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Texas Agricultural Extension Service

Brush Management Methods

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Brush Management Methods

Tommy G. Welch*

Brush plants now exist on more rangeland than at anytime in recorded history. Although the number of acres of dense brush has reduced since the mid-1960's, the areas supporting a thin stand of brush have increased. This indicates invasion of brush into new areas and reinvasion on acres where brush was previously controlled.

Brush has long been considered one of the major management problems confronting owners and managers of rangeland. A dense stand of brush usually minimizes grass cover. Reduced grass cover results in loss of livestock production, increased soil erosion and inefficient use of rainfall. Heavy brush infestations may significantly reduce the amount of water available from rangeland watersheds. The increased soil erosion reduces water quality and can reduce capacity of water reservoirs through siltation.

Brush also has some desirable attributes. It provides food and cover for many wildlife species. Certain livestock enterprises such as goats utilize brush as food. The presence of some brush plants also is often aesthetically pleasing. Brush plants such as mesquite may be useful for wood furniture, firewood and charcoal briquets.

Brush has both positive and negative characteristics. Thus, brush should be managed to meet the established ranch objectives.

Brush control methods are used to manage brush. Many methods have been developed in the past 50 years, and each method has applications for which it is best adapted. Seldom is there a best method for any ranch situation. Often more effective brush management may be obtained by using a combination of brush control methods in a sequence during a period of several years. An integrated management system can minimize the use of herbicides, while improving grass cover and maintaining or improving surface and subsurface water quality. Therefore, before selecting a method, evaluate feasible alternatives relative to 1) degree of expected control, 2) characteristic weaknesses, 3) expected treatment life, 4) secondary effects (i.e., release of a secondary undesirable plant), 5) application requirements, 6) effect on wildlife habitat, 7) cost and benefit and 8) safety.

For most effective brush management, a plan should be developed outlining the purpose of brush management (what is to be accomplished and why), what methods will be used where and when and what is the appropriate follow-up management (grazing and maintenance brush control). The plan must be consistent with the ranch objectives and be part of the overall ranch plan. An effective brush management plan will help meet long-term objectives for the ranch, as well as for the rangeland, livestock and wildlife resources.

Selection of brush management methods is important. Methods should be selected on the basis of ranch objectives, resources available, expected response, economics and personal preference. Brush management methods, including mechanical, chemical, biological and prescribed burning will be described here.

Mechanical Methods

Equipment used for mechanical brush management is designed to remove either the top growth or the entire plant. Methods that remove only top growth generally provide short-term woody plant control because most species will resprout. Methods that effectively remove part of the root system with the top provide longer term control (Table 1).

Hand grubbing

Hand grubbing may be effectively used as a maintenance practice for small brush plants when the number of plants per acre is small (Figure 1). This labor intensive practice may be used to control nonsprouting species and species that sprout from the stem base if they

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Table 1. Expected responses of rangeland vegetation to brush management treatments and special considerations.

Treatment	Expected Brush Responses	Treatment Life (yr)	Forage Responses	Special Considerations
Broadcast Herbicide Application				
Spike 20p	Effective control of some species (eg. oaks, white brush); little control of mesquite, Texas persimmon, prickly-pear, lime prickly-ash and others	10+ (Greatly dependent on abundance of tolerant species)	Maximum release by second or third growing season, highly dependent on ratio of tolerant to susceptible species	Use decision should be based on soil texture and brush stand composition (Also see remarks for Grazon ET + Grazon PC)
Grazon ET + Grazon PC, Banvel + Grazon PC	Good to excellent topkill season of application; 50% or more plants may resprout depending on species, season and initial effectiveness.	5-7	Forage release by end of first growing season; maximum production by second or third season after application	Alternative treatment for tolerant species should be considered at outset of planning
Reclaim + Grazon PC	Effective control of mesquite; Good to excellent topkill season of application; 40% or more plants may resprout depending on species, season and initial effectiveness	5-10 (Dependent on abundance of tolerant species)	Same as for Grazon ET + Grazon PC	Same as for Grazon ET + Grazon PC
Grazon P+D	Effective control of Chinese tallowtree; generally topkills Macartney rose for at least one growing season; many species of weeds controlled; may reduce topgrowth of mesquite by >80% year of application with most plants resprouting	2-3	Forage release by end of first growing season; maximum during year after application	Provides only short-term control of brush unless followed by subsequent treatments
Banvel + Grazon ET	Mesquite topkill good to excellent year of application; responsse of other species variable	5	Same as for Grazon ET + Grazon PC	Same as for Grazon ET + Grazon PC
Reclaim, Reclaim + Grazon ET	Effective control of mesquite; good to excellent topkill season of application; 40% or more plants may resprout depending on initial effectiveness	7-10	Same as for Grazon ET + Grazon PC	Same as for Grazon ET + Grazon PC

