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Weed and Brush Control for Pastures and Rangeland

Texas Agricultural Extension Service
The Texas A&M University System

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Weed and Brush Control for Pastures and Rangeland

Recommended for study by pesticide applicators in preparation for license testing by the Texas Department of Agriculture.

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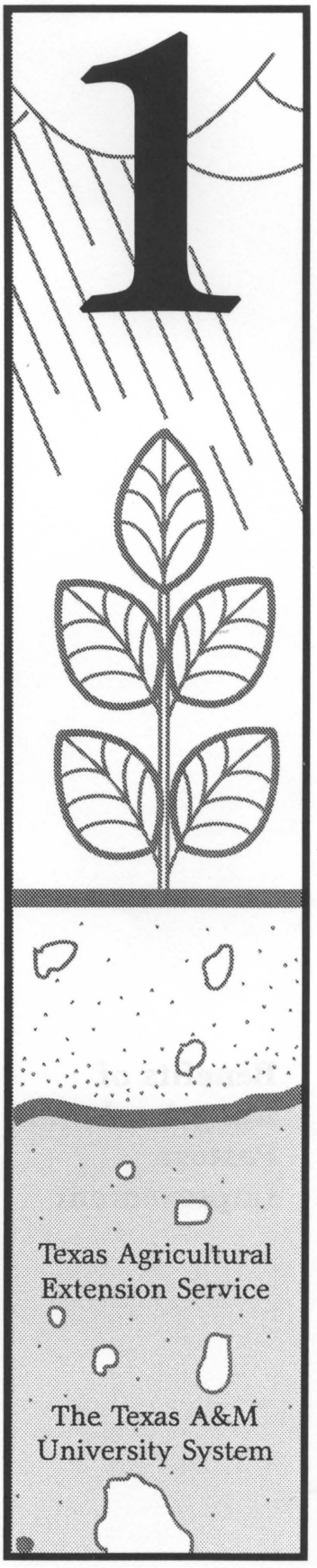


Weeds and brush plants infest more Texas pastures and ranges than ever before. Forage production on much of this land would improve if weeds and brush were controlled. Proper control helps produce a good mix of grasses, forbs and woody browse plants for livestock grazing and for wildlife food and cover.

Learning Objectives

- Know why it is important to control weeds and brush on range and pasture land.
- Learn the benefits of improving range and pasture land.
- Understand the role that weed and brush control plays in good land management.

For several reasons, unwanted forbs and brush are spreading in Texas. Some grazing practices foster the spread. For example, overgrazing leaves few desirable plants to compete with weeds and brush. Overgrazing also may force livestock to eat brush and seed pods. The seeds are spread in manure as the animals roam.

Many rangeland and pasture improvements are beneficial. Seeding, controlling undesired plant species, fertilizing, pitting, furrowing and watering all can help develop and improve land resources.

However, improvements must be based on ecological principles. A knowledge of plant competition and succession is essential. For example, when seeding, you must choose a desirable adapted species to replace weeds and brush.

Texas has ten distinct vegetational regions. (See map on page 8.) The plants in each region vary because of differences in soil, rainfall and temperature. As a result, the plants may not respond the same to some control measures. Take care to choose control methods that work well in your area.

Benefits of Rangeland and Pasture Improvement

Water conservation

Removing brush and weeds and replacing them with forage can reduce surface water runoff and improve soil moisture. For example, in South Texas, a 1/3-inch increase in water yield occurred when mesquite-covered brushlands were converted mainly to herb species. Water savings from brush control vary, depending on the amount of brush removed, the rate of regrowth and the control method used. Methods that do not kill plant roots may save water for only a short time. Complete plant removal, with follow-up treatments, gives the most lasting effects.

Land and animal productivity

Brush and weed control also improve land and animal productivity. Without management, rangeland cannot support as many livestock and wildlife. Livestock may stop gaining weight if ranges or pastures don't provide enough forage plants. During winter months, malnutrition from lack of forage affects subsequent calf crops and weakens animals to disease. Poisonous plants that invade the land can cause additional livestock and wildlife losses.

Even land reserved only for wildlife may need improvements. Brush management may be needed when:

1. plant cover provides feed during one season but is a poor food source the rest of the year.
2. plant stands are too dense for animals or hunters to pass through.
3. brush is so tall that edible browse is beyond reach of wildlife.
4. thick brush crowds out beneficial plants.

Usually, total brush control is unnecessary. Strips of treated and untreated areas may provide adequate range improvement.

In improved pastures and hay meadows, controlling weeds results in higher forage yields and higher quality hays. Research shows that from 2 to 5 pounds of grass are produced from improved pastures for each pound of weeds controlled. The production increase varies depending on rainfall, soil type, forage species, fertilization program and type of weed controlled.

Hay quality is affected by weeds in a number of ways. For example, when contaminated with unpalatable weeds, hay is less appealing to livestock. In addition, weed contamination can cause hay to mold. That's because certain weeds dry at different rates than grasses. After cutting, if dry grass is baled with moist weeds, the bale may mold. Waiting for weeds to dry delays the baling operation. Also, weeds may cause round bales that are stored outdoors to sustain more weather damage. Because weeds do not thatch over as grass does, the bale can be penetrated more by rain.

Generally, weed and brush control can sustain and improve livestock gain per acre as well as give other benefits:

- less labor needed to work livestock,
- gentler livestock,
- less injury to livestock,
- fewer breeding males required,
- a higher percent of offspring,
- more grazing capacity,
- less need for supplemental feeding, and
- less livestock loss to toxic plants.

A good weed and brush management plan can enhance both wildlife habitat and livestock production. Successful plans require a long-term ecological view of the economic potential of each site. Today, managers should have a 10- to 15-year plan and treatment schedule.

Property value

Brush management can be used to maintain or improve both aesthetic and real estate values of land. These benefits are often accomplished through selective control of unsightly and undesirable plants while allowing landscape-enhancing plants to remain.

Study Questions

1. Texas has ___ distinct vegetational regions that differ because of differences in soil, rainfall and temperature.

2. True or False
   A good brush and weed management plan can enhance both wildlife habitat and livestock production.

3. Brush management plans should be developed to cover a __ to __ year period.

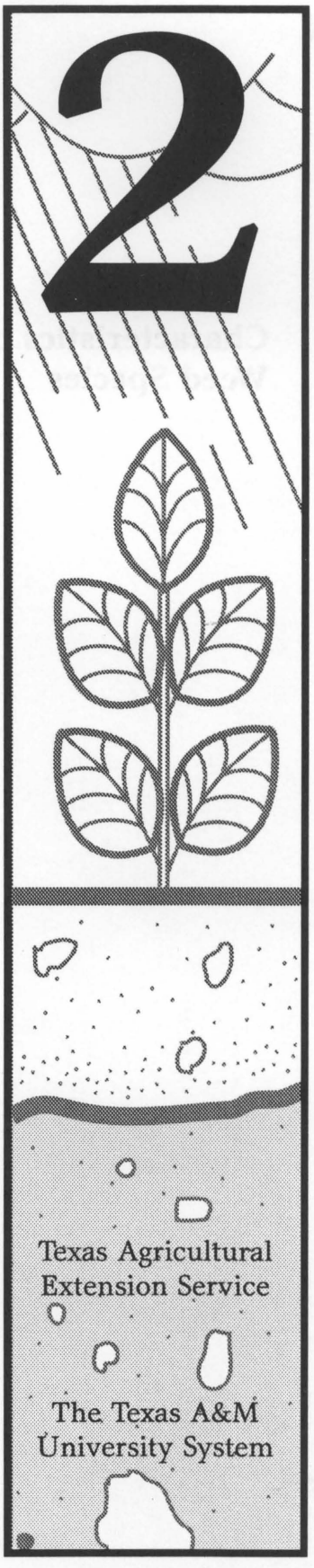
4. True or False
   Aesthetics and real estate value may be brush management objectives.

5. Controlling weeds in improved grass pastures results in __ to __ pounds of grass produced for each pound of weeds controlled.

6. True or False
   Weeds baled with grass in hay fields usually reduces hay yields and hay quality.

Answers
1. 10
2. True
3. 10 to 15
4. True
5. 2 to 5
6. True

2 Identifying Weeds and Brush



It is important to be able to identify weeds and brush before you plan control. Different control methods may work better on some species than on others. Because most methods work better at certain stages of plant growth, it also is important to learn about the target plant's life cycle.

Learning Objectives

- Know how to identify various types and species of weed and brush pests.
- Learn also to identify the growth stages of these plants.
- Understand why proper identification is important to good control.

Characteristics of Weed Species

Weed species are classified as annuals, biennials and perennials. Annuals complete their life cycle in less than one year. Warm-season annuals germinate in the spring and complete their life cycle by fall. Examples: giant ragweed, common ragweed, woolly croton.

Cool-season annuals germinate in the fall and early winter and complete their life cycle in the spring or early summer. Examples: tallow weed, henbit, little barley.

Biennials go through the same cycle as annuals but take two years to complete it. Biennials grow vegetatively one year, produce seed the second year, then die. Examples: mullein, some thistles.

Perennials persist more than two years, reproducing vegetatively or by seed and are classified as simple or creeping. Simple perennials reproduce by seed. Examples: gray goldaster, perennial broomweed, broadleaf milkweed.

Creeping perennials reproduce by seed and vegetatively by stolons, rhizomes or tubers. Examples: western ragweed, yankeeweed, silverleaf nightshade, Johnsongrass.

Weed Growth Stages

Grasses and broadleaf weeds go through four growth stages:
- seedling
- vegetative
- bud and flowering
- maturity

Seedling. The seedling stage is the same for annual, biennial and perennial weeds. All start from seed. Because seedlings are small and tender, weeds are easier to control at this stage than any other. This is true whether you use mechanical or chemical control. Both foliar- and soil-applied herbicides work well.

Vegetative. During the vegetative stage, the plant's energy goes into production of stems, leaves and roots. Control at this stage is possible but generally more difficult than at the seedling stage. Mowing and post-emergence herbicides are effective controls.

Bud and flowering. When a plant enters the flowering stage, most of its energy goes into flower and seed production. As plants reach this more mature stage, they usually are much harder to control by either mechanical or chemical methods (with the exception of some perennial broadleaf weeds).

Maturity. Maturity and seed-set complete the life cycle of annuals and biennials. With perennials, only the above-ground portion of the plants dies each year. Underground roots and stems remain alive through winter and sprout new growth the next spring. Chemical control usually does not work at the maturity stage.

Control at any growth stage depends on the weed species and the herbicide used. Good control of biennials occurs during the rosette stage, in addition to the seedling stage. Perennials usually can be controlled well during bud and early flowering stages.

Distribution

Weeds spread in many ways, including those described below.

Wind. Some seeds have a parachute-like part that carries them in the wind. Examples: dandelion, prickly lettuce, sea aster and butterfly milkweed. Some weeds break off near the soil surface and roll with the wind, scattering their seed. Examples: Russian thistle, tumble mustard, tumble pigweed.

Water. Weed seed may move with surface water runoff in irrigation canals, drainage ditches, creeks and rivers. The effect of soaking in water on seed viability varies among plant species.

Physical. Forages or grain feeds may contain weed seeds that can pass through the digestive tracts of animals and remain viable. Seeds also may be in the soil that sticks to equipment tires and parts. Clean your equipment to help prevent weeds from spreading.

Some weeds have barbs, hooks, spines or twisted awns that cling to animals or clothing. Examples: field sandbur, common cocklebur, devil's claw, beggar's tick, wild barley, red threeawn, Texas wintergrass.

Germination

Most weeds produce numerous seeds per acre. Some seeds remain viable in the soil for many years. The length of time after which a seed can sprout varies. It depends on the kind of seed, condition of the seed coat and time required to break dormancy (a resting stage for the seed). Factors affecting dormancy include temperature, moisture, oxygen, light, resistant seed coats and immature embryos.

