



Mesquite Ecology and Management

Robert K. Lyons and Barron Rector*

Mesquite is native to Texas, where three major species and four varieties (Table 1) of mesquite occur. The most widespread species/variety is honey mesquite (*Prosopis glandulosa* var. *glandulosa*). When most people in the state talk about mesquite, they are probably referring to honey mesquite.



Figure 1. Bull seeking relief from the summer sun under a honey mesquite tree in South Texas.

Historically, mesquite has had many uses including firewood, fence posts, food (beans only), wood for furniture and flooring, and

shade for livestock (Fig. 1). Today, many think of mesquite as only a pest. However, it is still used to make fine furniture and it does appear to have some ecological benefits if the stand is not too thick.

Mesquite is common across the southwestern United States at elevations of up to 4,500 feet; its northern limit—southwestern Kansas, southeastern Colorado, New Mexico, southern Nevada, southern Utah—is defined by cold.

This plant grows well in many types of soil, except for deep sands and soils that remain wet for long periods. Its geographic range in Texas does not appear to have changed since European settlement, although its density within that range has increased significantly.

To manage mesquite successfully, landowners need to understand the plant's growth and development processes as well as the management options that have been proven to be the most successful, cost effective, and environmentally safe. This knowledge

will enable the landowner to time control efforts to treat the most vulnerable growth stage and the right part of the plant.

* Professor and Extension Range Specialist, and Associate Professor and Extension Range Specialist; The Texas A&M University System

Common name	Scientific name	Characteristics	Texas distribution
Honey mesquite	<i>Prosopis glandulosa</i> , var. <i>glandulosa</i>	Compound leaf with usually 2 branches; 12–20 leaflets/branch; leaflets 3/4–2½ inches long, ½ inch wide; pods straight, yellow-brown, 4–9 inches long	All regions except Pineywoods
Running mesquite	<i>Prosopis glandulosa</i> , var. <i>prostrata</i>	Smaller form of honey mesquite with strong underground horizontal branches and with very low-lying above ground branches	All regions except Pineywoods
Western honey mesquite	<i>Prosopis glandulosa</i> , var. <i>torreyana</i>	Similar to honey mesquite; leaflets ½–1 inch long, close to each other	Western Edwards Plateau, South High Plains, Trans Pecos
Velvet mesquite	<i>Prosopis glandulosa</i> , var., <i>velutina</i>	Compound leaf with 3–4 branches; finely hairy leaflets and pods; leaflets 1/5–½ inch long; 12–30 leaflets/leaf branch; pods 4–9 inches long, flattened, straight, velvety	Far Southwest Texas
Screwbean mesquite	<i>Prosopis pubescens</i>	Tightly coiled, hairy pods; leaves with 1 pair of branches; 8–16 leaflets/branch, 1/6–½ inch long	Trans Pecos
Creeping or dwarf screwbean mesquite	<i>Prosopis reptans</i> , var. <i>cinerascens</i>	Low-lying creeping shrub; leaves with 1 pair of branches; leaflets 1 inch long, close together, often touching, 12–24 per branch; pods tightly and spirally coiled	Southwest Rio Grande Plain

Table 1. Major mesquite species and varieties occurring in Texas.

Growth and development

Mesquite plants have three growth stages:

- The **seedling** stage lasts from seed germination until the establishment of the first true leaf.
- The **juvenile** stage begins at the appearance of the first true leaf and ends when the plant produces mature, woody xylem tissue.
- The **mature** stage follows the juvenile stage.

Seedling stage

For mesquite, maximum germination occurs at 80 to 85 degrees F and when the seed is covered with about 0.2 inch of soil. Establishment is successful if the seeds germinate beneath a thin layer of soil or organic material or debris. Light is not needed for germination.

Greenhouse studies have reported that fewer seedlings are established when the seeds are planted deep. Also, seeds scattered on grassy surfaces do not germinate well, which suggests that mesquite establishment may be limited by a well-managed grass stand. Seeds on bare soil will germinate but usually die.

Although soil cover is not necessary for germination, it is needed for seedling survival. Soil temperatures must be at least 77 degrees F for mesquite seedlings to establish. They grow fastest at soil temperatures of 80 to 90 degrees F; seedling growth slows at above 95 degrees.

To survive, seedlings need light, and the soil must be moist for at least 3 to 5 days after germination. Seedlings are usually established about 10 days after germination when the first true leaf, or cotyledon, is completely developed.

Newly emerged seedlings can be destroyed by insects or browsing animals if the plant tops are removed below the cotyledon. However, the seedlings will branch if the tops are removed above the cotyledon. Older seedlings are more likely to survive top removal, and plants will survive several years of successive top removal. This ability to survive top removal is the reason that methods to control mesquite using top removal do not work.