Table 1. Continued

Treatment	Expected Brush Responses	Treatment Life (yr)	Forage Responses	Special Considerations
2,4-D	Good control of sand sagebrush; may reduce topgrowth of Macartney rose by >80% year of application; little control of other brush species; some weeds controlled when treated at the proper growth stage	2-3 (for sand sagebrush) 1 (for others)	Forage release by end of first growing season	Repeated treatment required for sustained improvement or follow with prescribed burning
Weedmaster	Many species of weeds controlled; may reduce topgrowth of mesquite by >80% year of application with most plants resprouting	1-3	Same as 2,4-D	Repeat treatment often necessary
Grazon PC	Somewhat more effective than 2,4-D mixture on Macartney rose; effective control of pricklypear, huisache, blackbrush acacia, twisted acacia and other hard-to-kill species	Depends on species	See Grazon ET + Grazon PC	See Grazon ET + Grazon PC
Individual Plant Treatments				
Primarily as maintenance treatment after broadcast treatment; or for scattered stands of woody plants; forage release after treatment is usually minimal				
Spike 20P	Complete kill depending on dosage and brush species	Depends on brush reinvasion rate	Injures grasses in local area of herbicide deposition	Do not apply near desirable trees such as oaks
Grazon PC (high-volume foliar application)	Controls small huisache, pricklypear, twisted acacia, Macartney rose, ashe juniper, eastern redcedar, redberry juniper and many other woody plants	5+	May temporarily injure grasses in local area of herbicide deposition	May be especially useful for spot treatment following prescribed burning
Grazon ET + Grazon PC, Banvel + Grazon PC	Good to excellent topkill season of application; 30% or more plants may resprout depending on species, season and initial effectiveness	5+	See Grazpm PC	

Table 1. Continued

Treatment	Expected Brush Responses	Treatment Life (yr)	Forage Responses	Special Considerations
Reclaim + Grazon PC	Excellent topkill of mesquite season of application; 20% or more plants may resprout depending on initial effectiveness and species	5-10 (Dependent on species)	See Grazon PC	
Reclaim, Reclaim + Grazon ET	Excellent topkill of mesquite season of application; 20% or more plants may resprout depending on initial effectiveness	7+		
Banvel + Grazon ET, Banvel, Grazon ET	Mesquite topkill good to excellent in season of application; 50% or more plants may resprout depending on initial effectiveness	5+		
Grazon P+D	Effective control of Chinese tallowtree, Macartney rose and honey locust	5+	See Grazon PC	
Grazon PC (soil application)	Controls ashe juniper and eastern redcedar	5+	May temporarily injure grasses in local area of herbicide deposition	Do not apply near desirable trees such as oaks
Velpar L	Controls acacias, hackberries, oaks, junipers and mesquite on sand-clay loams	Depends on brush reinvasion rate	Kills grasses in local area of herbicide deposition	Do not apply near desirable trees such as oaks
Grazon ET, Crossbow, Diesel (basal bark application)	Controls most species except junipers and lime pricklyash	5+	May temporarily injure grasses in immediate area of woody plant, depending on rate and carrier	
Grubbing	Control non-sprouters and basal sprouters if grubbed to first root; less effective on root sprouters	5+	Pits remove grass cover but trap water; hand seeding may be effective for grass establishment	Most effective for light to moderate stands of single-stemmed plants
Bulldozing	Effectively controls most plants that are uprooted, but many plants may be left rooted; rooted plants that are sprouters will regrow rapidly; growth form changed from single- to multi-stemmed form	2-3	Dozer blade may remove grass; seeding of grasses may be effective	Soil disturbance will be greater than for grubbing; best adapted for light to moderate stands of single-stemmed non-sprouting plants

