids) in northern Hidalgo County in August 1980, and their germination was compared with that of plants from the gray loam site.

During August 1979, seeds were recovered from fresh coyote feces from the gray sandy loam site near La Joya and their germination was compared with that of control groups of seeds from this same site. Seeds were taken from approximately 50 fecal samples. Three-hundred seeds from fecal samples and 300 control seeds

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were placed in a growth chamber at 30° C. Each experimental unit consisted of 10 seeds in a 15-cm petri dish containing 2 filter papers wetted with 20 ml of distilled water. Treatments were replicated 10 times and each experiment was conducted 3 times.

Percentage germination and emergence data were transformed (Arcsin) before statistical analyses. Data from 2 or 3 experiments were pooled prior to analyses. Data were subjected to analysis of variance and Student's *t*-test. An LSD was calculated in selected experiments (Steel and Torrie 1960). All statistical comparisons were made at $P>0.05$.

Results and Discussion

Germination of Texas persimmon seed appears to be restricted to a relatively narrow temperature range (Fig. 1). Germination was ≥93% at constant temperatures of 20–30° C, but decreased abruptly

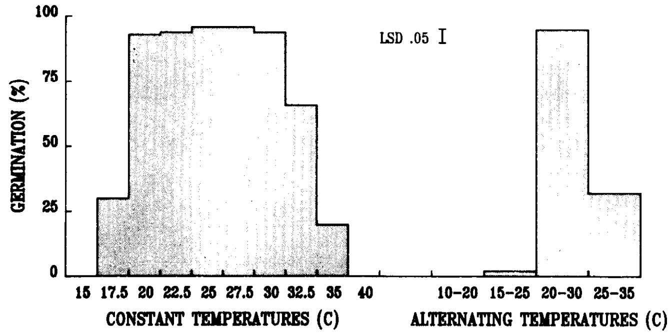

Fig. 1. *Average germination percentage of Texas persimmon seed after 14 days exposure to 14 constant and alternating temperatures.*

or ceased outside this range. Germination is apparently less tolerant of cold than warm temperatures. Germination dropped from 93% at 20° C to 30% at 17.5° C. Only 2% of the seeds germinated at an alternating temperature of 15–25°C, and none of the seeds germinated at a constant temperature of 15°C. The temperature requirements for Texas persimmon seed germination are apparently more specific than that reported for other troublesome woody plant species from central and southern Texas (Mayeux and Scifres 1978; Everitt 1983a, b.)

The percentage of seeds that germinated in light did not differ from those germinated in darkness. These results are in agreement with those reported for other woody plant species from Texas rangelands (Scifres and Brock 1972; Scifres 1974; Whisenant and Ueckert 1981; Everitt 1983a,b).

Texas persimmon seeds germinated over a broad range of pH values. Seed germination ranged from 93 to 97% at pH values from 4 to 11. None of the seeds germinated at pH 2 or 3, and only 12% of the seeds germinated in the most alkaline solution, pH 12, but these values rarely exist under field conditions. Seedling radicle lengths followed a similar trend to germination, but were suppressed in the pH 11 solution. These findings support those reported for numerous other woody plant species that may occur in association with Texas persimmon (Scifres 1974; Mayeux and Scifres 1978; Everitt 1983a, b).

Germination and radicle growth were sensitive to osmotic potentials of PEG solutions (Fig. 2). Both germination and radicle length were inhibited at only 0.2 MPa and continued to be progressively reduced as the osmotic potentials of the solutions were increased. Apparently, germination is dependent on high adequate water availability, indicating that seedling establishment is probably confined to periods of high soil moisture. The highest rainfall in central and southern Texas occurs in late spring and early fall, and temperatures during these periods are generally mild, which probably favors germination and establishment (National Oceanic and Atmospheric Administration 1974).