VEGETATIONAL REGIONS OF TEXAS

1. **Pineywoods**
2. **Gulf Prairies and Marshes**
3. **Post Oak Savannah**
4. **Blackland Prairies**
5. **Cross Timbers and Prairies**
6. **South Texas Plains**
7. **Edwards Plateau**
8. **Rolling Plains**
9. **High Plains**
10. **Trans-Pecos, Mountains and Basins**

Bitter sneezeweed

Range: Central, eastern and southern Texas
Reproduction: By seed; bears yellow flowers.
Control notes: Use foliar-applied herbicides.
Characteristics: An annual that can survive on wastelands, old feed lots, pastures, idle lands, roadsides and yards.

Broomweed (annual, common or perennial)

Range: Most of Texas except the far south
Reproduction: By seed; bears numerous small yellow flowers.
Control notes: Use foliar-applied herbicides. Soil-applied herbicide may also be used for perennial broomweed.
Characteristics: Found in dry, upland prairies; rocky, open, limestone barrens; roadsides; fallow fields and railroads. These plants are taxonomically related but are quite different anatomically and ecologically; perennial broomweed is commonly known as broom snakeweed in Texas.

Cocklebur

Range: Most of Texas
Reproduction: By seed encased in spiny burs.
Control notes: Use foliar-applied herbicide.
Characteristics: Found in cultivated fields, abandoned land, poor pastures, roadsides, bottomlands, waste places and vacant lots; burs easily cling to clothing and animal fur; mature burs vary in shape, hairiness and spininess. Toxic to livestock when in the cotyledon growth stage.

Dogfennel or yankeeweed

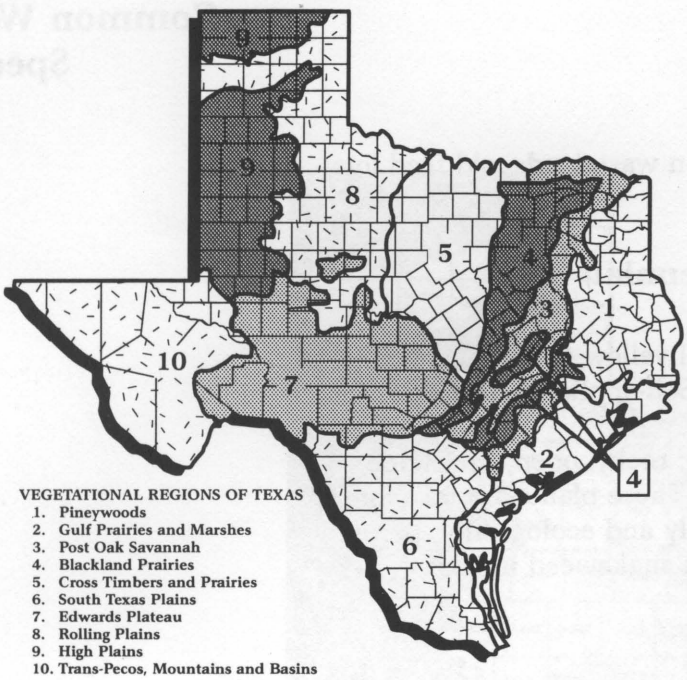
Range: East Texas south to coast
Reproduction: By seed and rhizomes.
Control notes: Use foliar-applied herbicides.
Characteristics: A perennial found in borders of woods, old fields, pastures and rangeland, usually on sandy soils.

Field sandbur

Range: Most of Texas
Reproduction: By seed.
Control notes: Use foliar-applied herbicide.
Characteristics: An annual grass found in sandy soil pastures.

Ragweed (common, giant or western)

Range: Statewide
Reproduction: By seed, which are produced in a raceme at branch tips. Western ragweed also reproduces by rhizome.
Control notes: Use foliar-applied herbicides.
Characteristics: Common and giant ragweed are annuals and are not common on rangelands and pastures, while the perennial western ragweed is; each species grows on a variety of sites.



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Smutgrass

Range: Southeast and East Texas
Reproduction: By seed.
Control notes: Use foliar-applied herbicides or plowing.
Characteristics: A perennial grass found in clay soil pastures.

Sunflower

Range: Statewide
Reproduction: By seed.
Control notes: Easily controlled with foliar herbicide when applied at proper time. Shredding or plowing will remove top growth and give moderate control.
Characteristics: An annual found in cultivated fields, waste places, grain fields, pastures, fence rows and roadsides.

Thistles

Range: Statewide
Reproduction: By seed.
Control notes: Use properly timed herbicide application.
Characteristics: Biennials seen in fields, pastures, rangeland, first-year meadows and wastelands.

Upright prairie coneflower

Range: Statewide, particularly Central Texas
Reproduction: By seed.
Control notes: Use properly timed, foliar herbicide application.
Characteristics: A perennial found in pastures, rangeland, fence rows, roadsides and other locations.

Vaseygrass

Range: Southeast Texas
Reproduction: By seed.
Control notes: Use foliar-applied herbicides or plowing.
Characteristics: A perennial grass found in wet, clay soil pastures.

Woolly croton

Range: Eastern two-thirds of the state
Reproduction: By seed.
Control notes: Use foliar-applied herbicide.
Characteristics: An annual often seen in waste places and overgrazed pastures and rangeland; supported by dry, sandy or open soils; germinates later in the spring than many warm-season annuals; seeds are good bird food.

Woolly locoweed

Range: High and Rolling Plains, Edwards Plateau, Trans-Pecos
Reproduction: By seed; bears bluish-purple to rose-purple flowers in May and June.
Control notes: Control with herbicide and hand grubbing.
Characteristics: A perennial with deep-penetrating roots; found in dry plains and foothills at lower elevations.

Characteristics of Woody Plants

Woody plants go through the same four growth stages as other perennials. They do not die back to the ground during the winter, but many lose their leaves. You can control woody plants with herbicides at any stage of growth, but control is easiest on young plants.

Strong perennials live for many years. They reproduce by seed and vegetatively by basal stem buds, root sprouts or rhizomes. Examples: mesquite, huisache, Macartney rose.

Knowing other facts about the biology and physiology of woody plants is helpful. For example, most woody plants have dormant buds that grow when the top of the plant is disturbed. Many species have buds on the stem base 4 to 8 inches below the soil. If you know about such traits, you can choose the best control method to deal with them. Overall, woody plants have four basic growth forms:

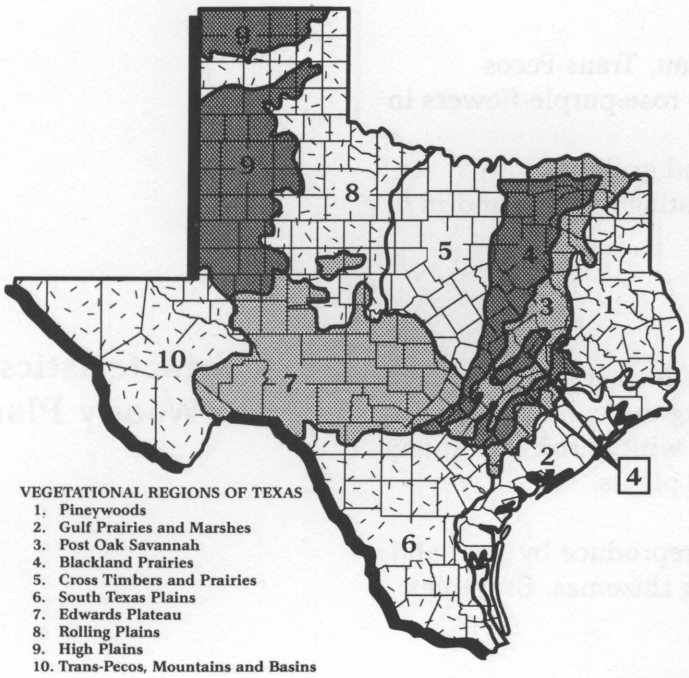
- upright, single-stemmed bushes and trees,
- bushes with a running or creeping growth habit,
- multi-stemmed bushes and trees, and
- plants that grow as vines or canes.

Plants that are not upright, or that have an underground stem and root system with buds, are the most difficult to control.

Common Brush Species

Agarito (Algerita)

Range: Central and West Texas
Reproduction: Spread by seed; wildlife and birds like the fruit.
Control notes: The entire plant, including the crown, must be removed; top growth starts rapidly where only surface mechanical controls are used. Basal bark application of herbicide is effective.
Characteristics: A hollylike, evergreen bush usually no more than 5 feet tall; contains alkaloids once used for medicinal purposes; root tissue extracts are a deep yellow color and may be used as a dye; growing tips are browsed by deer and goats; found on clay loam or gravelly soils.



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Ashe juniper or blueberry juniper

Range: Edwards Plateau, Grand Prairie, North Central Prairies, eastern Rolling Plains
Reproduction: Spreads only by seed; does not sprout from crown after top removal.
Control notes: Prescribed fire and mechanical top removal are effective. Individual plant treatment with soil- and foliar-applied herbicides is effective.
Characteristics: May grow only 25 feet tall; has twisted trunks and low branches; occurs in limestone hills and valleys; provides cover for wildlife and is consumed by sheep, goats and deer.

Baccharis or dryland willow

Range: Central and East Texas
Reproduction: Spreads by seed, but persists by sprout development after top removal.
Control notes: Use translocated herbicides or shallow plowing.
Characteristics: Found along streams and old cultivated fields, this 3- to 6-foot shrub rapidly invades a site; adapts to flood plains, waste areas and vacant city lots; twigs from young plants can be grazed by cattle.

Berlandier wolfberry

Range: South Texas, Rolling Plains
Reproduction: By seed and stem base regrowth; bears small red berries containing many seeds.
Control notes: Mechanical methods that uproot the entire plant are effective.
Characteristics: Woody shrub that grows in mixed brush stands on heavy soils with good drainage.

Blackbrush acacia

Range: Gulf Coast, South Texas Plains
Reproduction: Small white to light yellow flowers produce slender 2- to 3-inch pods that are constricted between seeds.
Control notes: When controlled with herbicides, the dead plants still serve as excellent wildlife cover.
Characteristics: Perennial, woody legume that grows as a small tree or shrub with dark green leaves and dark, almost black stems; grows in mixed brush complexes or in thick, impenetrable thickets.

Catclaw acacia and catclaw mimosa

Range: South Texas, Edwards Plateau, the High and Rolling Plains, Trans-Pecos
Reproduction: By seed and from the stem base with top removal; acacia flowers are cream-colored and clustered into dense spikes, mimosa

flowers are usually pale pink to whitish; both produce a flat pod that is usually curved and constricted between seeds.
Control notes: Soil- and basal bark-applied herbicides are effective.
Characteristics: Spiny shrubs with short, stout, curved thorns; both also called "wait-a-minute" bush; adapted to gravelly loam and sandy loam sites; although small, they can make up most of the ground cover in some brush stands; thick stands seriously limit forage production and the efficiency of working livestock; provide cover for upland game birds.

Coyotillo

Range: South Texas and occasionally Edwards Plateau
Reproduction: By small brown or black fruit with egg-shaped drupes that contain one to four seeds.
Control notes: Mechanical methods are effective.
Characteristics: A poisonous, woody evergreen that grows on hills and ridges, and in arroyos and river canyons where there are calcareous, shallow soils.

Creosotebush

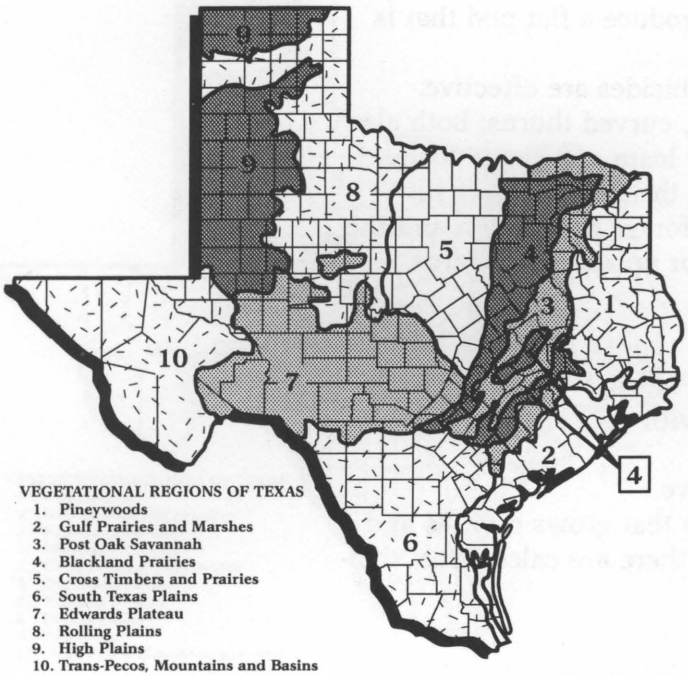
Range: Trans-Pecos, western Edwards Plateau, Rio Grande Plains
Reproduction: By seed; bears aromatic yellow flowers.
Control notes: Plowing and soil-applied herbicides are effective.
Characteristics: Evergreen bush found only on shallow, gravelly, dry sites and sometimes on soils underlaid by a hardpan; not eaten by cattle; often found with tarbush.