Seed dispersal and survival

It has generally been believed that mesquite seeds live indefinitely in the soil and therefore can reinfest areas for long periods after mesquite has been controlled. It is true that mesquite seeds from stored herbarium samples have maintained germination levels of 60 percent after 50 years. However, seed survival differs greatly in natural settings. For example, it has been reported that seeds planted in soil did not emerge after 6 years, with about 79 percent of the seeds that lived emerging the first year after planting. Recent studies at Texas AgriLife Research centers at Uvalde and Vernon have reported that after 1 year of exposure on the soil surface, 95 to 99 percent of seeds could not germinate. These findings suggest that to germinate, the seeds must be dispersed to new areas during the same year that they were produced.



Figure 2. Mesquite seedlings germinating and emerging in cattle feces. Many animal species eat mesquite beans and disperse the seeds, which produce new plants.

Any animal that swallows an intact mesquite bean can spread the seed (Fig. 2). Cattle drives in the 1880s are thought to be partially responsible for increased mesquite density and genetic variety within stands of mesquite. A study at Texas AgriLife Research at Spur demonstrated that reinfestation can occur even when livestock are excluded from an area. This study began in 1941 (Table 2) with hand grubbing of all the mesquite in a 1-acre area. Every 5 to 7 years, all the seedlings were removed by grubbing. Over a 25-year period, 689 plants, including 473 seedlings, were removed from the area.

Year	Plants removed per acre
1941	213 trees
1945	109 seedlings
1952	185 seedlings
1957	75 seedlings
1964	107 seedlings
Total	689 plants (including 473 seedlings)

Table 2. Mesquite removal and reinfestation at Texas AgriLife Research at Spur over a 25-year period, which points out the need for a long-term mesquite management plan.

A study conducted near San Angelo in 1999 and 2000 suggested that mesquite seed disappearance was not affected by the presence or absence of livestock. In this experiment, seeds disappeared from the ground within 3 to 5 weeks—even when livestock were absent—apparently from wildlife consumption.

Juvenile stage

The juvenile growth stage lasts about 2 to 3 years; in this period, no flowers or seeds are produced. The first year is

critical to plant survival. During this stage, the optimum soil temperature for growth is 85 to 90 degrees F. The plants may grow a few inches or up to 3 feet during the first growing season. Plants usually reach 5 to 6 feet tall in 2 to 3 years. After the top has been removed, the plant can have a juvenile top, but the root system and lower stems are several years old.

Mature stage

Plants are usually mature (able to produce flowers and seed) after 3 years. Mature honey mesquite plants occur in two growth forms:

- Single- or few-stemmed plants (Fig. 3) that indicate unaltered, vigorous growth during the juvenile stage
- Multi-stemmed plants (Fig. 4) that indicate that the top growth has been removed or interrupted during the juvenile stage or later



Figure 3. Mature mesquite exhibiting single stem growth form, indicating no top removal.



Figure 4. Mature mesquite tree exhibiting the multi-stem growth form, indicating top removal during the juvenile growth stage or later.

The roots of mature mesquite have been documented to extend 45 feet deep below the soil surface and 45 feet horizontally from the base of a plant.

Mesquite and soil fertility

Mesquite is a legume and fixes nitrogen. Some studies have found no nitrogen-fixing nodules on mesquite roots; however, studies in Texas have found these nodules.

Although small mesquite trees—those with trunk diameters of less than 3 inches and heights of less than 14 feet—actively fix nitrogen, this size plant does not appear to increase the net amount of nitrogen in the soil. However, significantly higher nitrogen and carbon levels have been found under mature mesquite than in the open spaces between the trees. Therefore, it appears that dense stands of smaller mesquite may not add enough nitrogen and carbon to compensate for their shading effect and competition for water. These smaller mesquite should be thinned.

Mesquite and grass production

Brush competition is not considered a problem for grass when the brush canopy cover is below 11 percent. However, when that canopy cover approaches 20 percent, the brush competes with grass for water and nutrients.