Germination was not adversely affected by NaCl concentrations

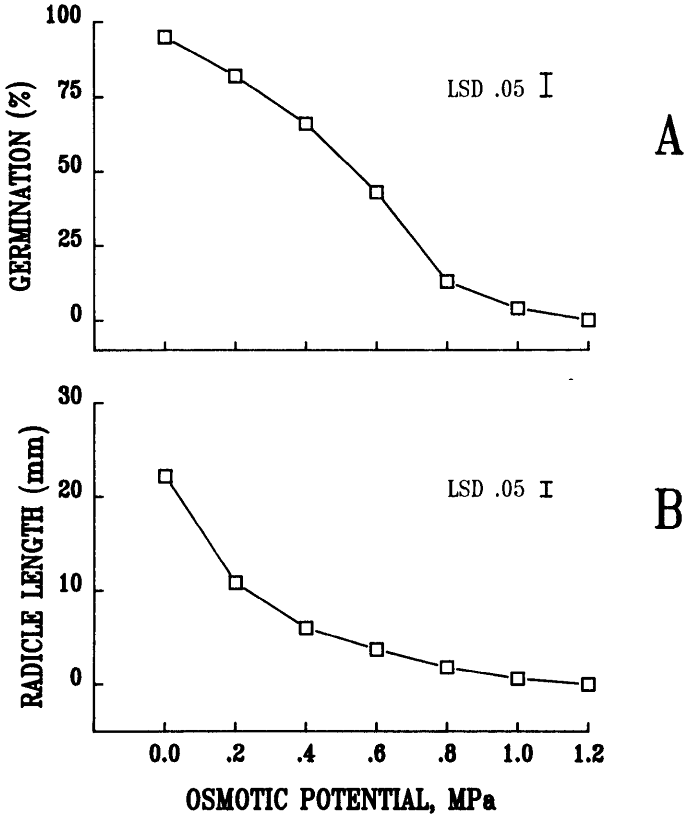

Fig. 2. *Texas persimmon percentage seed germination (A) and radicle length (B) after 14 days exposure to germination media of various omsotic potentials.*

up to 2.5 g/l (Fig. 3). However, germination was suppressed in the 5 g/l solution and nearly ceased in the 10 g/l NaCl solution.

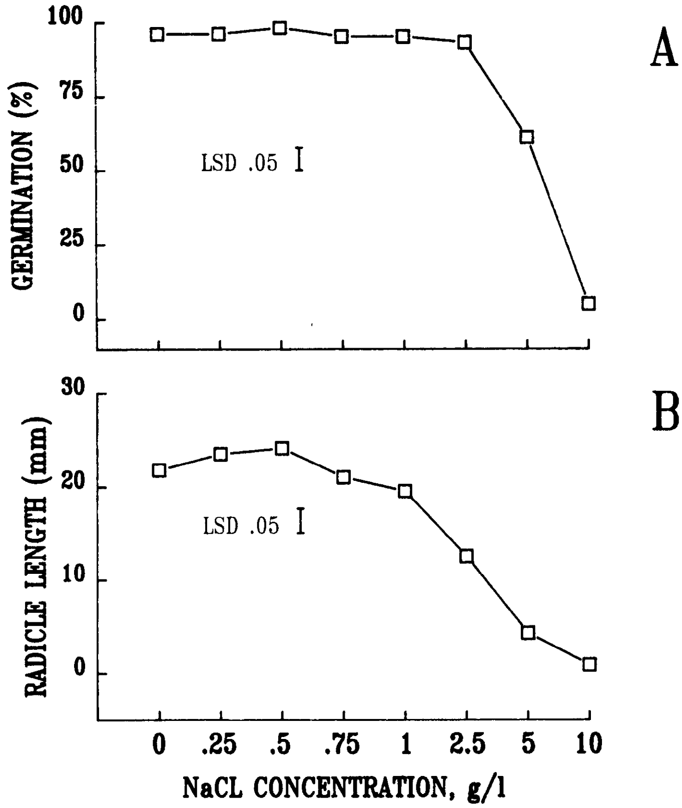

Fig. 3. *Texas persimmon percentage seed germination (A) and radicle length (B) after 14 days exposure to various NaCl concentrations.*

Seedling radicle length was apparently more sensitive to salinity than germination. Radicle elongation was restricted when NaCl concentration reached 2.5 g/l, and severely inhibited at a concentration of 5 g/l. Soil salinity may have an inhibitory effect on germination and establishment of Texas persimmon. This may explain the absence of this species on saline range sites in southern Texas (Everitt et al. 1984). Sodium chloride is the dominant salt in the saline soils of southern Texas and the electrical conductivity in the upper 30 cm of these soils ranges from 6.9 to 12.6 mmhos/cm (4.4 to 8.1 g/l) (Fanning et al. 1965; Everitt et al. 1982).