Eastern red cedar

Range: Cross Timbers, Prairies, Post Oak Savannah
Reproduction: Spreads only by seed; does not sprout from crown after top removal.
Control notes: Prescribed fire and mechanical top removal are effective. Individual plant treatment with soil- and foliar-applied herbicides is effective.
Characteristics: An evergreen tree occasionally found in stands with redberry and ashe junipers; can reach a height of 45 feet; occurs in many varieties and forms but twigs and bark are usually reddish brown.

Granjeno or spiny hackberry

Range: South Texas and north to the Post Oak Savannah
Reproduction: Produces seeds in fleshy yellow or orange berries that are eaten and dispersed by birds; resprouts from base with top disturbance.
Control notes: Remove mechanically or treat with translocating herbicides.
Characteristics: A densely branched, spiny, evergreen shrub with smooth, gray bark covered with long, stout spines; berries and foliage are excellent food for game birds and deer, respectively.



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Guajillo

Range: South Texas Plains
Reproduction: Spread by seed; also sprouts after top removal.
Control notes: Root plowing may be used to control dense stands; however, many sites have shallow, rocky soils that are difficult to plow. Soil-applied herbicides give acceptable control.
Characteristics: A small shrub or tree found along caliche ridges and sometimes on sandy loam or clay sites; occurs in mixed brush communities; serves as browse for livestock and white-tailed deer. May be toxic to livestock if it makes up an excessive amount of the diet.

Huisache

Range: Gulf Coast, South Texas Plains, lower Post Oak Savannah
Reproduction: Small fragrant yellow flowers bloom in February and March; produce reddish brown to black bean pod; resprouts rapidly from stem buds after top disturbance.
Control notes: Same as mesquite.
Characteristics: Woody, multi-stemmed legume shrub; provides little or no food value for livestock and wildlife but does serve as protective cover; can rapidly infest rangeland and pastures; tolerant of low, poorly drained sites; hardy seedlings.

Knife-leaf condalia

Range: South Texas
Reproduction: By fruit - a black drupe with one seed per fruit.
Control notes: Difficult to control.
Characteristics: A thorny evergreen shrub that reaches 8 to 10 feet tall; another mixed-brush species, it is found on dry, rocky, shallow sites - often on gravelly caliche slopes or on thin soils.

Lechuguilla

Range: Trans-Pecos, Edwards Plateau
Reproduction: Produces a flower stalk 6 to 12 feet tall rising from a cluster of 16 to 30 thick basal leaves; the flowers are greenish to yellowish white and the fruit are a brown to black capsule holding many shiny, black, flat seeds.
Control notes: Individual plant treatment with translocating herbicide is most effective.
Characteristics: Similar to the yucca; can survive beyond its range as an ornamental if planted on a well-drained site; highly adapted to rocky, arid hillsides and high elevations; poisonous to livestock, especially sheep and goats.

Lotebush, bluewood and chaparral

Range: South Texas, High and Rolling Plains, Edwards Plateau, Central Texas, Trans-Pecos
Reproduction: By seed borne in small, shiny black drupes; also sprouts easily from the base and from roots.
Control notes: Individual plant treatment with soil- and basal bark-applied herbicide is effective.
Characteristics: Thorny, stiff shrubs generally found in mixed brush complexes; they readily invade areas where overstory woody species have been removed; the fruit is good wildlife food and the brush is excellent quail cover.

Macartney rose

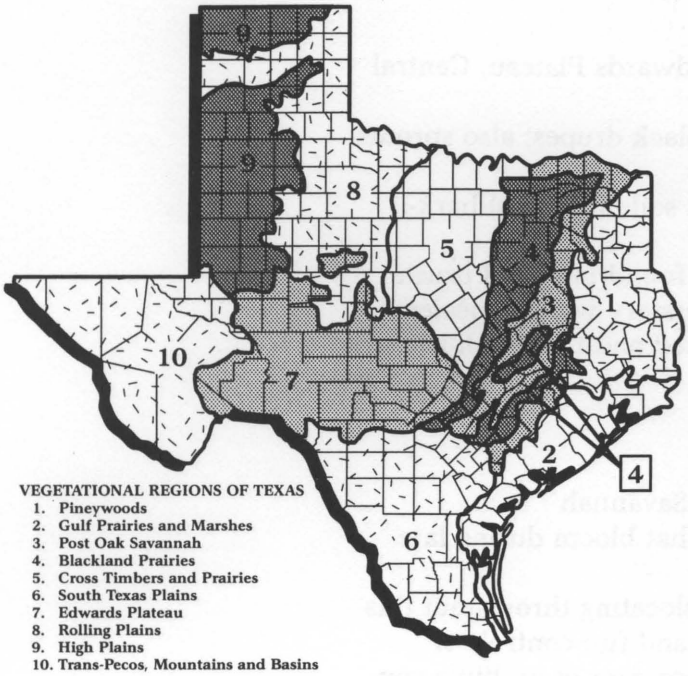
Range: Gulf Coast, East Texas, lower Post Oak Savannah
Reproduction: Produces seeds in white roses that bloom during late summer and fall; also sprouts from roots.
Control notes: Herbicides have difficulty translocating throughout this plant's root system; a combination of chemical and fire controls or mechanical controls are needed. A systematic program of multiple controls used at 18-month intervals may provide effective control.
Characteristics: A major problem species in its range; livestock graze on the rose hips and distribute the seeds in feces.

Mescal bean or mountain laurel

Range: Trans-Pecos, Edwards Plateau, South Texas Plains
Reproduction: By seed; has large showy, purple flowers with sweet pungent fragrance.
Control notes: The plant often grows on steep slopes, making liquid or soil-applied herbicides difficult to use.
Characteristics: A small tree or shrub; the leaves and seeds can be toxic if eaten in sufficient quantities; a secondary invader that moves into shallow, gravelly or rocky sites following brush control practices or fire.

Mesquite

Range: All vegetational areas except Pineywoods–the most prevalent woody species in Texas
Reproduction: Produces seed pods profusely; seeds can lie dormant up to 40 years; sprouts from extensive basal buds and bud system.
Control notes: Destroy underground buds by mechanically uprooting, killing with diesel fuel oil or using translocating herbicides; requires long-term control plan.
Characteristics: Perennial, woody legume of varying height and longevity; has natural resistance to fire, drought and livestock grazing; competes aggressively for water and plant nutrients (a pound of mesquite foliage requires two to four times more water than production of a pound of desirable native forage); foliage is low in palatability; excessive consumption of mesquite beans can cause livestock health problems.



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Redberry juniper

Range: Rolling Plains, Edwards Plateau, Trans-Pecos, Cross Timbers and Prairies
Reproduction: Spreads only by seed but can sprout from the crown after top removal.
Control notes: Chaining and cabling give acceptable control. Individual plant treatment with soil- and foliar-applied herbicides also gives good control.
Characteristics: A small evergreen shrub or tree no taller than 25 feet; branches sweep close to the ground and are covered with scale-like leaves of a yellowish to dark green color; once found only on shallow, rocky slopes but now found also at base of hillsides, canyons and lowland ranges; a primary problem species in several regions of Texas; a low-value browse but may furnish wildlife cover. Small white, waxy flakes on its scale-like leaves distinguish redberry juniper from ashe juniper.

Retama

Range: Gulf Coast, South Texas Plains, lower Post Oak Savannah
Reproduction: Large yellow flowers produce eight seeds in each 2- to 4-inch bean pod.
Control notes: Mechanically remove basal bud zone or treat with translocating herbicides.
Characteristics: Perennial, woody legume that grows as a spiny, deciduous tree or shrub with greenish bark on young stems; dense stands often seen near water sources.

Salt cedar

Range: Western half of state
Reproduction: By seed and root sprouts.
Control notes: Difficult to control. Individual plant treatment with basal bark application of herbicide is effective.
Characteristics: A woody shrub or tree common in low, moist areas in association with willow and cottonwood trees; can reach a height of 30 feet; branches are drooping and gray to reddish gray.

Sand sagebrush

Range: Rolling Plains, High Plains, Trans-Pecos
Reproduction: Spreads by seed, persists by sprouts from a shallow basal bud zone.
Control notes: Deep plow with a disk plow or apply foliar herbicide.
Characteristics: A short, aromatic shrub that is an indicator of sandy soils; may be localized to sandy valleys and hillsides; can shade surrounding forages and grasses, diminishing the browse plant community;

has a greater impact on grasses than on other woody plants, such as mesquite and sand shinnery oak; is a major problem in its range.

Sand shinnery oak

Range: High Plains, Rolling Plains, Trans-Pecos
Reproduction: Acorns, also sprouts from rhizomes.
Control notes: Deep plowing or goats are more effective than foliar-applied chemicals. Soil-applied herbicides are effective.
Characteristics: Usually a shrub less than 3 feet tall, although it can grow to 15 feet; has an extensive rhizome root system and is a good indicator of deep sand; acorns are sought by prairie chickens, bobwhite quail and feral hogs; severely limits forage production and can cause livestock poisoning; the bud stage is the poisonous stage.

Other oaks and hardwood trees

Other oaks and hardwood trees can become a problem in areas of the Post Oak Savannah. However, with the use of herbicides, the range condition recovers. Post oak, blackjack oak, live oak and water oak can be used for fuel or for landscape trees in urban areas. They may also be valuable for aesthetics, wildlife habitat and real estate values in rural areas if selective control practices are used to eliminate excessive numbers of the trees.

Tarbush

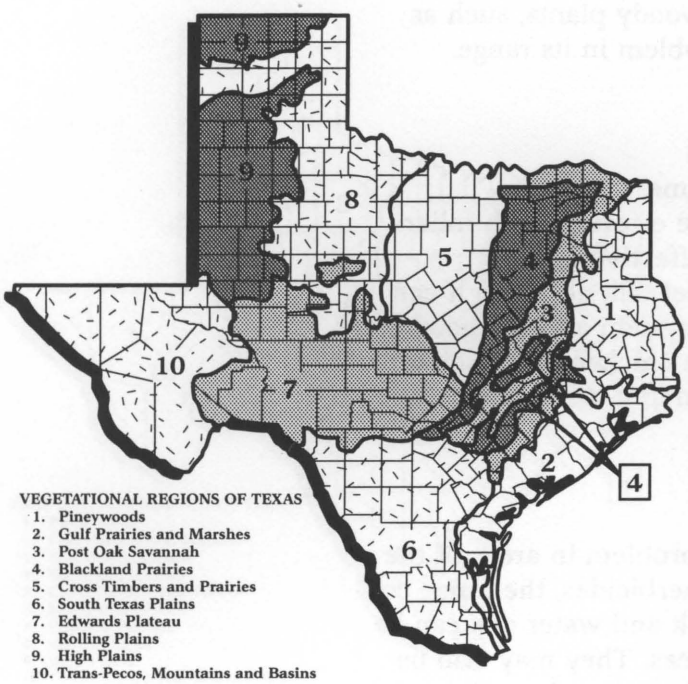
Range: Trans-Pecos, western Edwards Plateau
Reproduction: By seed; also resprouts from crown.
Control notes: Soil-applied herbicide and plowing will control the plant.
Characteristics: 2- to 6-foot tall shrub occurring on dry soils in persistent stands in valleys, mesas and flats; may be grazed during drought by white-tailed deer and sheep; however, the branch tops, flowers and fruit can be toxic.