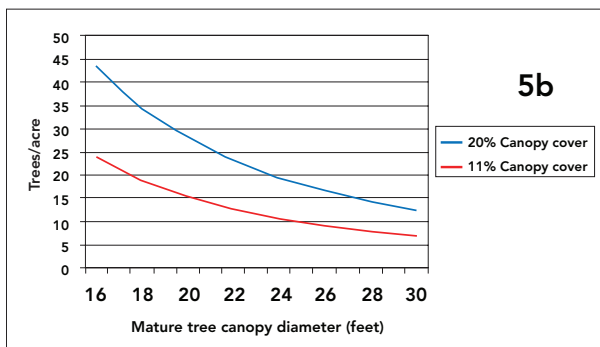
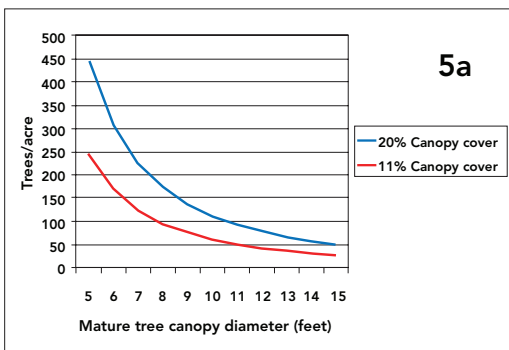


Figure 5. Number of mesquite trees required to reach a 20-percent canopy cover of the ground, which is considered competitive with grasses for water and nutrients, depending on the tree canopy diameter.

The number of plants necessary to reach 20 percent canopy cover depends on the mesquite trees' size. For example, a canopy averaging 5 feet in diameter would need to have about 450 trees per acre (Fig. 5a) to reach this 20-percent threshold. When the canopy is 15 feet in diameter, only about 50 trees per acre would be needed to reach this threshold, and at a 30-foot diameter, only 12 trees per acre would be needed (Fig. 5b).

In some cases, the presence of mesquite can actually benefit grass. In South Texas, a single large mesquite will provide shade and a nutrient-rich site and will moderate extreme soil temperatures. This situation enables stands of grass to survive and thrive under such trees, whereas the open spaces between the trees are too harsh for grass to do well (Fig. 6). However, as mesquite density increases, so does competition for light, moisture, and nutrients, and the grass does not do well.



Figure 6. In South Texas, grass may thrive under a single large mesquite but may be unable to grow well in the hot open spaces between the trees.

Mesquite management

In efforts to manage mesquite, it has been suggested that the weakest link is the seedling. If the seedlings can be managed to prevent or reduce reestablishment, treatments will cost less and the plants will be prevented from reaching maturity, when they can produce seed.

To successfully reduce mesquite plant density, landowners must understand the target of the control practice. Mesquite produces buds above ground on its stems and trunk and below ground on a central bud zone to a depth of 12 to 18 inches (Fig. 7). This below-ground bud zone is the target for mesquite control. Unless these buds are killed, the mesquite will continue to resprout. This bud zone can be eliminated as a source of regrowth by either physically removing the bud zone from the soil or by applying a herbicide that moves into the bud zone of the plant.



Figure 7. The below-ground central bud zone of a mesquite tree with buds that can sprout after top removal. Buds are found up to 12 to 18 inches below ground to the point where the first lateral root forms.

Another vital point is that it is unrealistic to try to eradicate mesquite once and for all. As illustrated in the Texas AgriLife Research at Spur study mentioned previously, various species of wildlife will continue to bring seeds to the property. For example, mesquite seedlings grow on Conservation Reserve Program (CRP) lands that were in cropping for decades and have not been grazed by cattle since being converted to CRP. The seedlings on these lands could not have grown from seeds long ago in the soil before it was cropland, and cattle have not brought new seeds into the site. Thus, wildlife must be bringing in new seed. Therefore, a mesquite management plan must be designed for the long term, incorporating follow-up treatments to maintain mesquite densities at a level that meets landowner goals.

Density considerations

Mesquite may be managed by both broadcast and individual plant treatment methods. For thick stands (more than 400 trees per acre), the preferred method is usually a broadcast method such as aerial spraying. However, another treatment option might be mechanical control—

grubbing, chaining, and root plowing (for more information on these methods, see Extension publication E-44, *Brush Management Methods*, which is available at <http://agriflifebookstore.org/>).

Individual plant herbicide applications are used most often when there are fewer than 400 plants per acre and the trees are small.

Two fairly easy ways can be used to estimate the density of mesquite on a site:

- Measure off at least four square areas 66 feet by 66 feet (one-tenth acre) in representative areas of the pasture. Count the mesquite plants in these areas, average the number of plants per square, and multiply by 10 to estimate the density per acre.
- Walk at least four lines about 363 feet long (about 121 big steps) toward a landmark in representative areas of the pasture. Turn around and slowly walk a straight line to your starting point counting every mesquite rooted within 3 feet of your path. To estimate the number of mesquite per acre, calculate the average number along these lines and multiply the average by 20.

