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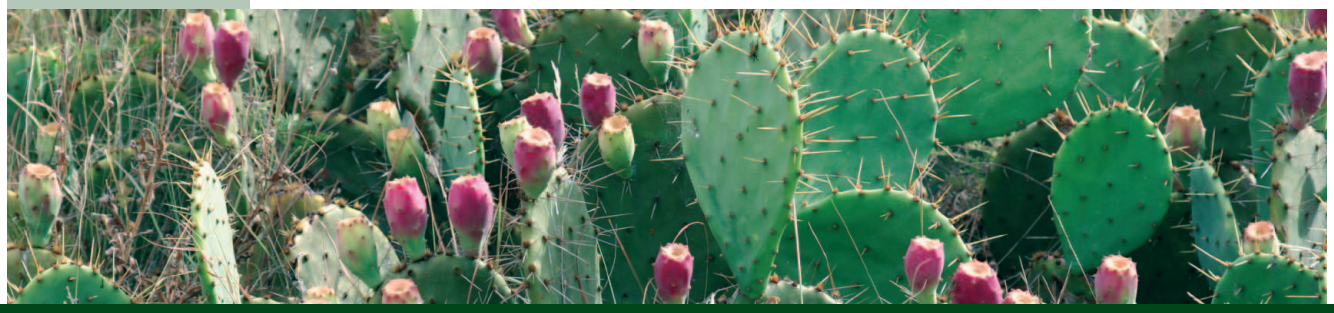

Pricklypear Biology and Management

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Pricklypear Identification

Pricklypear is the common name given to a large group of succulent cacti in the *Opuntia* genus. This genus is the most widespread and common of all cacti (Cactaceae family) in the world. There are more than 40 species and varieties in Texas, including pricklypear, tasajillo and cholla cactus. Most

Figure 1. Engelmann pricklypear.

are native, cool-season perennials with species and varieties that occur in every major vegetational area of the state. The Trans-Pecos region has the largest variety of *Opuntia* species. They range from tall to short with green to purple pads, short to long spines, and red to yellow flowers.

It can be extremely difficult to identify individual species of pricklypear, for several reasons. First, pricklypear can react to changes in the environment more quickly and in more ways than other species of cacti. Changes in growth form, spine numbers, flower color and other characteristics can occur because of environmental influences.

Second, many species of pricklypear cover large ranges, with extreme variations in growing conditions.

Finally, pricklypear can reproduce vegetatively and by cloning as pads break away and form new plants that are genetically identical to the parent. Over time, as conditions change, an especially dominant form may take over large areas and be quite different from other plants nearby. In addition, pricklypear species can easily cross-pollinate with offspring that retain some characteristics of each parent, thereby producing a true hybrid. Hybridization in

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pricklypear is very common and adds to the difficulty of identifying the plant to the species level.

Nevertheless, some of the most common species in Texas include Lindhiemer or Texas pricklypear (*O. lindheimeri* Engelm.), Engelmann pricklypear (*O. phaecantha* var. discata [Griffiths] L. Benson and Walkington), Brown-spine pricklypear (*O. phaeacantha* var. *phaeacantha* Engelm.) and Edwards pricklypear (*O. edwardsii* V. Grant and K. Grant).

Lindheimer pricklypear is considered the most abundant and widespread in Texas. The typical Lindheimer pricklypear is 2 to 5 feet high. Its oval pads are 8 to 12 inches long and covered with erect, yellow spines. More common in the Edwards Plateau region is Edwards pricklypear. It is usually less than 1 foot high and has 4- to 6-inch rounded pads covered with slightly curved, gray

Figure 2. Lindheimer pricklypear.

Figure 3. Engelmann pricklypear.

spines. Engelmann pricklypear grows to 6 feet or more and has the largest pad, at 8 to 16 inches long, with white spines. It is scattered throughout the Edwards Plateau and Trans-Pecos regions. Plains pricklypear is typical of the Rolling and High Plains regions and is a short, spreading variety.

Pricklypear Biology

Physical Characteristics

Typical characteristics of *Opuntia* species include jointed stems; cylindrical or conical leaves on young stems; small spines called glochids; spreading, showy flowers with sensitive stamens; and fleshy, edible fruits with thick rinds and

Figure 4. New pad growth with leaves.