Texas persimmon or black persimmon

Range: South Texas Plains, Coastal Prairie, areas of Central Texas and the Edwards Plateau
Reproduction: Spreads by seeds borne in a fleshy fruit; regenerates rapidly from roots.
Control notes: Control is difficult; long, lateral roots make mechanical methods less effective. Basal bark application of herbicide is effective.
Characteristics: A small tree or large shrub with dark green leaves and dark bark; often found in mixed-brush communities; large fruit relished by wildlife and livestock; serves as wildlife cover.

Common or Eastern persimmon

Common or Eastern persimmon occurs across the eastern one-third of the state. It is a vigorous root sprouter and adapts to most soils. Like the Texas persimmon, it is difficult to control. Herbicides seem to work best.



VEGETATIONAL REGIONS OF TEXAS
1. Pineywoods
2. Gulf Prairies and Marshes
3. Post Oak Savannah
4. Blackland Prairies
5. Cross Timbers and Prairies
6. South Texas Plains
7. Edwards Plateau
8. Rolling Plains
9. High Plains
10. Trans-Pecos, Mountains and Basins

Whitebrush

Range: Areas of the Rolling Plains, Edwards Plateau, Gulf Coast, Trans-Pecos and South Texas
Reproduction: Older plants sprout rapidly from an enlarged, buried part of the stem known as the "burl." Flowers are small and white.
Control notes: Mechanical control is more effective than foliar-applied chemicals if the plants are uprooted completely. Soil-applied chemicals are effective. Seedlings are fragile and easily controlled.
Characteristics: Highly branched shrub seldom taller than 10 feet; often found on productive soils; an aggressive invader.

Yaupon

Range: Post Oak Savannah, Pineywoods
Reproduction: Readily sprouts from the base and underground stems; produces berries.
Control notes: Difficult to control. Individual plant treatment with soil- and basal bark-applied herbicides is effective.
Characteristics: An evergreen shrub that is prevalent in low, moist woods but easily occupies a more diverse habitat; the worst infestations develop in woody plant complexes in East Texas where yaupon is the main understory species; can form dense stands and eliminate surrounding forage production; berries are eaten by birds.

Yucca or soapweed

Range: High Plains, Rolling Plains, Edwards Plateau, Trans-Pecos (sparse stands of related species grow throughout the rest of the state)
Reproduction: By seed and root sprouting; bears showy white blooms.
Control notes: Individual plant treatment with translocating herbicide is most effective.
Characteristics: Leaves are distinct–over 1 foot long, rigid, with very sharp tips; grows most commonly on sandy soils; blooms often browsed by cattle.

Cacti

Several cacti are among the nuisance plants that may invade overgrazed or poorly managed rangeland:

Cholla

Range: High Plains, Rolling Plains, parts of the Trans-Pecos
Reproduction: Spread by seed and vegetatively by joints removed from the parent plant.
Control notes: Individual plant treatment with foliar-applied herbicide is

effective.
Characteristics: Rapidly invades any area with enough soil for it to take root.

Pricklypear cactus

Range: Prevalent in southern, central and western Texas; scattered in remaining vegetative regions except the Pineywoods
Reproduction: Spreads by seed and vegetatively by "pads."
Control notes: Foliar-applied herbicide is effective. Prescribed burning used in combination with foliar-applied herbicide is very effective. Mechanical treatment may increase the stand by spreading cactus pads.
Characteristics: Provides refuge and food for some wildlife, including raccoons, birds, javelinas and coyotes; ranchers use pear-burners to singe thorns off the leaves (pads) so the cactus can be eaten by livestock.

Tasajillo

Range: All vegetational regions except the Pineywoods
Reproduction: Spreads by seed and vegetatively by "joints."
Control notes: Foliar-applied herbicide is effective. Mechanical treatments may increase the stand by spreading the joints.
Characteristics: Bears red fruit attractive to wildlife, particularly wild turkey and other game birds.

Study Questions

1. Plants that complete their life cycle in less than one year are called _____.

2. Weeds are easier to control during the:
   a. mature growth stage
   b. bud and flowering growth stage
   c. seedling growth stage

3. True or False
   Many perennial broadleaf weeds can be controlled well during bud and early flowering stages.

4. True or False
   Weed seeds are spread in many ways, including wind, water, animals and vehicles.

5. Many brush species are difficult to control because they have _____ _____ on the stem base below the soil surface.

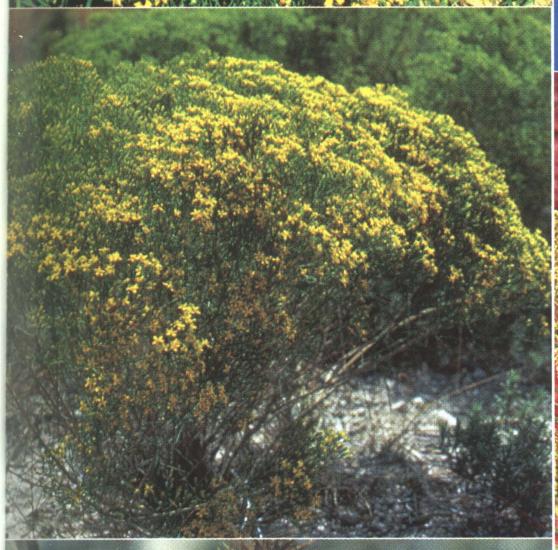
6. The most prevalent brush species in the state that has been the target of many control measures is_____.

7. A sequence of herbicide and fire treatments can be used to effectively control _____ _____ and _____.

8. True or False
   Western ragweed is a perennial that reproduces by seed and rhizome.

Answers
1. Annuals
2. c.
3. True
4. True
5. Dormant buds
6. Mesquite
7. Macartney rose and pricklypear
8. True



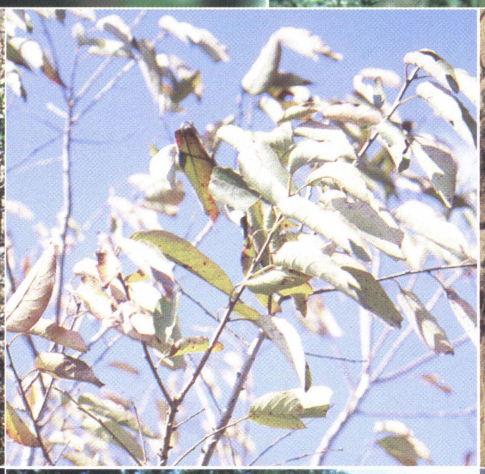








Left Column (top to bottom): Bitter sneezeweed, Annual (common) broomweed, Cocklebur, Yankeeweed
Center Column: Field sandbur, Ragweed, Smutgrass
Right Column: Sunflower, Thistles, Upright prairie coneflower, Woolly croton







Row 1 (left to right): Sand shinnery oak, Whitebrush
Row 2: Tarbush, Common or Eastern persimmon, Cholla
Row 3: Yaupon, Yucca, Tasajillo
Row 4: Texas persimmon or black persimmon, Pricklypear cactus

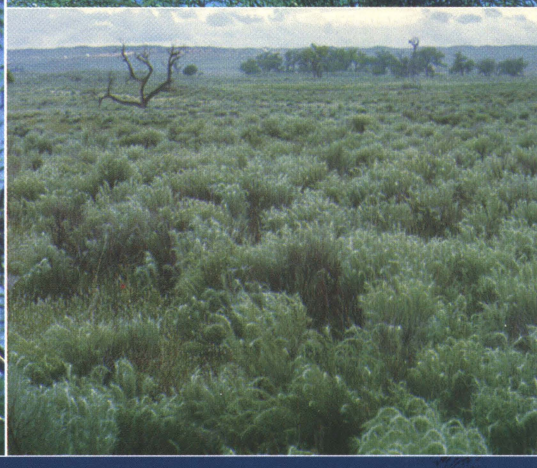








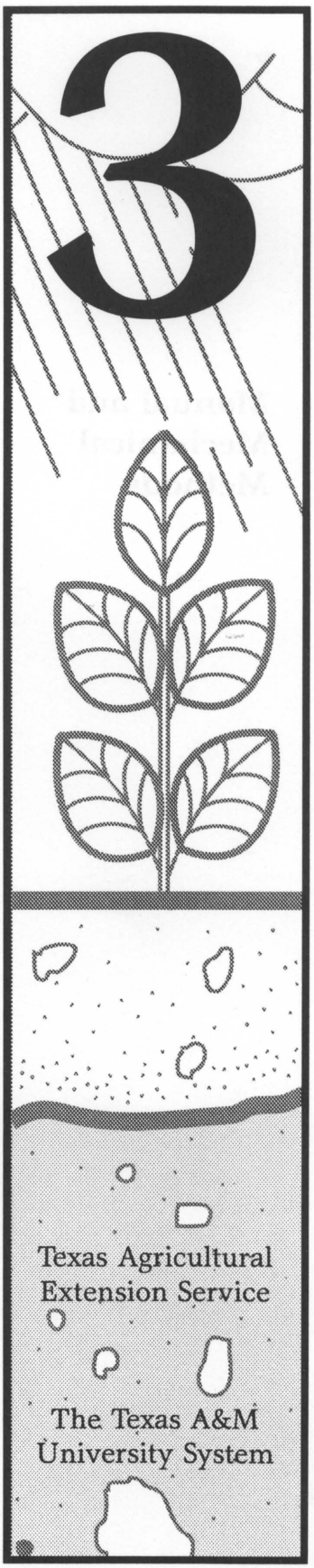




Left Column (top to bottom): Guajillo, Huisache, Lechuguilla, Lotebush
Center Column: Macartney rose, Mescal bean, Mesquite
Right Column: Redberry juniper, Retama, Salt cedar, Sand sagebrush

Left Column (top to bottom): Woolly locoweed, Agarito (Algerita), Blueberry juniper, Berlandier wolfberry
Center Column: Baccharis or dryland willow, Blackbrush acacia, Blackjack oak
Right Column: Coyotillo, Creosotebush, Eastern red cedar, Granjeno or spiny hackberry

Methods of Control



There are several methods of weed and brush control. These include manual, mechanical, biological and chemical methods, and fire. Controls may be used alone or in combination, depending on several factors. Base your selection of control method on 1) management objectives, 2) terrain, 3) soils and site potential, 4) growth form and density of the main problem species, 5) biological effectiveness of method and 6) nature of other problem species.

Learning Objectives

- Learn the different methods of weed and brush control.
- Know the advantages and disadvantages of each method of control, and how to decide which method to use.

Manual and Mechanical Methods

Most manual control methods are slow and useful only for small areas. However, these methods require only common hand tools. The tools are usually inexpensive, simple to use and easy to repair. They include saws, axes, shovels, machetes, mattocks, brush hooks and grubbing hoes.

Equipment used for mechanical brush management is designed to remove either the top growth or the entire plant. Methods that remove only top growth provide only short-term control because most species will resprout from dormant buds below ground. Methods that effectively remove part of the root system along with the top provide longer term control.

Grubbing

Digging up plant roots to stop sprouting or regrowth is called grubbing. Grubbing hoes or mattocks (an axe and hoe combination) are used to chop plants at ground level before grubbing out the roots. Grubbing works best on small, nonsprouting brush species. You can control plants that sprout from the stem base if you cut and uproot them below the lowermost bud.

Low-energy power grubbers are available for use on small crawler and rubber-tired tractors. The efficiency of power grubbing declines on dry clay soils and on deep sandy soils. With dry clay soils, plants are more likely to break at ground level instead of below ground, leaving part of the bud zone in the soil. With deep sands, soil buildup around the plant base requires deeper grubbing to be effective.

Grubbing leaves pits in the soil that help collect water and reduce runoff. However, extensive grubbing leaves the ground very rough. Grasses grow well in the pits when seeded in the early spring.