Mechanical control considerations

Several mechanical broadcast and individual plant treatment methods are available for mesquite control. However, to be effective in preventing resprouting, the method must remove the bud zone. For example, two of the most effective broadcast mechanical methods are chaining and root plowing. Both have advantages and disadvantages and must be applied under the right conditions (for more information on these conditions, see Extension publication E-44, *Brush Management Methods*). Grubbing is a very effective method for treating individual plants and can be accomplished with several types of machinery.

Herbicide control considerations

Herbicides can be applied either as broadcast or as individual plant treatments. Broadcast herbicides are applied to the foliage. Dense mesquite stands require broadcast treatments, either aerial or ground. Individual plant treatments are applied to either the leaves or the tree base. These treatments are used on small plants and at low plant densities.

For optimum control, apply foliar treatments—broadcast or individual—when the plant carbohydrates are being transported from the leaves to the roots, which is usually 45 to 90 days after bud break. Basal treatments can be applied any time of the year.

Each year, a mesquite tree undergoes a specific sequence during its annual growth cycle. Events during the growth cycle determine the most effective time to apply foliar herbicide treatments for control.

The cycle begins with bud break in the spring, starting in the southern part of the state and proceeding northward. Twigs and leaves begin to grow when the soil temperature reaches 65 to 75 degrees F and continues for about 6 weeks.

About 45 days after bud break, when soil temperatures at a depth of 12 inches reach at least 75 degrees F, the twigs and leaves stop growing, and the plant begins to replenish the carbohydrate reserves in its root system through manufacture by the now mature leaves. This period, which lasts for about 45 days, is characterized by dark, green leaves and an absence of twig elongation. It is the best time to use leaf-applied herbicides.

Although mature trees progress uniformly through the annual growth cycle, individual plants many not all respond the same way to short-term weather changes such as late spring or early summer rains that interrupt growth. Differences among plants in their response to these interruptions can result in variable plant populations and may explain the erratic results from herbicide applications in some years.

The foliage is heaviest on the trees 30 to 60 days after the leaves are fully formed. If there is light, sporadic rain during drought, the tree canopy will have leaves in several stages of growth. Many of those leaves cannot absorb and move enough herbicide for adequate control. In wet years, mesquite can be difficult to control because each pulse of rain initiates new growth. A dry year can be an excellent time for control because the plants are at a more similar physiological stage and all are more or less moving carbohydrates downward.

Control measures are less effective on older trees with corky bark than on young plants with stems that are less than 3 inches in diameter. The differences may be caused by a lack of vigor and a limited amount of foliage in older trees, which reduces the amount of foliar-applied herbicide that is moved to the root system. For herbicides applied to stem bases, the younger, smooth-skinned bark will absorb the chemical more easily than will older, corky bark.

Stem sprays are less effective on multi-stemmed re-growth than on plants with one or a few basal stems. The reason that fewer multi-stemmed plants die is probably that stem-applied herbicides do not move laterally, and therefore the herbicide does not reach buds that are not directly below the treated stems.

Trees become dormant by fall. Most defoliate by November from insects and/or freezes.

The best single herbicide for foliar treatment of mesquite is clopyralid (Reclaim®, Pyramid R&P®, Clopyralid 3®). For an even better response, mix clopyrolid with triclopyr (Remedy Ultra®, Clear Pasture®, Triclopyr R&P®, Triclopyr 4 EC®). The mixture increases both the uptake and the movement of clopyralid. In addition, adding triclopyr reduces the cost of the spray. Consult the most current update of B-1466, *Chemical Weed and Brush Control Recommendations for Texas Rangelands*, for any changes in herbicide suggestions. Herbicide absorption and movement are mostly complete within 4 days of application, with most occurring on the day of spraying.

Any spray additive that removes leaves too quickly after spraying will reduce control. Do not apply sprays to wet foliage. However, once the spray is on the leaf, rain is unlikely to wash off mesquite herbicides. In experiments in which simulated rainfall was applied to leaves within 15 minutes of spraying, both clopyrolid and triclopyr were highly toxic to the honey mesquite leaves.

For aerial or ground broadcast sprays, use either 1) a diesel oil and water emulsion or 2) water plus a surfactant, crop oil, or methylated seed oil as the herbicide carrier. For individual plants, leaf sprays that use water plus a surfactant, crop oil, or methylated seed oil as a herbicide carrier cause fewer mixing and handling problems than do diesel oil and water emulsions.

Foliar sprays work best when:

- Soil temperatures at 12 to 18 inches deep are more than 75 degrees F.
- The leaves are dark green and have no significant damage by hail, insects, or drought.
- No new leaves have been initiated by recent rains.
- Any mesquite bean pods present are fully elongated.
- Any flowers present are yellow, not white.