Table 1. Continued

Treatment	Expected Brush Responses	Treatment Life (yr)	Forage Responses	Special Considerations
Broadcast Mechanical Methods				
Chaining One-way	Effectively controls most plants that are uprooted, but many plants may be left rooted; rooted plants will regrow rapidly; growth form changed from single- to multi-stemmed form	2-3	Forage released year of treatment, declines as brush regrows	Soil water must be adequate to allow uprooting of plants; chain may ride over or break off tops of small plants; pricklypear may be increased
Chaining two-ways	Generally uproots more plants than one-way chaining	4-5	See above	See above
Raking + stacking	Generally a follow-up to other treatments; some uprooting and removal of small brush and pricklypear; sometimes used for top removal of Macartney rose	1-2	See above	Effectively removes and consolidates debris resulting from previous treatment; localizes pricklypear pads
Stacking	Effective for removal of pricklypear	>5 Depending on reinvasion rate	Released year of treatment	May be used to thin heavy stands of pricklypear; also removes small- to medium-sized woody plants
Roller Chopping	Most plants regrow rapidly; growth form changed from single- to multi-stemmed form; pricklypear cover increased	2-3	See above	Can use on larger brush than with most shredders; may prepare adequate seedbed for seeding grasses
Shredding	See above	See above	See above	Generally cannot be applied when most plants basal diameter >4 inches
Rootplowing	Highly effective in killing most species if done properly. Not effective on some plants that can root from severed or broken plant parts such as pricklypear	10-20	Most existing forage plants destroyed. Most forage production year of treatment is from annuals	Should be followed by seeding
Offset disk	Effective on smaller, shallow-rooted brush species such as whitebrush	10	See above	See above

Table 1. Continued

Treatment	Expected Brush Responses	Treatment Life (years)	Forage Responses	Special Considerations
Biological				
Goating	Effective in combination with prescribed burning, roller chopping, shredding and other mechanical methods that stimulate basal and/or root sprouting on shinoaks and other mixed brush	>5 Depending on continued use of goats		Goats will utilize large amounts of shinoak if stock density is high enough and goats are removed when brush is defoliated and returned when new leaves develop
Prescribed Burning				
Prescribed burn	Controls non-sprouters such as ashe juniper, eastern redcedar and pricklypear; sprouters regrow rapidly	2-5	Forage released year of treatment, declines as brush regrows	Effectiveness depends on intensity of fire. Quantity, continuity and distribution of fine fuel (grass) as well as weather are important factors that determine fire intensity

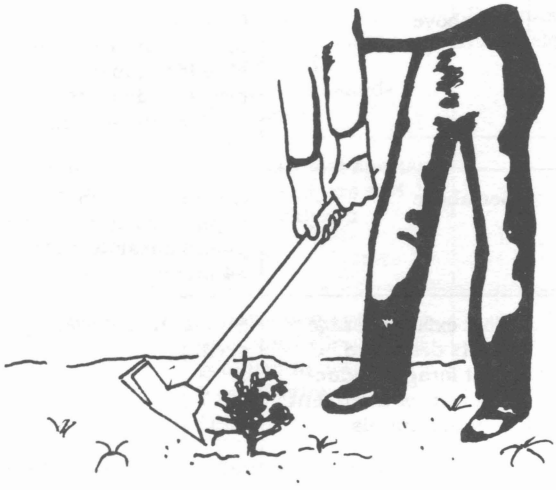

Figure 1. Hand grubbing for complete removal of small plants.

are uprooted below the lowermost bud. Hand grubbing is best accomplished when the soil is moist.

Power grubbing

Power grubbing is effective on nonsprouting species and species that sprout from the stem base, provided they are uprooted below the lowermost bud (Figure 2). Power grubbing is most useful with scattered plants that are large enough (at least 3 feet tall) to be seen easily by the equipment operator. The size of plant that can be effectively grubbed depends on the size of tractor and grubber used.

Soil texture and water content affect grubbing efficiency. The efficiency of power grubbing decreases as soil clay content increases and water content decreases. On dry clay soils, many plants may be cut off near the ground level by the grubber blade, leaving part of the bud zone in the soil. Likewise, grubbing on deep sands may not be successful because accumulation of soil around plant bases increases the depth requirement for effective grubbing. Grubbing in shallow, rocky soils is usually hard on equipment, less effective and may leave the soil surface extremely rough.

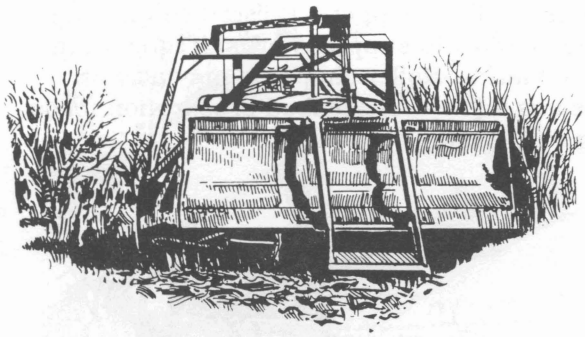

Figure 2. Power grubber for cutting roots 4 to 14 inches beneath the soil surface.

Various types of low-energy power grubbers have been developed. These grubbers are used on small crawler and rubber-tired tractors (Figure 3). Low-energy grubbers may be used to control thin stands of small brush plants. These grubbers are not recommended for plants with root diameters greater than 4 inches.