Table 1. Distinguishing characteristics of four common pricklypear in Texas.

	Plant height	Pad length	Pad shape	Spines	Flowers	Tunas	Distribution
Engelmann's	3-6 ft	8-14 in	rounded to egg shaped	<2.5 in, white, flat, typically in three's (bird's foot pattern)	mostly yellow	dark burgundy	western half of Texas
Brownspine	2-3 ft	4-9 in	rounded	0.75-3 in, yellow to grey with brown base, round	yellow to orange with maroon center	oval or goblet shaped, bright red to deep red	western two-thirds of Texas
Lindheimer	2-5 ft	8-12 in	long, oval shaped	yellow, erect with dark base	mostly yellow	dark burgundy	Far West, South and East Texas
Edwards	<1 ft	4-6 in	small, round	grey, deflexed spines	yellow to orange	reddish with large seeds	West Central Texas, mainly Edwards Plateau

relatively large seeds that are flat and round. The large, rounded, flat segments of pricklypear are commonly called pads. These pads are often mistaken for the plant's leaves but are actually modified stems. True pricklypear leaves are small and appear only briefly at the cluster of spines when new pads emerge in spring.

Figure 5. Flowers.

Flowers are large and showy and emerge in spring. Colors vary both among and within species and can be yellow, orange, red, pink, purple or white. After flowering, the fruit emerges where the flower dies. Pricklypear fruits, also called pear apples and tunas, can be red, purple, orange, yellow or green at maturity. These fruits are covered with small pockets of spines. The term "pricklypear" is actually derived from this prickly, pear-shaped fruit.

Figure 6. Mature fruits.

Reproduction can occur from seed (germination) or plant segments (vegetative). Seeds are produced inside the fruit. Their hard seed coats allow them to survive heat and lack of water and pass undamaged through the digestive systems of grazing animals and birds. Seed germination is the primary method of reproduction in undisturbed habitats. Seeds are dispersed mainly through animal droppings, including birds. Vegetative reproduction occurs when pads are detached from the parent plant by animals, wind, flood or mechanical disturbance and take root where they lodge. Pricklypear stems or pads quickly produce adventitious roots and form new plants when they contact moist soil.

Figure 7. Adventitious roots.

Mature pricklypear pads have thick, fleshy coverings coated with a heavy wax that makes the plant appear shiny. This thick, tough skin, along with the succulent nature of cacti, helps plants survive during drought. The plants use most of their internal tissues for water storage and their outer parts to reduce water loss and damage by grazing animals and predatory insects. They can remain relatively vigorous in hot, dry conditions that cause most other plants to lose vigor or even die. The pad surfaces are covered with small bud zones called areoles. From these areoles emerge either short, dense spines or longer, heavier spines (1 to 4 inches), or both. Pricklypear species cannot be identified by spine characteristics alone because there is so much variation within species. Flowers and new stems also emerge from areoles.

Figure 8. Mature pads.

Most pricklypear have roots that spread widely just below the soil surface. This allows them to absorb water that has percolated only through the upper part of the soil after a brief desert rain, or to take advantage of water that runs off the plant itself. Water is not stored in the roots, but in the stems of the plant.

Physiological Ecology

Pricklypear have some unique physical characteristics because they usually grow in regions that are very dry for at least a portion of the year. Succulence, or water retention, is one such feature. When fully hydrated, pricklypear can consist of 85 to 95 percent water. When moisture is limited, plants use that internal water and can survive to the point that their water content is as low as 20 percent. Even more remarkable, pricklypear can quickly absorb water through shallow root systems and rehydrate when rain falls.

Pricklypear also have a unique way of conserving water through a special photosynthetic process called crassulacean acid metabolism (CAM). This process is found only in the Crassulaceae and Cactaceae families and a few others. It is a kind of food production process that minimizes the loss of water in the plant. Gas-exchanging stomata are microscopic holes in the plant that can be opened and closed. Most plants open their stomata during the daytime so that carbon dioxide can be taken in (to be converted to sugars for plant food through photosynthesis) and oxygen can be released. Photosyn-

Figure 9. Mature population.

thesis occurs during daylight hours because it requires sunlight. This type of photosynthesis is very costly for a plant in extremely hot or dry conditions as a significant amount of water can be lost as vapor during gas exchange.