Girdling

Girdling is the removal of a strip of bark, and the tissues underneath that conduct food and water, from around a tree. It is effective on large trees, at least 8 to 10 inches in diameter, in forests or woodlands. You can use a hand axe, saw or mechanically-powered girdler. Spring and summer are the best times for this method.

Bulldozing

A bulldozer is a crawler tractor equipped with a heavy-duty pusher blade that can sever woody stems at or below the soil surface. Bulldozing works best on large non-sprouting plants in scattered stands. Sprouting species may resprout after bulldozing if the bud zone remains. For maintenance, follow up with burning or other control practices.

A tree dozer is also useful for cutting and removing belowground dormant buds or roots from the soil. It has a solid, V-shaped blade that pushes trees to the side with a push bar. Oak and juniper are sometimes controlled with this machine.

The cost for using dozers rises with the number and size of plants removed. Another drawback is the soil disturbance that dozing causes.

Shredding

Shredding removes the top growth of brushy plants but usually does not kill them. Drag-type shredders work best on plants with basal stems no more than 2 1/2 inches across. Heavy-duty, hydraulic shredders can cut plants with trunks up to 4 inches or more in diameter.

Many woody plants grow back quickly after shredding. For example, honey mesquite, lotebush, twisted acacia and whitebrush grow back to half their height within one growing season. Several other species reach half their original height within two growing seasons. Repeat shredding causes the number of stems and the size of the basal stem to increase. It also makes plants harder to remove by grubbing or to control with herbicides. Stands of Macartney rose and pricklypear may grow even thicker after shredding since canes and pads from those plants may take root. This can be minimized by shredding during hot, dry periods.

Shredding provides only short-term brush control. You may want to use this time to grow grass as a fuel for prescribed burning, or leave the new sprouts on shredded plants to improve the amount and quality of browse. Shredding may also make livestock easier to see and handle.

Shredding of improved pastures can control many weed species in Texas. The best results occur with broadleaf weeds that are shredded before they produce seed, and with plants for which removal of top growth cuts off the growing point. Shredding does not control most grassy-type weed species. However, even when weeds survive, shredding reduces the competition of weeds for light, nutrients and moisture.

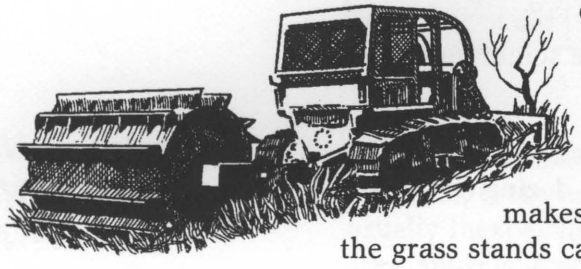
Compared to a herbicide spray application, shredding must be done later in the season. The weeds aren't tall enough earlier in the season to be shred below their growing point. Consequently, the grass grows less, because of weed competition, than grass treated earlier with herbicide. Shredding and a broadcast herbicide spray cost about the same per acre.

Another form of weed control is the practice of sacrificing the first cutting of hay. Allow weeds to grow with the grass until they are tall

enough to control by cutting, and then harvest. This results in some weed control, but reduces the value and quality of the first hay cutting.

Roller chopping

Roller choppers are drums with blades that run parallel to the axis of the roller. The drums vary in size; some can be filled with water to increase weight. Roller choppers are more durable than shredders and work better on larger brush and rougher ground. The rolling/chopping action knocks down and cuts up the brush and scarifies the ground surface.

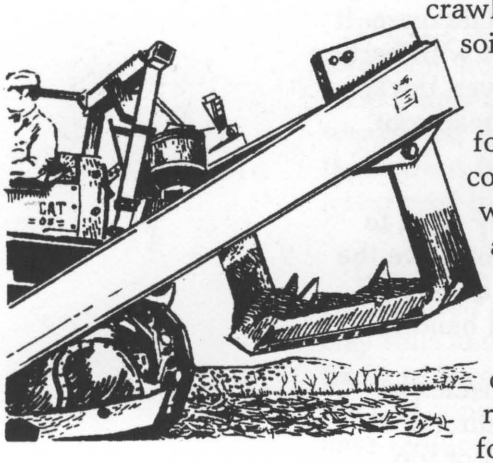


Chopper blades can dig into the soil 6 to 10 inches deep. This lets water soak into the soil better and makes good seedbeds for planting grass. Brush regrowth in the grass stands can be managed with prescribed burning. Roller chopping is also a low-cost way to prepare seedbeds after rootplowing.

The uses for roller chopping are similar to shredding. However, roller chopping kills few plants, provides only short-term control and may speed the spread of Macartney rose and pricklypear.

Rootplowing

A rootplow is a V-shaped blade, 10 to 16 feet long with several short fins attached to the upper surface of the blade. It is mounted behind a crawler tractor and pulled with the blade 8 to 15 inches into the soil.



Rootplowing can uproot stands of brush that are too dense for other mechanical methods and does a very good job of controlling most brush species. However, it does not work as well on shallow-rooted species such as whitebrush and cacti, and it may spread pricklypear and tasajillo.

Rootplowing cuts the roots and disturbs the soil enough to kill most perennial grasses and forbs. Thus, seeding is critical (although the seeds may not sprout well on arid rangeland). Without seeding, annuals and other plants of low forage value will dominate for several years. The loss of plant cover after rootplowing also may prompt the germination of brush species such as huisache.

Rootplowing is costly, but its benefits may last more than 20 years. It is best used on deep friable, fertile soils where desirable plants can grow more easily. It is less suited for shallow rocky soils and deep clay soils.

Heavy offset disk

Heavy offset disks may control small, shallow-rooted brush species such as whitebrush. They cannot control mesquite and other plants with

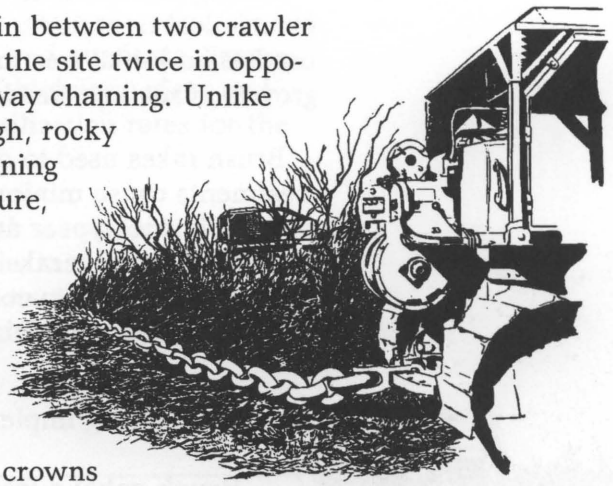
deep buds because the disks reach only 6 to 8 inches deep. Disking does not work well on rocky soils or just before or after a rain because the disked plants may reroot themselves. Disking works best on deep soils that can be seeded.

Plowing

Turning under certain perennial weeds by plowing is an effective weed control option in bermudagrass pastures. Perennial grassy weeds such as smutgrass and vaseygrass can be killed by plowing with a disk plow or a moldboard plow. Although seeds of these grasses are present, they will have to germinate and compete with the bermudagrass to reestablish. This method does not kill bermudagrass sprigs and can provide several years of weed control. In fact, plowing can renovate bermudagrass pastures when soil moisture is maintained after plowing. Fertilization according to soil test recommendations will increase the competitiveness of the bermudagrass and increase the duration of weed control achieved by plowing.

Chaining

Chaining involves dragging a heavy anchor chain between two crawler tractors as they move alongside each other. Cover the site twice in opposite directions for best results. This is called two-way chaining. Unlike many other methods, chaining works well on rough, rocky terrain without disturbing the soil too much. Chaining is an effective, low-cost method for removing mature, nonsprouting, single-stemmed plants such as ashe juniper and other conifers.



Use chaining on trees 4 to 18 inches in diameter in a density of no more than 400 plants per acre. Small, "switchy" brush bends under the chain or breaks off without uprooting. Plan the operation when the soil is moist enough for plant crowns and lateral roots to pull completely out of the soil. (However, moist soil conditions make it easier for pricklypear to spread afterward.) Remember, chaining does not work well on sprouting brush species such as mesquite.

Chaining alone gives only temporary control. It may not kill many plants and regrowth may be rapid. Follow-ups often include goat grazing or fire. You may need to rake and stack woody debris after chaining a thick brush stand. Chaining also works well as a follow-up to herbicides.

Cabling

Dragging a cable instead of a chain to remove brush is called cabling. Because a cable weighs less, it tends to ride over the tops of small brush, leaving many plants intact. Cabling works best on upright, nonsprouting plants of moderate size, such as ashe juniper.

This method causes little soil disturbance. When the soil is moist, cabling uproots woody plants better but is more likely to spread prickly-pear. During dry periods, cabling is sometimes used to control cholla.

Railing

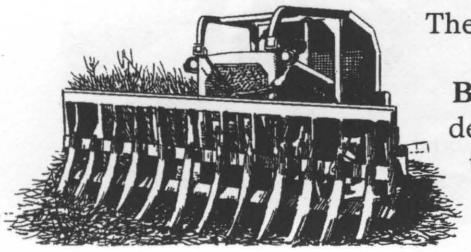
Two or more railroad irons dragged one behind the other is called railing. Channel irons and I-beams also may be used. Railing breaks off or uproots brittle shrubs so that herbaceous plants can spread. Railing twice in opposite directions crushes most cactus stems and pads. Repeat this procedure every 6 to 12 months and follow up with herbicides to improve control.

Railing works best on cactus when the soil surface is very dry, the temperature is hot and the weather is dry enough afterward to kill the cactus pads. Soil disturbance is minimal, so herbaceous response depends on soil moisture conditions following treatment.

Raking and stacking

Raking and stacking are used to collect and pile debris left from other mechanical treatments, such as rootplowing. Occasionally stacking is used as an initial treatment to control pricklypear and to remove the top growth of mature, dense Macartney rose.

Brush rakes used to collect and pile debris left from other mechanical treatments cause minimal soil disturbance. Stacker rakes used to remove and stack pricklypear and mature Macartney rose will disturb the soil more than a brush rake. These rakes penetrate the soil 6 to 10 inches deep and are used to control whitebrush and to prepare a clean, firm seedbed after rootplowing.



The following implements are used in raking and stacking operations:

Brush rake: a front-end rake pushed by a crawler tractor to pile debris left by a previous treatment. Brush rakes have open tines that gather debris without major accumulations of soil. They may be used on either disturbed or firm soil surfaces.

Root rake: a drag-type rake pulled behind a crawler tractor to remove debris on and beneath the soil surface following rootplowing. The primary purpose of this implement is to clean and smooth the land surface for seedbed preparation. By removing woody plant crowns and root tissues from the soil, root raking reduces the probability of resprouting.

Stacker: a special front-end rake modified with closed tines near the soil surface. It uproots or shears off woody plants at ground level and gathers them with less debris loss than the brush rake. Modifications include turned-in ends (V-shaped) and a steel plate across the tines near the soil surface. Additional pads may be added to the bottom tines to

support the stacker's weight and hold it in the correct position for the soil surface. The implement works on a firm soil surface and is especially effective for removal of pricklypear.

Prescribed Burning

Prescribed burning is the oldest known control practice for vegetation on grazing lands. It is a common follow-up to mechanical methods. It reduces the number of woody plants and improves herbaceous plant numbers. The site, its uses, its plant makeup and your management objectives determine if burning is a suitable control method. If it is, then air temperature, wind, moisture and other factors determine the best timing for a burn.

You must follow burning with appropriate grazing practices. Livestock and wildlife are attracted to the new growth on recently burned areas, so monitor grazing closely. If possible, defer grazing during the first part of the next growing season.

Cultural Practices

Proper fertilization of improved pastures

Increasing the thickness and vigor of an improved grass stand helps reduce weed infestations. Thick, healthy stands of grass can compete successfully with weeds for growing space, moisture and nutrients. Proper fertilization of improved pastures increases stand thickness, vigor and grass yields. A recent soil test provides proper fertilization rates for the grass species present in the pasture.

Research shows that fertilization, combined with weed control methods such as shredding or spraying with a herbicide, maximizes yields from improved pastures. The following table reports results from a pasture where early spraying, late spraying and shredding were done for weed control with and without fertilization.