Pits are left in the soil surface where brush plants are removed. Runoff water will accumulate in these pits increasing the water infiltration. However, the soil surface may become extremely rough if high densities of brush are grubbed. The pits allow a good chance for establishing desirable grasses if seeds are scattered in the pits in early spring.

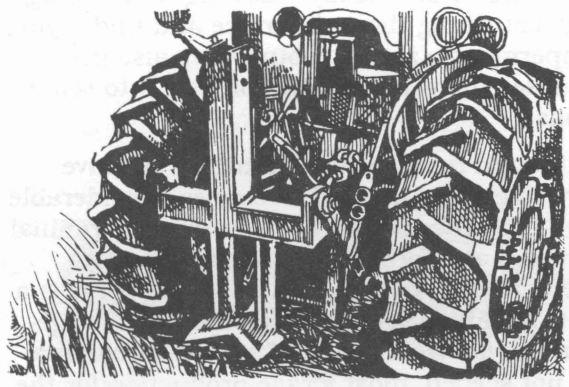

Figure 3. Low-energy power grubber for use on row crop tractors.

Bulldozing

The bulldozer (a crawler tractor equipped with a heavy-duty pusher blade) is used to sever woody stems at or below the soil surface (Figure 4). Since few plants are uprooted by bulldozing, it is best adapted for use on large non-sprouting species in scattered stands. If sprouting species are bulldozed, expect plants to resprout unless the bud zone is removed. Bulldozing may cause considerable soil disturbance.

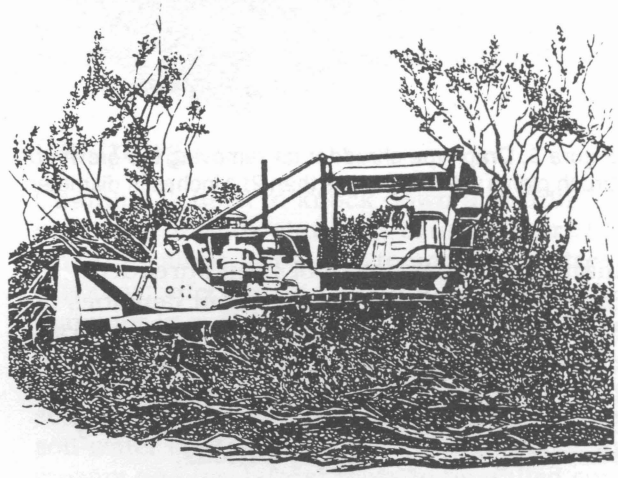

Figure 4. Bulldozer for severing woody stems at or below the soil surface.

Shredding

Shredding uniformly removes brush top growth but rarely kills woody plants, especially those capable of sprouting from roots or stem bases. Drag-type shredders (Figure 5) are most efficient on plants with stem basal diameters of less than 2 1/2 inches, although heavy-duty, hydraulically operated shredders may remove woody plants with trunk diameters of 4 inches or more.

Woody plants may regrow rapidly following shredding. For example, honey mesquite, lotebush, twisted acacia and whitebrush replace 50 percent of their original heights during the first growing season after shredding. Several other woody species replace 50 percent of their height during the second growing season. Repeated shredding generally causes the number of stems and size of the bud zone (basal stems) to increase. Plants that have been shredded repeatedly are more difficult to control with herbicides and may require more energy to remove by grubbing

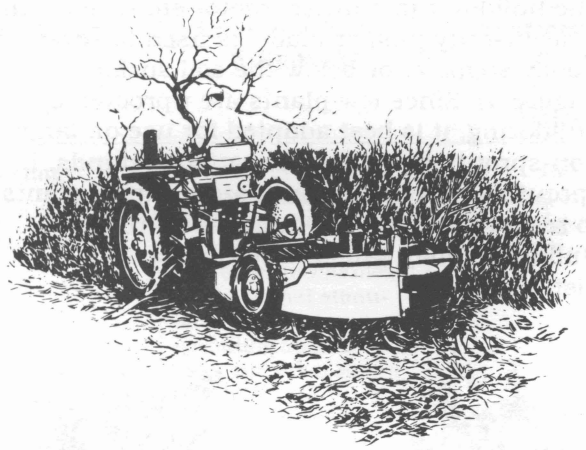

Figure 5. Drag-type shredder for removing top growth of brush plants with stems less than 2 1/2 inches in diameter.

than plants that have not been shredded. Shredding can increase the plant densities of Macartney rose and pricklypear because fragments of rose canes or pricklypear pads scattered over the soil surface may take root. Spreading of such species is minimized by shredding during hot, dry periods.