Germination in saline soil is influenced not only by direct ion effects, but also by osmotic interference (Uhvits 1946). The relationship between osmotic potential and concentrations of various salts was presented by Richards (1954). Mayeux (1982) used this information in conjunction with germination response to osmotic potentials of PEG solutions to determine which effect, osmotic potential or toxicity of salt solutions, was most responsible for suppressed germination and seedling vigor. This same comparison was used in this study. Germination and seedling radicle length in the 10 g/l concentration of NaCl was 5% and 0.9 mm, respectively (Fig. 3). The osmotic potential of this solution is about 0.6 MPa. Germination and seedling radicle length in the 0.6 MPa PEG solution was 43% and 3.7 mm, respectively (Fig. 2). This comparison suggests that the toxic effect of ions predominated in the reduction of germination and radicle growth rather than osmotic potential.

Germination after storage for 1, 6, 12, 15, 18, 21, and 24 months showed no changes in viability. Germination was ≥91% throughout the 2-year period. Apparently no dormancy or after-ripening requirements exist for this species.

The germination of seeds collected from plants growing on the gray sandy loam site did not differ significantly from those collected from plants on the more droughty shallow sandy loam site. Plants on the shallow sandy loam site were generally shorter in stature and less vigorous in appearance than those on the gray sandy loam site, but this apparently had no effect on germination.

Seedling emergence (73%) and height (20.8 mm) were greatest when seeds were planted 1 cm deep in soil, but burial of seeds at depths from 2 to 7 cm did not severely restrict emergence or seedling height (Fig. 4). Only 11% of the seeds left exposed on the soil surface produced seedlings and their height was lower than that of seedlings that emerged from buried seeds. However, since seedling emergence is not dependent on seed burial, this may contribute to the establishment of this species under natural conditions.

Passage of seeds through coyote digestive tracts had no significant effect on their germination. Germination of seeds from coyote feces averaged 96% as compared to 94% for the control. These findings are not in agreement with those reported for honey mesquite *(Prosopis glandulosa)* seeds. Honey mesquite seed germination was significantly reduced after passage through the digestive tracts of both coyotes and peccaries *(Pecari tajacu)* (Meinzer et al. 1975, Everitt and Gonzalez 1981). Apparently coyote digestive juices had no effect on Texas persimmon seed germination. Little information is available on coyote diets in southern Texas, but during late summer Texas persimmon fruits comprise a major portion of the diet (Bob Schumacker, Biologist, U.S. Fish and Wildlife Service; Personal Communication). I observed that Texas persimmon fruit comprised over 50% of the mass of coyote feces from which seed were removed. These data suggest that the coyote serves as an agent of seed dispersal for this species.

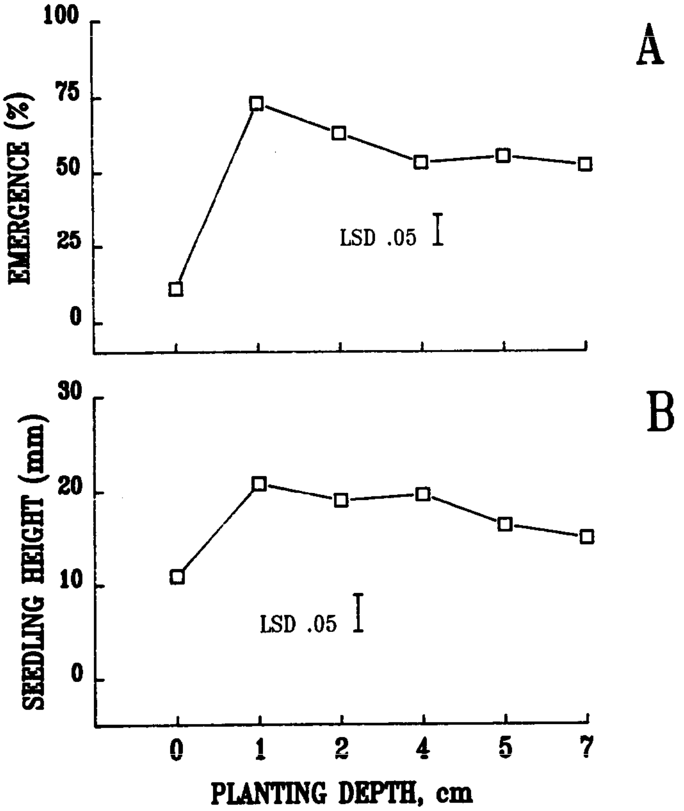

Fig. 4. *Percentage seedling emergence (A) and seedling height (B) 60 days after planting Texas persimmon seeds at various soil depths in pots in the greenhouse.*