Response of Coastal Bermudagrass to Weed Control and Fertilizer Texas A&M University Trials, 1990-91

	Dry Matter Lbs/Acre			
	1990 (Dry Year)		1991 (Wet Year)	
Treatment	Grass	Weeds	Grass	Weeds
Early herbicide with fertilizer	2,142	209	8,323	-0-
Early herbicide, no fertilizer	1,330	202	4,988	-0-
Late herbicide with fertilizer	881	333	7,610	1,494
Late herbicide, no fertilizer	477	377	4,898	1,266
Shredding weeds, with fertilizer	577	1,078	5,089	2,208
Shredding weeds, no fertilizer	341	761	4,787	998
No weed treatment, fertilizer only	645	1,698	2,587	7,452
Control, no treatment or fertilizer	377	1,127	1,385	4,252

Source: Dr. David Bade and Dr. Paul Baumann, Texas Agricultural Extension Service.

Biological Methods

Managed grazing

One of the simplest biological controls is managed grazing. The right combination of animals and stocking rates, along with the right grazing season and system, leads to an increase in favored plants. Animals have selective grazing habits. Cattle consume mainly grass and certain shrubs or forbs. Sheep eat many different forbs, shrubs and grasses. Deer graze many of the same forbs and browse plants eaten by goats. In fact, goats give the most effective control of woody range plants. Repeated defoliation by goats controls plant growth and spread, and may kill the plants.

In Texas, goats have been used successfully to control oaks, sumac, hackberry and ashe juniper. Unfortunately, if stocked too heavily or for excessive time, goats readily shift their grazing to herbaceous plants. This can hurt desirable herbaceous forage. Prior use of roller chopping, chaining or prescribed burning increases access to woody plants for goat browsing.

Beneficial insects

Insects also may aid in biological weed and brush control. In Texas, the mesquite twig girdler *(Oncideres rhodosticta)* provides limited control. At one site in Texas, girdlers infested 90 percent of the mesquite trees. The insects girdled 40 percent of all branches .2 to .8 inch in diameter.

Two other insect species, the conchuela *(Chlorochroa ligata)* and the seed beetle *(Algarobius prosopis)*, attack honey mesquite seeds. These insects can reduce viable seed by 70 percent. Unfortunately, the conchuela also is a cotton pest.

The blue cactus borer *(Melitara dentata)* can attack and limit the number of pricklypear in South Texas. The insect *Diapheromera covilleae*, or the walking stick, can defoliate large areas of creosotebush. Many other plant-feeding or disease-causing organisms — natural enemies of target species — can sometimes partially control or suppress undesirable species.

Chemical Methods: Herbicides

Chemical herbicides may be used to remove noxious shrubs and weeds from grazing lands. Herbicides are cheaper than mechanical methods in some situations but usually are more costly than fire. Chemicals can be used in locations that are hard to reach with mechanical controls. Chemical applications also may be less labor intensive and more selective. Maintaining a grass or litter cover limits the exposure of soil surfaces to erosion. Chemicals provide fairly rapid control, considering plant response time and the acreage that can be covered.

Disadvantages to using chemical controls include: some species are unaffected by some chemicals; costs may outweigh benefits on low-potential rangeland; and careless use is hazardous to the environment. Incorrectly chosen or applied chemicals can kill beneficial forbs and shrubs.

If correctly used, herbicides can improve rangeland and pastureland by controlling unwanted weeds and brush. However, eradication of undesirable species is seldom possible because of reinfestation and sprouting. In addition, weed seeds that are dormant or brought in by wildlife often flourish on newly cleared land.

Types of Herbicides

Selective herbicides. Not all plants react the same way to any one herbicide. When a plant species is more tolerant to a herbicide than another plant species, the herbicide is considered to be selective. A complex interaction between plants, the herbicide and the environment determines the selectivity of the herbicide.

Plant factors that affect response to a herbicide are age, growth rate, morphology, physiology, biophysical processes, biochemical processes and genetic inheritance.

Molecular configurations, type of toxicity, concentration, formulation and application method are herbicide factors that affect selectivity.

The primary environmental factors that affect herbicide selectivity are soil texture, rainfall and temperature. Selective herbicides are useful to control unwanted weeds and/or brush without harming the desired rangeland or pastureland vegetation.

Nonselective herbicides. Nonselective herbicides kill almost all plants in the application area. These chemicals may leave the soil nonproductive for a year or more, depending on the herbicide and the rate at which it is used. Ideally, the herbicide kills existing plants and keeps others from growing only during the desired period.

Nonselective, soil-applied herbicides kill existing perennials slowly. To speed the process, combine the soil chemical with contact or translocated herbicides. Nonselective herbicides are useful where bare ground is needed.

Contact herbicides. Contact herbicides kill only the green part of plants. Such herbicides cause fluid loss from the plant cells, thus drying out or desiccating the plant. These products sometimes are referred to as "chemical mowers." They require good coverage since they affect contacted surfaces only. Most contact herbicides are nonselective and are useful for control of early germinating weeds before perennial pastureland grasses begin growth.

Translocated (systemic) herbicides. These herbicides are absorbed by leaves or roots and move readily in the veins of the plant. The chemicals work by stopping or disrupting some vital physiological process such as cell division or tissue development, or a metabolic process such as

photosynthesis or respiration. Translocated herbicides are most useful on perennial plants.

Plant Variables that Affect Control

Plants differ in susceptibility to herbicides and other control methods because of differences in the following characteristics.

Location of growth points. The growing point of a grass seedling is protected below the soil surface. The plant will grow back if the growing point remains unharmed. Creeping perennial grasses have buds below the soil surface.

Seedling broadleaf weeds have growing points at the tip of the plant in the leaf axils. Herbicides and mowing easily reach these points. Established perennial broadleaf plants are hard to control because of the many buds on the creeping roots and stems.

Many woody plants, either cut or uncut, sprout from the base or roots.

Leaf characteristics. These are morphological (structural) features that affect herbicide contact with and entry into the leaf.

Shape. Herbicide sprays tend to bounce or run off plants with narrow vertical leaves. Broadleaf plants usually hold the spray. If recommended on the label, add an adjuvant to increase spray retention.

Wax and cuticle. The herbicide must penetrate the leaf surface of the weed. Sprays penetrate leaves with thin cuticles and wax better than leaves with thick cuticles and wax. The cuticle and wax are thinner on young weeds. This is another reason to apply herbicides at the early growth stage.

Hairs. Hairs on the leaf surface keep spray from penetrating. Droplets without a surfactant stand up on the hair and do not reach the leaf surface. Seedling weeds usually have fewer and shorter hairs. This is another reason for early control.

Size. Seedling weeds are easier to control than older weeds. Small plants, regardless of their growth stage, usually are easier to control than large plants. However, brush plants that have been reduced in size by shredding are more difficult to control because they usually have a large root system in relation to the leaves available for herbicide uptake.

Study Questions

1. Selection of control method should be based on:
   a. management objective
   b. growth habit and density of main problem species
   c. nature of other problem species
   d. soil and site potential
   e. all of the above

2. True or False
   Plants that sprout from the stem's base can be controlled by cutting the mainstem with an axe at the soil surface.

3. Shredding may cause plants such as _____ and _____ _____ to increase.

4. _____ herbicides kill only the green part of plants.

5. _____ or systemic herbicides are most useful on perennial weeds.

6. True or False
   Brush plants that have been reduced in size by shredding are usually more difficult to control with foliar-applied herbicide than undisturbed plants.

7. True or False
   Spray easily penetrates leaves with thick cuticles and wax.

8. A _____ added to a herbicide mixture helps the mixture to penetrate hairs on the leaf surface.

9. True or False
   Grassy type weeds are usually controlled by shredding.

10. True or False
    Shredding for weed control usually results in lower grass yields per acre compared to spraying with a herbicide.

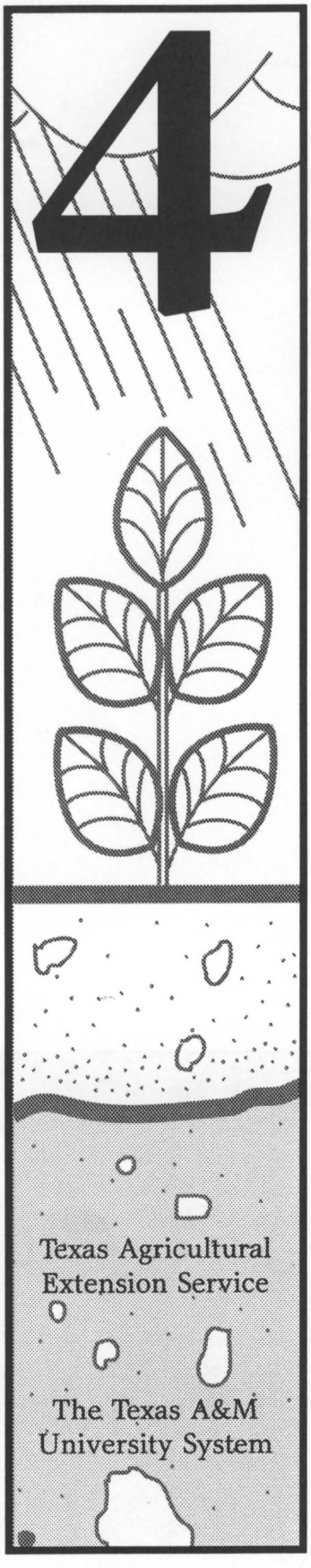
11. True or False
    Costs per acre are similar for both shredding and spraying pastures for weed control.

12. True or False
    Plowing can help control perennial grassy weeds in bermudagrass pastures.

13. True or False
    A thick, healthy grass stand will reduce weed infestations.

Answers

1. e.
2. False
3. Pricklypear and Macartney rose
4. Contact
5. Translocating
6. True
7. False
8. Surfactant
9. False
10. True
11. True
12. True
13. True



Chemical Safety, Application and Equipment

You should use herbicides carefully because they:

- may present a hazard to people and the environment if used incorrectly
- may lose effectiveness over time with repeated use
- vary greatly in classification, origin, use, toxicity and other properties.

Learning Objectives

- Learn the importance of proper handling and application of herbicides.
- Understand available application equipment and methods.
- Know the importance of a brush and weed management plan.

Safety Practices

Proper handling and application of herbicides, after careful selection, prevent possible injury to you and other people, to livestock and to desirable plants, fish and wildlife.

When using chemical controls, remember these basic safety tips.

1. Read the label on each container before buying the product. After purchase, read the label again before using the contents. Follow all instructions and note all cautions and warnings given on the label.

2. Note instructions about weather conditions needed to apply the chemical effectively and to avoid drift. Wind speed and direction, humidity, temperature and air stability all influence how much chemical reaches the target. Do not apply liquid spray when a fog or inversion condition exists. Do not spray when air temperatures reach 95° F or higher. In such hot weather, convective thermals may carry spray particles out of the target area.

3. Apply the chemical only as directed. Follow the label's recommended application rates. Also follow restrictions on grazing and crop feeding.

   The growth stage of target plants is as important to check as weather. Poor control can result if you spray the target at incorrect plant growth stages.

4. Avoid chemical contact with your skin, avoid breathing vapors or dust, and avoid splashing liquid into or near your eyes and mouth. Wear protective equipment and clothing as stated on the label.

5. Make sure you correctly calibrate equipment and correctly hook up hoses, nozzles, pressure gauges and valves. Check that they all work properly. Conduct a trial run using water before mixing a chemical solution. This allows you to conduct necessary checks. Also make sure equipment is clean before adding chemical to the tank. After adding and mixing the chemical, keep the tank properly agitated. Keep all equipment operating correctly to ensure full and even coverage of the target area.

6. Mix chemicals, load and clean spray equipment away from lakes, streams, ponds, recreational areas and wells. Accidental spills or dumping could contaminate water and cause harm to plants and animals that come in contact with the chemicals.

7. Dispose of excess chemicals and empty herbicide containers according to the label and the law. Triple-rinse all herbicide containers before disposal. Do not reuse pesticide containers for any reason. They may contain pesticide residue even after triple-rinsing.