Although shredding provides only short-term control of most undesirable plants, sufficient time may be allowed for grass to grow and provide fine fuel for prescribed burning. Shredding may increase browse availability and quality by increasing the number of young, succulent sprouts. Shredding may also improve livestock handling efficiency by increasing accessibility and visibility for the manager.

Roller chopping

Roller choppers are drums with several blades running parallel to the axis of the roller (Figure 6). The drums vary in size; some types are filled with water to increase their weight. Roller choppers are more durable than shredders and can be used on larger brush and rougher topography.

Roller chopping, like shredding, kills few plants. Forage response and treatment life are similar to those described for shredding. Likewise, roller chopping Macartney rose and pricklypear may result in a significant increase in plant density as cane and pad fragments take root.

Chopper blades may penetrate the soil surface from 6 to 10 inches deep. Thus, soil disturbance may be sufficient to improve water infiltration. Seeded grass stands have been established on seedbeds prepared by offset, tandem roller choppers. Prescribed burning may be used to suppress brush regrowth in such stands. Roller chopping may also be used as a low-cost seedbed preparation following rootplowing.

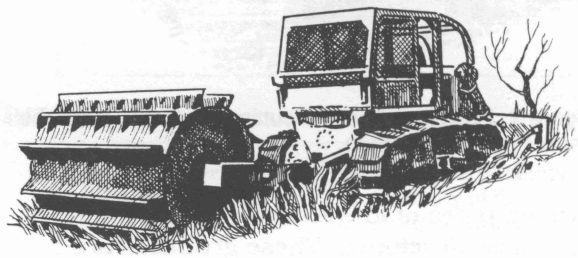

Figure 6. Roller chopper for removing top growth of brush plants.

Rootplowing

Rootplowing is a nonselective treatment used to sever woody plants in moderate to dense stands of brush. A rootplow is a V-shaped blade, 10 to 16 feet long with several short fins attached perpendicular to the blade (Figure 7). It is mounted on and pulled behind a crawler tractor with the blade 8 to 15 inches below the soil surface.

Rootplowing will control most brush species. It is least effective on shallow-rooted species such as whitebrush and cacti. However, ground cover of pricklypear and tasajillo may increase dramatically following rootplowing. By disturbing the soil surface and underlying impermeable zones, rootplowing also increases the water infiltration rate into some soils.

Although rootplowing is a highly effective brush control method, it causes considerable soil disturbance and destroys most perennial grasses and forbs. Thus, seeding is often necessary as a follow-up treatment. This is a serious limitation when used on arid rangeland in far West Texas. If a rootplowed area is not seeded, most forage production for the first several years will be from annual and other plants low on the successional scale.

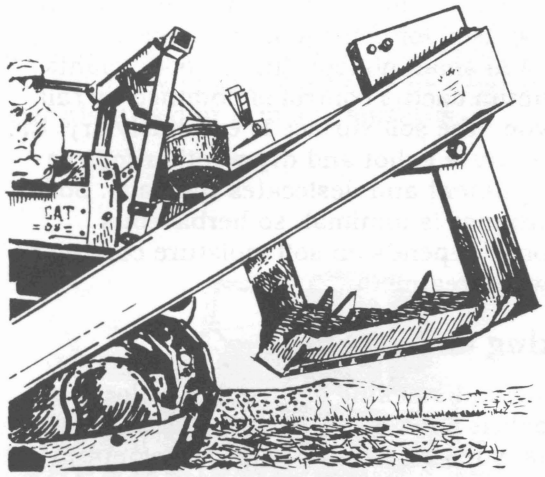

Figure 7. Rootplow for cutting roots 8 to 15 inches beneath the soil surface.

The carrying capacity for cattle is reduced until higher successional grasses become established. The flush of annual forbs on rootplowed areas may drastically improve wildlife forage supply until perennial grasses become dominant. The soil disturbance and destruction of vegetative cover on rootplowed areas may stimulate the germination of some brush species such as huisache.

Rootplowing is costly, but the benefits of the practice may exceed 20 years. Rootplowing is best suited for deep friable, fertile soils where revegetation is feasible. The effectiveness is generally reduced on shallow rocky soils and deep clay soils.

Heavy offset disk

Heavy offset disks may effectively control small, shallow-rooted brush species such as whitebrush (Figure 8). Because of the limited soil depth (6 to 8 inches) reached by the offset disk, it is generally ineffective on plants with deep bud tissues such as mesquite. Disking does not work well on rocky soils either. Disking is less effective just before or immediately after rain because many plowed plants reestablish root systems. The extreme soil disturbance and possible damage to existing perennial vegetation caused by disking make the method most applicable to deep soils that can be seeded.