Several basal-type individual plant treatments are available. These treatments are best for mesquite with one or a few basal stems. Multi-stemmed plants are more difficult to treat with basal methods, and control levels are typically lower than on one- to two-stem plants.

Basal treatments usually include two ingredients, the herbicide triclopyr mixed in diesel oil. Although diesel can be used alone if applied at a high volume, adding triclopyr increases its effectiveness by about 25 percent. Triclopyr is the only herbicide recommended for mesquite basal treatments.

Newer basal treatment methods typically use low-spray volumes with high concentrations of herbicide, such as up to 25 percent triclopyr in diesel, depending on the stem size. For example, the stem-spray method involves lightly wetting each plant all the way around from 10 to 12 inches above the ground to the ground line but not to the point of runoff. This approach reduces the potential of diesel contaminating the soil and is environmentally friendly and responsible.

For multi-stemmed mesquite, the best treatment is to apply herbicide to the leaves. Detailed individual plant treatment information and instructions can be found in Texas AgriLife Extension Service publication L-5144, *Brush Busters: How to Beat Mesquite*.

Managing for a mesquite savannah

Texas AgriLife Research at Vernon recently investigated the potential of using fire and possibly herbicide to establish mesquite savannahs, which are areas with relatively few, large trees. In the study, low-intensity fires were used to kill the lower canopy foliage and stems but prevent the tree from resprouting from the base. This reduction in canopy foliage:

- Decreased the competition with understory grasses for water
- Improved vegetation for livestock management
- Left mesquite trees to provide shade for the livestock
- Increased the availability of understory forage

Three to four fires may be required over a 10- to 15-year period to create the savannah. However, savannah development could be accelerated by using low rates of clopyralid herbicide alone to create stem-flagged mesquite that will not resprout from the base. Low-intensity fires may help manage mesquite seed production because flower and bean development is inhibited during the growing season after a fire.

Mesquite savannahs offer several potential benefits. They may improve soil fertility through nitrogen fixation and organic carbon additions. Plant species diversity is often enhanced because some species grow better under mesquite than in open spaces. Mesquite savannahs or a mixture of savannah, grassland, and thick brush should improve wildlife habitat.

Fire can be used to develop a savannah under these conditions:

- During the winter
- Relative humidity of more than 30 percent

- Air temperature of less than 68 degrees F
- Wind speed between 8 and 20 mph

Use fine fuel loads of 800 to 2,500 pounds per acre. For afternoon headfires, use fuel loads of 800 to 1,500 pounds per acre. Fuel loads of more than 2,500 pounds per acre topkill mesquite, causing resprouting. Headfires of less than 800 pounds per acre have no effect on mesquite.

General mesquite management recommendations and considerations

- Establish long-term goals and management plans.
- Remember that mesquite eradication is not possible, but mesquite management is.
- Concentrate your control efforts on smaller, younger mesquite (young plants with stems of less than 3 inches in diameter are more effectively controlled), but also make a plan to control the mature trees, even if you must implement it a little at a time.
- Multi-stem regrowth is difficult to control when it is less than 4 feet tall. Furthermore, treatments that topkill mesquite—such as high intensity fires, chaining, shredding, or roller chopping (see E-44, *Brush Management Methods*)—will shift the mesquite plant into a multi-stemmed regrowth form. Plan for subsequent treatment.
- Retreatment may be needed every 3 to 7 years to prevent new plants from producing seed.
- Defer grazing of pastures where many seeds are produced.
- Fence off areas with high seed production.
- Confine livestock 3 to 6 days after having access to mesquite beans to allow passage and reduce dispersal.
- Leave adequate grass to discourage seedling establishment.

For more information

E-44, *Brush Management Methods*

B-1466, *Chemical Weed and Brush Control Recommendations for Texas Rangelands*

L-5144, *Brush Busters: How to Beat Mesquite*

L-5291, *Brush Busters: How to Estimate Costs for Mesquite*

L-5421, *Brush Busters: How to Avoid Lumps When Using Cut Stump*

“Behind the Dozer: A Comprehensive Investigation of Follow-up Brush Control Options.” Agriculture and Natural Resources Field Day. Texas A&M University Research & Extension Center, San Angelo. 2004.

The Magnificent Mesquite, by K. E. Rogers. University of Texas Press, Austin. 2000.

“Mesquite seed longevity under field conditions,” by M. K. Owens, R. M. Cooper, R. J. Ansley, W. E. Pinchak, and J. F. Slosser. Society for Range Management 56th Annual Meeting, Casper, WY. 2003.

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