Instead of opening the stomata for gas exchange during the heat of the day, cacti open stomata for gas exchange only at night; this conserves water because much less water vapor is lost during cooler night hours. During the night, carbon dioxide enters the plant cells and, with the CAM process, is stored as organic acids. At the same time, oxygen is released and only a small amount of water vapor is lost. The following morning, the cells begin photosynthesis as the sun rises, without the need for gas exchange. This allows the stomata to remain closed.

Pricklypear can adapt to changes in the environment more rapidly than most other plants. This can be good for the pricklypear, but is sometimes bad for the ecosystem when pricklypear quickly out-competes other native vegetation for space, sunlight and water. As the ecosystem changes, plant characteristics such as the number and length of spines, pad size or shape, overall plant height, stem size or shape, and flower or fruit size, color and shape may also change.

Friend or Foe?

Although pricklypear are tough and thorny, they are food for both man and animal. Their pads and stems are fed to animals in Texas and Mexico, especially during drought conditions. The spines are burned away so that livestock, particularly cattle, will consume the plant.

Figure 10. Pricklypear being burned by ranch hand.

Animals must consume large amounts to satisfy their appetites. The nutrient content of pricklypear is too low to maintain animals other than non-lactating, early-bred beef cows. Crude protein levels are generally below the level (6 percent) needed to maintain rumen function. Pricklypear's low protein level and large amount of indigestible fiber cause the formation of "pear balls" in the rumen. Therefore, cattle fed pricklypear will need a protein supplement.

On the positive side, pricklypear is moderately high in energy and appears to be high in vitamin A. It is also high in dietary calcium and magnesium. But the high intake of these ions results in an increased rate of passage through the digestive tract, which leads to scouring because of water retention in the gut. This increased rate of passage also reduces the absorption of the nutrients from prickly-pear. Therefore, cattle eating pricklypear should also have hay or some other forage to increase dry matter intake and reduce the rate of passage.

Figure 11. Fruits eaten by sheep.

Feeding prickly-pear can cause cattle to become "pear eaters," as cattlemen call them. They begin to relish and seek out prickly-pear, whether or not the spines have been burned away. These cattle can be recognized by their poor body condition and mouth sores.

Pricklypear has become a major problem in many parts of Texas, particularly where sheep and goats are raised. When other forage is not available, sheep and goats have a tendency to eat large amounts of pricklypear tunas or fruit and usually do not stop until all the tunas are consumed. Animals may pass this feeding behavior along from generation to generation, creating problems even when desirable forage is present. When animals are consuming the tunas they lose weight. If they also eat the pads for a prolonged period, the small spines and glochids cause ulcerations and infection of lips, tongue, gums, palate and gastrointestinal tract. The seeds can also cause rumen impaction, which can lead to death.

Wildlife species use pricklypear for food, water and cover. White-tailed deer and javelinas (collared peccary) eat the most pricklypear. The greatest consumption occurs in


Figure 12. Deer browsed pad.

dry summer months when deer consume pricklypear presumably for the water source. Wildlife also relish young leaves in the spring and fruits in the fall. Pricklypear is an extremely important source of cover and protection for ground-nesting birds, especially bobwhite quail. Quail and other birds also eat the fruits.

Many people also enjoy eating pricklypear, especially in South Texas and Mexico. Young pads, called nopalitos, are harvested early before their tissue has hardened or their spines have been produced. Pads are often de-spined and then canned or pickled. But the most widely used part of the plant is the fruit or tuna. Certain species that produce large, sweet tunas are cultivated as crops in Mexico and other parts of the world. New species introduced as cultivated crops have escaped and become pests in some areas.

While pricklypear has undisputed value, many people consider it a weed. Pricklypear can become so dense that it out-competes other native vegetation, suppresses forage production, and limits livestock access to pastures. Dense stands of pricklypear are usually a result of past land management decisions. For example, some brush control techniques will exacerbate pricklypear problems. Dense pricklypear may also be a symptom of overgrazing, perhaps as long as 75 to 100 years ago. During prolonged droughts, pricklypear density can increase 25 to 30 percent each year while other plants decline. Once a threshold is met, it is very difficult to reduce pricklypear populations.