Chaining

Chaining is used to knock down and thin moderate to thick stands of brush (Figure 9). Chaining alone gives only temporary control. It is most effective on trees 4 to 18 inches in diameter in a density of no more than 400 plants per acre. Small, "switchy" brush will bend under the chain or break off above the soil surface. To obtain maximum control, the soil-water content must be sufficient for plant crowns and (or) lateral roots to be pulled completely out of the soil. Chaining under these conditions, however, may increase the cover of pricklypear. Two-way chaining, covering the area twice in opposite directions, usually gives better control than one-way chaining. Chaining can be used on rough, rocky terrain with only moderate soil disturbance.

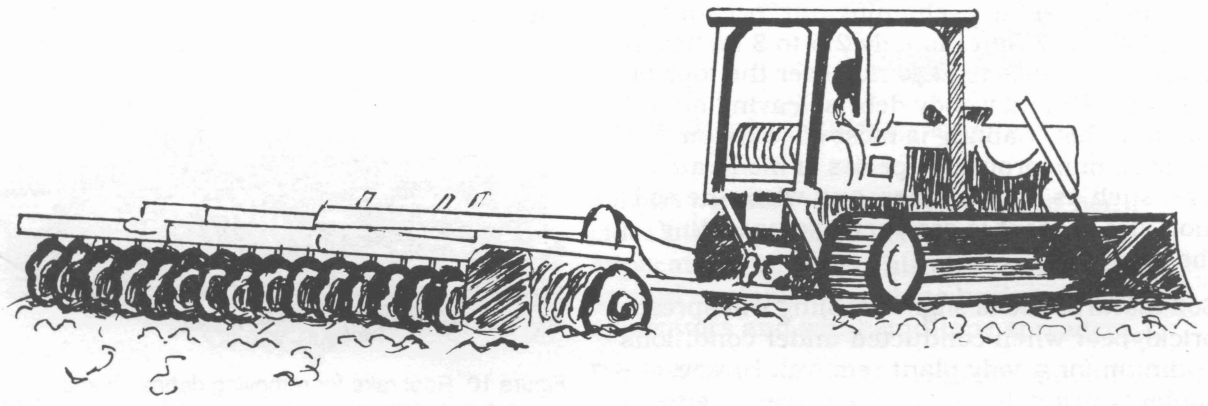

Figure 8. Heavy offset disk for control of shallow-rooted brush species.

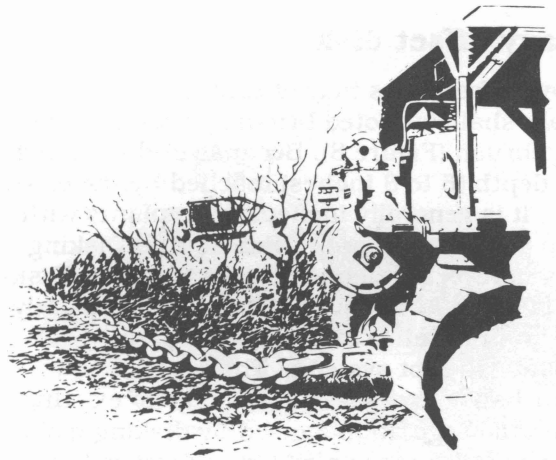

Figure 9. Heavy anchor chain pulled between two crawler tractors for knocking down trees 4 to 18 inches in diameter.

The percentage of brush plants actually killed by chaining is often low, and regrowth may be rapid. However, herbaceous production may increase the year of treatment, given average or greater rainfall. This may provide adequate fine fuel for prescribed burning to remove debris and suppress brush growth. Raking and stacking may be necessary to remove woody debris after chaining areas of heavy brush cover. Less debris allows maximum development and utilization of range forages and minimizes livestock-handling problems.

Chaining has been used successfully in combination with aerial application of herbicides. Chaining two or three years after aerial spraying reduces time required to chain and also improves brush kill by uprooting partly dead large plants.

Cabling

Cabling is similar to chaining but, because of their lighter weight (usually 2.5 to 3 inches in diameter), cables tend to ride over the tops of small brush and woody debris, leaving many plants intact. Cabling is most effective on upright, nonsprouting species of moderate size, such as ashe juniper, and when the soil moisture content is conducive to uprooting the plants.

Soil disturbance is slight. Cabling will spread pricklypear when conducted under conditions optimum for woody plant removal. However, cabling during dry periods has been used to control cholla.