Literature Cited

Arnold, Jr., L.A., and D.L. Drawe. 1979. Seasonal food habits of white-tailed deer in the South Texas Plains. J. Range Manage. 32:175-178.

Correll, D.S., and M.C. Johnston. 1970. Manual of the vascular plants of Texas. Tex. Res. Found., Renner, Texas.

Everitt, J.H. 1983a. Seed germination characteristics of three woody plant species from southern Texas. J. Range Manage. 36:246-249.

Everitt, J.H. 1983b. Seed germination characteristics of two woody legumes (Retama and Twisted Acacia) from South Texas. J. Range Manage. 36:779-781.

Everitt, J.H., M.A. Alaniz, and A.H. Gerbermann. 1982. Chemical composition of native range grasses growing on saline soils of the South Texas Plains. J. Range Manage. 35:43-46.

Everitt, J.H., and C.L. Gonzalez. 1981. Germination of honey mesquite *(Prosopis glandulosa)* seeds after passage through the digestive tracts of peccaries. Southwestern Nat. 26:432.

Everitt, J.H., c.L. Gonzalez, and A.H. Gerbermann. 1984. Botanical composition of eleven south Texas rangeland sites. Proceedings of Symposium Tamaulipan Biotic Province. October 28-30, 1982, Corpus Christi, Texas (In Press).

Fanning, C.D., C.M. Thompson, and D. Issacs. 1965. Properties of saline soils of the Rio Grande Plain. J. Range Manage. 18:190-193.

Mayeux, Jr., H.S. 1982. Germination of false broomweed *(Ericameria austrotexana)* seed. Weed Science. 30:597-601.

Mayeux, Jr., H.S., and C.J. Scifres. 1978. Germination of goldenweed seed. J. Range Manage. 31:311-374.

Meinzer, W.P., D.N. Ueckert, and J.T. Flinders. 1975. Foodniche of coyotes in the Rolling Plains of Texas. J. Range Manage. 28:22-27.

Michel, B.E., and M.R. Kaufman. 1973. The osmotic potential of polyethylene glycol 6000. Plant Physiol. 51:914-916.

National Oceanic and Atmospheric Administration. 1974. Climates of the United States—western states. U.S. Department of Commerce, Vol. 2, Washington, D.C.

Richards, L.A. (ed.). 1954. Diagnosis and improvement of saline and alkali soils. U.S. Department Agriculture, Agriculture Handb. No. 64. Washington, D.C.

Scifres, C.J. 1974. Salient aspects of huisache seed germination. Southwestern Nat. 18:383-392.

Scifres, C.J. 1975. Texas persimmon distribution and control with individual plant treatments. Tex. Agr. Exp. Sta. Bull. 1157.

Scifres, C.J. 1980. Brush Management-Principles and Practices for Texas and the Southwest. Texas A&M Univ. Press, College Station, Texas.

Scifres, C.J., and J.H. Brock. 1972. Emergence of honey mesquite seedlings relative to plant depth and soil temperatures. J. Range Manage. 25:217-219.

Steel, R.G.D., and J.H. Torrie. 1960. Principles and Procedures of Statistics. McGraw-Hill Book Co., Inc., New York.

Uhvits, R. 1946. Effects of osmotic pressure on water absorption and germination of alfalfa seed. Amer. J. Bot. 33:278-285.

Vines, R.A. 1960. Trees, Shrubs, and Woody Vines of the Southwest. Univ. Texas Press, Austin, Texas.

Whisenant, S.G., and D.N. Ueckert. 1981. Germination responses of *Anisacanthus Wrightii* (Torr.) Gray (Acanthaceae) to selected environmental variables. Southwestern Nat. 26:379-384.