8. When spraying, rinsing or disposing of extra mixture, confine the spray, rinse spray or extra mixture to the property or waste container you have. Avoid drift, runoff and spills.

9. In case a spill does occur, have safety equipment, clay and other absorbents, emergency information, hospital telephone numbers, a shovel for diking up the spill, and other implements recommended by the chemical label.

10. After spraying, clean equipment thoroughly so it will be ready for the next spray job. This precaution prevents contamination of future spray mixtures and prevents damage to equipment.

Spray Equipment and Application Methods

Successful applications require that you know how and when to operate spray equipment. The best equipment for a job depends on weed and brush size, density and location; the season, weather and plant growth stage; and operation costs.

When considering herbicide use for vegetation management, gather the following information:

- product labels and material safety data sheets (MSDS)
- applicable herbicides—where to use each, which are selective, and the characteristics of each
- kinds of plants each herbicide controls
- reaction of each herbicide in the environment and its mode of action within target plants
- correct time to apply
- kind of equipment, nozzle size and pressure for proper application
- mixing and application procedures necessary for success

Individual Plant Treatment

When using chemical control, a slow but effective method is individual plant treatment. This method is very useful for maintenance brush control when the brush stand is less than 200 to 400 plants per acre. Several application methods lend themselves to individual plant treatments. These include foliage and basal sprays from hand-operated sprayers or power sprayers and some soil applications.

Environmental and plant conditions for foliar applications to individual plants are similar to those for broadcast application. However, the effective spray period may last longer into the growing season than for broadcast application.

Liquid herbicides used for broadcast application may also be applied to individual plants as a foliar application. The herbicides are usually mixed with water as the carrier. The mixture is sprayed to uniformly wet the foliage. A power sprayer, backpack sprayer or a "pump-up" sprayer may be used.

Use pressurized hand sprayers or knapsack (backpack) sprayers for spot treatments and for areas not reachable with power sprayers. Most pressurized hand sprayers use compressed air or carbon dioxide to pressurize the supply tank. They are relatively inexpensive, simple to operate and easy to clean and store. The most common hand sprayer is the compressed air type. This sprayer generally does not have pressure gauges or controls. Pressure in the tank drops as the tank empties. To maintain better pressure, fill the tank only two-thirds full (to leave air space for initial expansion) and repressurize the tank frequently. If your sprayer has a gauge, repressurize when the pressure drops 10 pounds per square inch (psi) from the initial reading.

A backpack (knapsack) sprayer has a 3- to 5-gallon tank and is equipped with straps so you can carry it on your back. You do not have to pressurize the tank because it has a constant-pressure positive displacement pump (diaphragm or plunger). The pump has a long handle that extends over your shoulder or under your arm so you can pump with one hand and direct spray with your other hand.

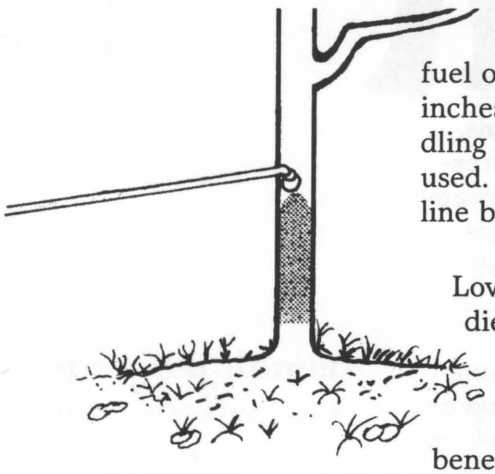
When using a hand sprayer for weed spraying, hold the nozzle at a constant height and spray across the target area in swaths. Or swing the nozzle back and forth with even speed in a sweeping, overlapping motion. Maintain a steady walking speed during application. Before starting, estimate the size of the target area and then determine the amount of spray mix needed to cover it.

Liquid herbicides may be wiped onto brush plant leaves with the carpeted brush roller. The roller is a 10-inch-diameter rotating cylinder covered with carpet that is kept wet with a herbicide mixture. The roller is mounted on the front of a farm tractor, and the herbicide solution is wiped onto leaves and twigs as the rotating cylinder passes over the plant, usually at a height of 1 to 2 feet (depending on the height of the brush plant). The roller applies herbicide to individual plants; thus, it is effective for maintenance control and for treatment of selected brush plants. Herbicides are mixed with water at ratios of 1:7 to 1:8. Individually treated plants usually receive a higher concentration of herbicide than from a broadcast treatment, so more are killed. The carpeted brush roller is most effectively used on thin stands of brush with flexible

stems that are 1 1/2 to 6 feet tall. The carpeted brush roller must be custom-made. Plans for the roller are available from the county Extension office or from the Extension Rangeland Ecology and Management Office, Room 225 Animal Industries Building, Texas A&M University, College Station, Texas 77843-2126.

A hand sprayer with a hand-held boom is excellent for applying herbicides to small areas. Equip the boom with a pressure regulator and the proper nozzles to deliver the correct application rate.

Basal sprays are used for brush control. Backpack or knapsack sprayers and small "pump-up" (compressed air) sprayers work well for basal bark treatments. Pouring solution from a can with a long spout is another typical method.

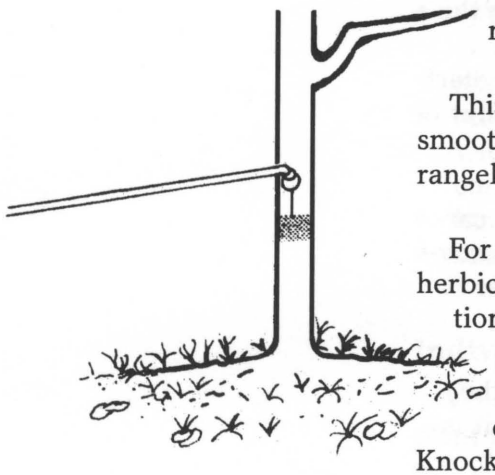


Low-volume basal

Conventional basal treatment involves the application of diesel fuel oil or a herbicide-diesel mixture (2 to 4 percent) to the lower 12 to 18 inches of the stem. Apply enough solution around the stem to cause puddling at the base of the plant. The soil should be dry when this method is used. Variations of this technique are the low-volume basal and streamline basal methods.

Low-volume basal uses a mixture of 15 to 25 percent herbicide in diesel applied to the lower 12 to 18 inches of stem. Apply enough solution to wet the stem without causing puddling. Less solution is needed per plant because the higher concentration delivers more herbicide through the bark. Herbicide does not need to reach beneath the soil surface, as with the conventional basal technique.

Streamline basal uses a mixture of 15 to 25 percent herbicide, 65 to 75 percent diesel and 10 percent penetrant. Spray the mixture in a band (3 to 4 inches wide) on the stem near ground level, or above the line dividing the young (smooth) and mature (corky) bark. A straight stream nozzle provides the band-width required.



Streamline basal

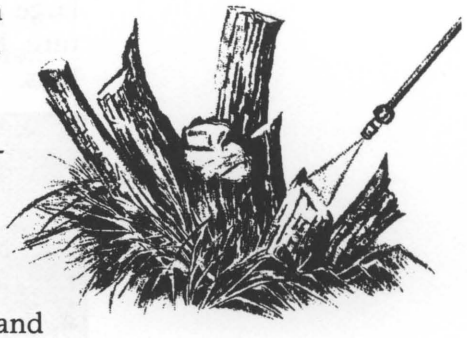
This method works best on stems less than 4 inches in diameter with smooth bark. The streamline basal technique is well suited for use on rangeland because it requires less time and labor than other methods.

For frill applications, cut a ring in the bark around the tree base. Apply herbicide mixture directly to the cut. Saturate the cut or frill until solution bubbles out.

A notch type application is similar to the frill. Make overlapping, downward axe cuts every 3 inches around the base of the tree. Knock out the chips and saturate the cuts with herbicide.

A one-step process for applying herbicide to woody brush is the injector method. An injection tool is used to cut into the tree and inject the chemical.

Yet another control method is stump treatment. Simply cut down woody plants and treat the stumps with herbicide spray or crystals. The chemical passes through the stump to the plant roots.



Soil-applied herbicides are available in liquid and pelleted formulations. Apply a measured quantity of pelleted herbicide, determined by plant size, species and soil type on the ground under the plant canopy of individual brush plants. No special equipment is generally required for individual plant applications (wear chemical resistant gloves). Rainfall is necessary for dissolving the pellets and moving the herbicide into the soil.

Liquid herbicides for soil application are applied undiluted, in measured quantities, to the soil under the target plant. Some type of metering device (exact-delivery spotgun) is required to dispense the herbicide. Since these herbicides are liquid, they move into the soil immediately. However, rainfall is necessary to move the herbicide into the plant's root zone.

When using soil-applied herbicides, apply the herbicide to the soil inside the dripline of the plant at the rate specified on the label. The dripline is at the edge of the plant canopy. After the herbicide moves into a plant's root zone, it is taken up by the roots with soil water. Death of the target species occurs slowly over one to three years. The treated plant may defoliate and releaf several times before it is killed. Grass may die for one to several years in a small circle where herbicide was applied. The best time to apply these herbicides is before periods of expected rainfall and plant growth. This allows movement of herbicide into the soil followed by a period of active root uptake as the plants grow.

Take care when applying soil-active herbicides near desirable trees and shrubs. To prevent injury to desirable plants, these herbicides should not be applied closer than three times the canopy diameter of the desirable plant. Also avoid slopes where water may carry lethal amounts downhill to the vicinity of desirable plants.

Broadcast Treatments

Many types of equipment are used to control weeds and brush on rangeland. For broadcast treatments, equipment selection depends on the chosen chemicals, the plant species and size, location, weather, the chemical, application timing, the control objective and cost per acre.

The most successful broadcast method for large brush is aerial application. This method is fast, economical and less affected by terrain and plant size. In heavy, thick brush this is the only practical broadcast treatment.

Fixed wing, single engine aircraft with 235 to 1200 horsepower are well-suited for brush work in Texas. Helicopters are better suited where air strips are difficult to build. Fixed-wing airplanes are used to spray

large areas, because they can carry 100 to 750 gallons of herbicide mixture. Helicopters, on the other hand, normally carry only 30 to 120 gallons.

Advantages	
Fixed-Wing Aircraft	**Helicopters**
1. have greater lifting power in thin, warm air	1. do not require a landing strip
2. carry larger payload but require a landing strip	2. are better for trees, snags and steep terrain
3. are cheaper for large projects	3. have better accuracy from slower airspeed and are easier to maneuver
4. are more available	

When planning an aerial application, consider the aircraft model and its spray system. Some applicators believe the greater turbulence created by large aircraft provides more uniform spray coverage to understory brush. However, at slow speeds helicopters produce a downward draft that forces spray directly into the canopy.

Spray equipment usually consists of a propeller-driven pump, a pressure regulator, a spray boom and a nozzle. On planes, spray booms are positioned behind and below the back edge of the wing. This allows the pilot to see the spray and to monitor nozzle operation during flight.

Spray pattern and aircraft handling are influenced by both aircraft design and horsepower. Aerial applicators should follow certain standards in preparing their aircraft and applying herbicide. These include:

- Releasing spray within 10 feet of the target plants.
- Using a swath width that, in general, is no more than the width of the wingspan plus 10 percent. The swath width may need to be reduced when spraying tall dense brush.
- Stopping work when air temperature exceeds 90 degrees.
- Spraying away from susceptible crops (cotton, vegetables and ornamentals) according to the following table:

When wind velocity is	Spray no closer than	
	Downwind	Upwind
0 to 3 mph	1 mile	1/2 mile
4 to 6 mph	2 miles	1/8 mile
7 to 10 mph	4 miles	250 feet

(Aerial spraying should not be conducted near water under any circumstance.)

If you are interested in information about aerial application, contact the Agricultural Engineering office of the Texas Agricultural Extension Service.

To remove heavy forage around low-growing target plants, concentrate grazing animals for a short period. Heavy grass cover prevents aerial sprays from contacting target plants.