Railing

Two or more railroad irons dragged in tandem may be used for control of pricklypear, other cacti and small nonsprouting woody plants. Maximum cactus control is obtained by railing when the soil surface is extremely dry, the temperature is hot and dry weather follows the treatment and desiccates the 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/or stacking operation:

Root rake – a drag-type rake (Figure 10) 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.

Figure 10. Root rake for removing debris on and beneath the soil surface.

Brush rake – a front-end rake (Figure 11) pushed by a crawler tractor to pile debris left by a previous practice. Brush rakes have open tines that gather debris without major accumulations of soil. They may be used on either disturbed or firm soil surfaces.

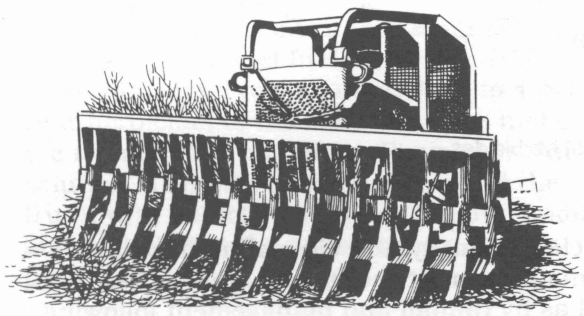

Figure 11. Brush rake for piling debris left by a previous practice.

Stacker – a special front-end rake (Figure 12) 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.

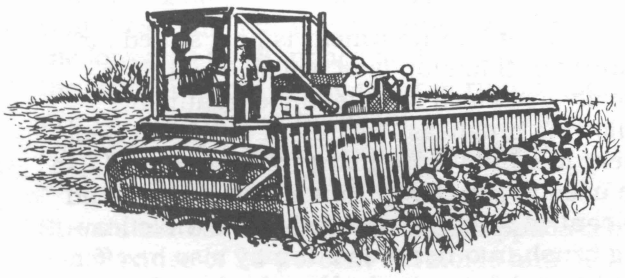

Figure 12. Stacker for uprooting or shearing off woody plants at ground line and gathering debris with minimum loss.

Chemical Methods

Herbicides used on rangeland may be formulated as liquids or pellets and applied by broadcasting or to individual plants. These herbicides include Grazon ET (triclopyr), Banvel (dicamba), Grazon PC (picloram), Reclaim (clopyralid), Crossbow (1:2 mixture of triclopyr and 2,4-D low volatile ester), Grazon P+D (1:4 mixture of picloram and 2,4-D amine), Weedmaster (1:3 mixture of dicamba and 2,4-D amine), Velpar L (hexazinone) and Spike 20P (tebuthiuron). Degree of brush control with herbicides depends largely on species susceptibility, rate of application and method of treatment (Table 1). Consult *Chemical Weed and Brush Control Suggestions for Rangeland* (B-1466) by the Texas Agricultural Extension Service for specific recommendations on each problem situation. The following descriptions are intended as general information only.

Broadcast application

Liquid herbicides are usually applied aerially in 2 to 5 gallons per acre of an oil:water carrier (Figure 13). When applied with ground equipment (cluster nozzle or boomsprayer), the herbicide-carrier volume is 10 to 30

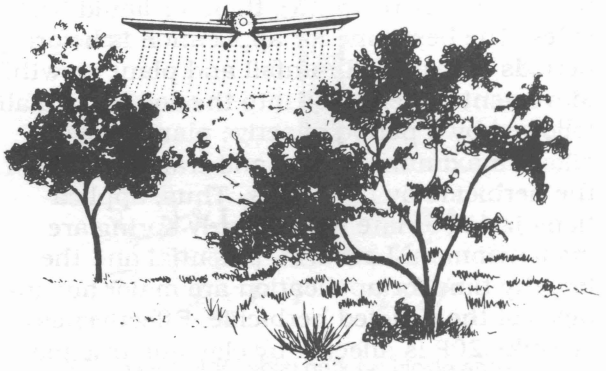

Figure 13. Aerial herbicide application for brush control.

gallons per acre (Figure 14). Pelleted herbicides may be applied aerially with special applicators. They may also be broadcast by ground equipment, such as backpack-airblast applicators and whirlwind-type spreaders.