However, dense stands of pricklypear may be a "blessing in disguise" when they become a refuge seed source after land has been overgrazed. Grazing livestock typically will not venture into dense pricklypear stands. As a result, this is where you may find some of the most sought-after plant species, protected from grazing. In these areas pricklypear has preserved a seed source that might otherwise have been grazed out.

Landowners must decide whether or not to control pricklypear, depending their goals and objectives for the land.

Pricklypear Management

Mechanical Control

Historically, mechanical brush control techniques such as chaining, disking, roller chopping, cabling and root plowing have not controlled pricklypear effectively. In fact, these practices usually cause pricklypear densities to increase 2 to 3 fold because they spread broken pads around the pasture where they take root. Grubbing and other individual plant mechanical control practices also increase the number of pricklypear plants, though not as dramatically as the other methods.

Some more recent mechanical control practices, such as high-powered mulching, have proven much more successful when the pricklypear pads are completely shredded and quickly desiccate. Individual plant grubbing with large hydraulic grubbers or hand grubbers can be effective if care is taken to pile and burn all pricklypear plant material. Two-way railing that adequately destroys pricklypear pads has also been effective. Any mechanical control strategy for pricklypear is much more successful if done during hot, dry weather so broken pads dry out quickly. Follow-up treatment is necessary to remove new sprouts or missed plants. However, mechanical control strategies are best used in combination with other control strategies.

Control with Fire

Pricklypear control is one of the major benefits of prescribed burning. Of the *Opuntia* species, tasajillo cactus is the most susceptible to fire, cholla cactus the least susceptible, and pricklypear is in the middle.

For effective control of pricklypear, fires must be very hot to rupture pricklypear cells and physically damage the plant. Summer fires are more effective than winter fires.


Figure 13. Pricklypear after a summer fire.

Within any given site, small clumps of pricklypear are easier to kill than larger clumps. When a fire lacks enough fine fuel to be really hot, burning may kill existing pads (top kill), but most clumps will resprout and grow to their original size in 3 to 5 years. It may be necessary to burn again every 2 to 4 years to effectively reduce pricklypear populations over time. Like mechanical control, prescribed fire is best used in combination with other control practices.

Control with herbicides

Pricklypear can be controlled with herbicides if done correctly. Picloram is currently the herbicide of choice. It is sold under various trade names and in combinations with various other compounds. Pricklypear can be chemically treated any time of year but the best results are obtained from late summer through fall.

Broadcast applications of Tordon 22K™ (picloram) at 1 qt/acre or Surmount™ (picloram + fluroxypyr) at 4 pt/acre are the most commonly used herbicides. Aerial application should be made at a total spray volume of 2 to 4 gallons per acre, and ground broadcast applications at 20 to 25 gallons per acre. Aerial treatments of pastures with overstories of mesquite or other deciduous brush species should be made in winter after trees have lost their leaves. If aerial treatments are made in summer or fall, they should be done with helicopters, using extremely large droplet size (1000 micron or larger) to maximize the amount of herbicide reaching the pricklypear. Broadcast applications typically kill 55 to 75 percent of pricklypear. For the most up-to-date recommendations on rates and trade names, refer to Texas AgriLife Extension publication B-1466, *Chemical Weed and Brush Control Suggestions for Rangeland.*

Individual plant treatments are considered most effective because spray can be targeted directly onto pricklypear.

Figure 14. Pricklypear controlled with herbicides.

Figure 15. Aerial application of herbicide.

Applications of Tordon 22K™ or Surmount™ in a 1% solution in water are currently suggested for this application method. Adding MSO and a blue marker dye is recommended. When treating individual plants, be careful to treat both sides of the pads and completely cover the plant. If done properly, this method will kill 80 to 90 percent of pricklypear. Other herbicide options and specific "how to" recommendations for individual plant treatments can be found in Texas AgriLife Extension publication L-5171, *How to Take Care of Pricklypear and Other Cacti.*

Recent evidence suggests that control is better if soil moisture is adequate and if there is rain shortly after application to move the herbicide into the root zone.

The thick wax cuticle or outer layer on pricklypear pads limits the absorption of herbicide into the plant. Surfactants such as methylated seed oil (MSO) or crop oil concentrates (COC) help get the herbicide into the plant, regardless of application technique. Herbicides can be applied by broadcast or individual plant spray techniques. Broadcast application, whether aerial or ground, is most practical where pricklypear density exceeds 350 to 400 plants per acre or where plants are extremely large. Below this threshold, individual plant sprays can be more effective and are usually more economical.