Ground spray equipment is also available for weed and brush control. These sprayers may be equipped with or without booms. In general, use a boom on smooth, level terrain where weeds and brush are shorter than the boom height.

As with aerial spraying, swath width and uniform spray pattern are important for good, environmentally sound applications with ground equipment. With boomless sprayers, set the swath width by adjusting spray pressure and nozzle settings. Also check the wind and the spray height to ensure even distribution.

For spray gun applications, use a wide cone spray pattern or a straight stream spray. It is difficult to produce constant, uniform coverage with this technique. You can use a hand boom with conventional nozzles to reach rough, thick areas where other power sprayers cannot go.

Properly calibrate all equipment, whether hand, ground or aerial equipment, for effective, economical and safe herbicide application. Nozzle flow rate, pressure, sprayer ground speed and spray width per nozzle are factors that affect the amount of spray mixture applied per acre. Miscalibration reduces effectiveness if you apply too little herbicide and increases costs if you apply too much.

Pelleted herbicides may also be applied by broadcast methods. These formulations are easily applied by rotary dispersing equipment, by air-blast applicators or by aircraft. To ensure accurate and uniform distribution of pellets, the aircraft must be equipped with a metering and spreading device.

Environmental Considerations

Rising application costs and environmental effects of herbicides are a concern to land managers. Chemical residues, chemical persistence and chemical dissipation point to the need for safe and reliable herbicides to use on rangeland and pastures.

From the time a herbicide is applied until the chemical dissipates, it is subjected to many environmental forces. For example, spray is subject to drift, evaporation, displacement and volatilization. Indeed, it is difficult to define "safe" conditions. Long-term experience of applicators and researchers has produced specific guidelines for individual chemicals. These guidelines are written on both the chemical label and on the material safety data sheet (MSDS).

It is important to stop runoff of soil-active herbicides. You must consider terrain, soil, product, location of desirable plants and weather factors. Herbicide movement is most likely on slopes when runoff-producing rains fall before the herbicide soaks into the soil.

Soluble herbicides that are not strongly adsorbed by soil and organic matter are more likely to move with water. Soluble herbicides are more hazardous to groundwater if they do not break down easily and if they are not strongly adsorbed to soils. Limit use of these herbicides in areas where you can expect leaching.

Persistence of a chemical also is difficult to assess. Photodecomposition of herbicides causes minor loss from range ecosystems, but can be a factor. Other factors that affect the time that herbicides stay active in the soil include 1) microbial decomposition, 2) chemical decomposition, 3) adsorption to soil colloids, 4) leaching, 5) volatility and 6) surface movement or runoff. Careful application prevents unwanted chemical persistence and contamination of ground and surface water.

Summary

Brush and weeds are widespread on Texas rangelands and pastures, but they are not homogeneous. Diversity in the ecosystem and resistance of some brush species to single control practices make brush management systems where two or more brush control methods are sequentially applied necessary for effective control.

A one-time control method very rarely results in satisfactory, long-term brush or weed control. Follow a continuing management program to:

1. control sprouts from plant roots and stems.
2. control seedling plants.
3. control other unwanted woody plants.
4. maintain a low level of brush and weed competition.
5. control annual and perennial weeds following chemical or mechanical controls.
6. improve land conditions, regulate grazing and provide better conditions for grasses to grow.

Study Questions

1. Read the _____ on each herbicide container before and after buying the product.

2. True or False
   The best time to apply liquid spray is when a fog or an inversion condition exists.

3. _____and_____sprayers are effectively used for spot treatment and for areas not reachable with power sprayers.

4. Application of herbicide in a 3- to 4-inch wide band on the stem near ground level, or at the line dividing young (smooth) and mature (corky) bark is called (circle one)
   a. low-volume basal application
   b. conventional basal application
   c. streamline basal application

5. Liquid herbicides may be wiped onto brush plant leaves with the _____ _____ _____.

6. Spray should be released within _____ feet of the target plants when using aerial application.

7. True or False
   Properly calibrate all equipment, whether hand, ground or aerial equipment.

8. True or False
   Texas brush species can be eradicated with a one-time control method.

9. To stop runoff of soil-active herbicides, you must consider (circle all that apply)
   a. terrain
   b. soil
   c. rate of plant growth
   d. herbicide efficacy

Answers
1. Label
2. False
3. Knapsack and pressurized
4. c.
5. Carpeted brush roller
6. 10
7. True
8. False
9. a., b.

Recommended Reading

Baumann, Paul A. and Donald J. Dorsett. *Suggestions for Weed Control in Pastures and Forages.* Texas Agricultural Extension Service. Publication B-5038, 1996.

McGinty, Allan and Rick Machen. *Reducing Livestock Losses to Toxic Plants.* Texas Agricultural Extension Service. Publication B-1499, 1994.

McGinty, Allan and Tommy G. Welch. *Brush Control for Small Acreages.* Texas Agricultural Extension Service. Publication L-2227, 1995.

Welch, Tommy G. *Chemical Weed and Brush Control: Suggestions for Rangeland.* Texas Agricultural Extension Service. Publication B-1466, 1995.

Welch, Tommy G. *Mixing Instructions for Liquid Herbicides.* Texas Agricultural Extension Service. Publication L-1839, 1993.

To order a single copy of any of these publications, send request, with numbers, to:

Extension Distribution and Supply
P.O. Box 1209
Bryan, TX 77806

Mixing Instructions for Liquid Herbicides

Tommy G. Welch

Controlling brush and weeds with herbicide sprays requires proper mixing and application at proven, effective rates. Herbicide treatment rates suggested in Extension publications are based on optimum levels of control indicated by research and demonstration results for a number of locations and conditions. Improperly mixed herbicides or significant deviation from suggested herbicide application rates often results in failure to control brush and weeds.

Before use, mix liquid herbicide concentrates with water (to form a solution), with water and oil (to form an emulsion) or with oil so they can be applied uniformly to the target plant populations. Before mixing, check the herbicide label to see if the concentrate is a water-soluble salt, water-soluble amine, oil-soluble amine or an oil-soluble ester formulation. Accordingly, one of the following approaches to mixing the spray should apply.

WATER-SOLUBLE AMINE OR MINERAL SALT FORMULATIONS

Water-Herbicide Solutions:

1. Add half the amount of water to be used into the spray tank.

2. Add the required amount of herbicide concentrate, maintaining agitation while mixing. The amount of herbicide concentrate required can be determined by:

   Herbicide required (gallons per tank) =

$$\frac{\text{acres per tank X application rate (pounds per acre)}}{\text{herbicide concentration (pounds per gallon)}}$$

3. Finally, add the balance of the water, continuing agitation.

Note: For treatment of weeds, brush or broad-leaved vegetation with waxy and/or hairy leaf surfaces, add 1 to 2 quarts of agricultural surfactant (wetting agent) per 100 gallons of water to produce uniform leaf coverage and increase penetration of the herbicide solution.

Oil-Water Emulsions:

1. Add half of the water to be used into the spray tank.

2. Add to the water the required amount of herbicide for the total volume being mixed. Mix thoroughly.

3. Premix the required amount of diesel fuel, fuel oil or kerosene oil with an oil emulsifier. Use 1 to 3 ounces of emulsifier per gallon of oil. Add the oil-emulsifier premix to the spray tank, maintaining agitation. Commonly used oil:water ratios range from 1:3 to 1:6, oil to water respectively. A 1:5 ratio is usually considered optimum for aerial application.

4. Finally, add the remaining amount of water required to bring the batch to the desired volume.

Note: Since an oil-water emulsion is a liquid dispersed in another liquid, not a solution, the oil and water components separate when standing even with an emulsifier. To prevent separation, maintain constant tank agitation during application. A properly mixed oil-water emulsion should be tan to creamy white.

OIL-SOLUBLE AMINE AND ESTER FORMULATIONS

Oil-Herbicide Solutions:

1. Add the herbicide concentrate to the required amount of diesel fuel, fuel oil or kerosene in the spray tank. Mix thoroughly. This solution can be prepared any time before use and will not separate.

Note: Do not get water or oil-water mixtures into the oil-herbicide mixture because a mayonnaise-like invert emulsion can form.

Water-Herbicide Mixtures:

Most ester and oil-soluble amine herbicide formulations contain an emulsifier which allows the oil-soluble herbicide to mix readily with water under agitation. However, a few are formulated especially

for oil-herbicide solutions and do not contain an emulsifier. Read the label before mixing.

1. Begin by running water into the empty spray tank.
2. Add the herbicide concentrate while running the water and agitating continuously. All of the herbicide concentrate should be in the spray tank by the time a third of the water is added.

Oil-Water Emulsions:

1. Premix the herbicide concentrate and diesel fuel, fuel oil or kerosene in a separate container. An oil:water ratio of less than 1:10 probably will require adding an oil emulsifying agent at 1 to 3 ounces per gallon of oil used.
2. Run water into the empty spray tank; then slowly add the premix while agitating continuously.
3. All of the premix should be in the tank by the time a third of the water is added. Ester and oil-soluble amine herbicide formulations in oil-water mixtures form an emulsion, not a solution, and the oil and water components separate unless constant tank agitation is maintained during application.

Note: If the premix is put into the tank before the water, the first water added can form a thick mayonnaise-like invert emulsion. To break the invert, add diesel oil.

GENERAL RECOMMENDATIONS

Water-herbicide solutions generally are used for spot treatment and for air or ground broadcast treatment of undesirable broadleaf weeds. Always add an agricultural surfactant to the solution.

Oil-water emulsions generally are used for individual plant treatment and for air or ground broadcast treatment of woody brush or tree-type vegetation where oil is needed to increase herbicide uptake by penetrating the bark or waxy leaf surfaces.

If applied at high volumes (broadcast at greater than 25 gallons per acre) or for individual plant treatment, oil-water emulsions occasionally damage forage grasses where oil touches the leaf surfaces. This "grass burn" usually is temporary and unless contamination is excessive, does not permanently damage grass cover.

Oil-herbicide solutions (diesel or kerosene mixed with herbicide concentrate) are used for basal treatment of brush or tree-type vegetation. Several application methods are practiced. The conventional application sprays the lower 12 to 18 inches of the trunk until runoff of the solution begins to accumulate at ground line. The low-volume application lightly to evenly wets the basal area of the trunk from 12 to 18 inches above ground line. The streamline application sprays a 2- to 3-inch band around the base of the target plants.

On larger trees with resistant bark, make cuts or frills through the bark to aid herbicide uptake. Painting freshly cut stumps of brush or trees with an oil-herbicide mixture also is an effective control technique.

Always clean equipment immediately after applying herbicides by flushing with water or household ammonia:water (1:25) solution to prevent corrosion of metal parts; damage to rubber or plastic parts; caking in lines, tanks and nozzles; and other forms of deterioration. If a water-soluble amine or mineral salt has been used, rinse the sprayer thoroughly with the household ammonia:water solution. Pump the solution through hoses, booms and nozzles. Rinse all ammonia residue from the sprayer (tank, hoses and booms) with clean water to prevent corrosion of brass nozzles and joints.

Rinse sprayers used to apply ester formulations once with water containing a detergent, followed by several rinses with clean water only. Fill the spray tank with the household ammonia:water solution and pump through hoses, booms and nozzles until all sprayer parts are full. Close the full tank and leave it for 24 hours.

The next day remove the ammonia solution and rinse the sprayer several times with clean water. If the sprayer is not going to be used for several months, rinse the sprayer with kerosene or fuel oil to protect parts from corrosion.

To prevent damage to susceptible plants or crops, do not use herbicides in equipment that later will be used to apply insecticides or other chemicals. For steps to calibrate spray equipment see Extension publication L-764, *Pesticide Application Ground Equipment Calibration Guide*.

Extension publications with suggestions for control of specific weeds or woody plant species are available from your county Extension agent or Extension brush and weed control specialist.

ACKNOWLEDGMENT

The original version of this publication was prepared by Richard S. Bjerregaard, former Extension range specialist, The Texas A&M University System.

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For Sale $10. Mail order to P.O. Drawer FS, College Station, TX 77841

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