Integrated fire and herbicide

Unlike most brush species, damaged or stressed pricklypear is more susceptible to herbicides. Research has shown that pricklypear is more susceptible to applications

of picloram after pads and stems have been killed by fire. To use this system approach to pricklypear management, conduct a burn in late winter to early spring (December to March). Grass and fine fuel should be adequate during the burn to kill at least 90 percent of existing pricklypear pads. Then apply picloram when new pad regrowth reaches silver dollar size (about 2 inches across), but no later than May 30. With the fire-herbicide system, picloram can be applied at a reduced rate and more than 75 percent of pricklypear should be killed.

Figure 16. Silver dollar-size pad.

Integrated mechanical and herbicide

Another integrated method is using mechanical control to top-kill pricklypear and then applying herbicide immediately or very soon afterward. When the use of offset roller choppers or large drum aerators was followed immediately by an application of picloram, at least 90 percent of pricklypear was killed. This integrated approach should increase pricklypear control 2 to 3 fold over mechanical methods alone.

Summary

Whether you consider pricklypear a benefit or a detriment on rangeland largely depends on where you live and your goals and objectives for the land. Pricklypear has helped many cattle ranchers survive extreme drought through emergency feeding. But in other cases, dense stands of pricklypear compete for limited moisture and sunlight, severely reduce the carrying capacity of the land, and limit cattle movement. It is a significant problem for ranchers when sheep and goats consume tunas, but many people enjoy the fruit. Some wildlife species survive on pricklypear at times during the year, although they may add to a growing problem by scattering seed in feces. Pricklypear is a significant source of food and cover for bobwhite quail. Each person who owns or manages rangeland in Texas must weigh the good with the bad and decide how to manage pricklypear cactus.

For More Information

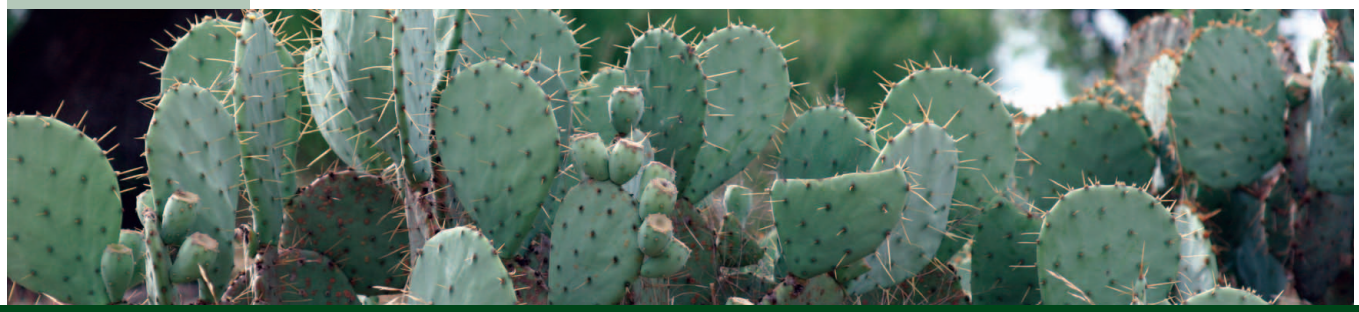
B-1466, *Chemical Weed and Brush Control Recommendations for Rangelands*

L-5171, *Brush Busters: How to Take Care of Pricklypear and Other Cacti*

E-459, *Woody Plants for Wildlife: Brush Sculpting in South Texas and the Edwards Plateau*

(all available at *http://agrilifebookstore.org*)

http://essmextension.tamu.edu/plants
(for plant identification assistance)



Acknowledgements

This manuscript was adapted from Texas AgriLife Extension publication B-5046, Pricklypear: Friend and Foe. The authors acknowledge the contributions of those authors: C. Wayne Hanselka, Joe C. Paschal and Roger Q. Landers. Appreciation is given to Jim Ansley, William Hatler and Roger Q. Landers for critical review of this manuscript.

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Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture. Edward G. Smith, Director, Texas AgriLife Extension Service, The Texas A&M System.

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