For best results, liquid herbicides must be applied when growing conditions optimize herbicide absorption by the plant. For example, foliar-applied herbicides usually should be

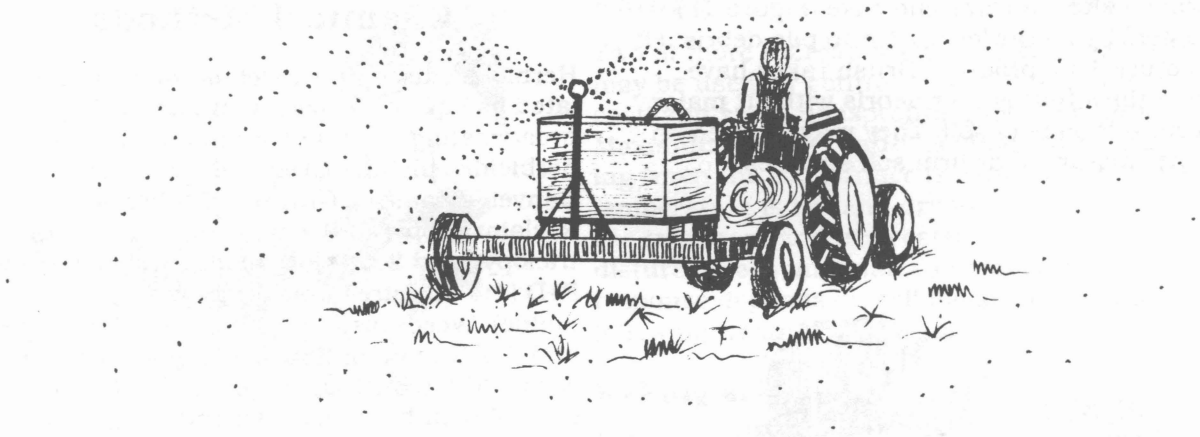

Figure 14. Cluster nozzle used for ground broadcast application of herbicides.

applied to mesquite after the leaves have matured in the spring and the soil temperature at 12 inches of depth is 75°F or more. Macartney rose, blackbrush acacia and huisache may be sprayed during spring or fall. Generally, best results are obtained when growth conditions allow development of full foliage and the plants are not water stressed or damaged by insects, leaf diseases, hail or frost. Climate and growth conditions often limit the use and effectiveness of liquid herbicides.

Conditions for application of the pelleted herbicide are less restrictive than for liquid herbicides. The best time for application is before periods of expected rainfall and plant growth. Movement of herbicide into the soil by rainfall followed by a period of active plant growth allows maximum uptake and translocation of the herbicide by the plants. Thus, applications in fall or late winter/early spring are most common. Low drift potential and the lengthy time for application are major advantages of the pelleted herbicide. Effectiveness of Spike 20P is affected by clay and organic matter content of the soil. To achieve a given level of brush control, the herbicide rate must be increased as clay and (or) organic matter content increases.

Forage production may increase significantly during the first growing season after a liquid herbicide is applied. When Spike 20P is used, the greatest increase generally occurs two or more growing seasons following application. Abundance and diversity of herbaceous plants may be reduced by some herbicides. The degree of forage response is influenced by species, quantity and vigor of herbaceous plants present at the time of application, as well as by rainfall and management following treatment. In time, grass production generally declines as woody plants reestablish and canopies are replaced. The length of time before grass production returns to pretreatment levels varies considerably depending on the herbicide and brush species treated (Table 1). Some foliar-applied herbicide treatments may regress to pretreatment forage production within three to five years. However, some soil-applied herbicide treatments have a projected treatment life of over 20 years.

Individual-plant treatment

Herbicides used for broadcast application may also be used for treatment of individual plants. In addition, some herbicides are labeled for individual-plant treatment only. Individual-plant treatments are usually more effective than broadcast treatments with the same herbicide when plant kill is the evaluation criterion.

Individual-plant treatment is best suited for control of thin stands of brush. Thus, it is ideally used as a maintenance treatment following broadcast treatment to extend treatment life. Individual-plant treatment may also be used to selectively thin a brush stand and to control brush in selected areas while leaving brush in other areas. It may also be effectively used for control of brush along fencelines, around watering areas and around corrals.

Individual-plant treatment methods include cut-stump, basal bark, soil, high-volume foliar and carpeted roller applications. Cut-stump treatment uses diesel fuel oil, kerosene or a herbicide applied to the surface of a freshly cut stump and the basal plant parts below the cut. Application is continued until runoff occurs and the liquid begins to puddle at the soil surface (Figure 15).

Three types of basal bark methods are available. Conventional basal treatment is the application of diesel fuel oil, kerosene or a herbicide/diesel fuel oil mixture (2 to 4 percent herbicide) to the lower 12 to 18 inches of the trunk of a brush plant (Figure 16). The solution is applied completely around the trunk with sufficient volume to allow runoff and puddling at the soil surface near the plant base.

Figure 15. Cut-stump herbicide application for maintenance control.

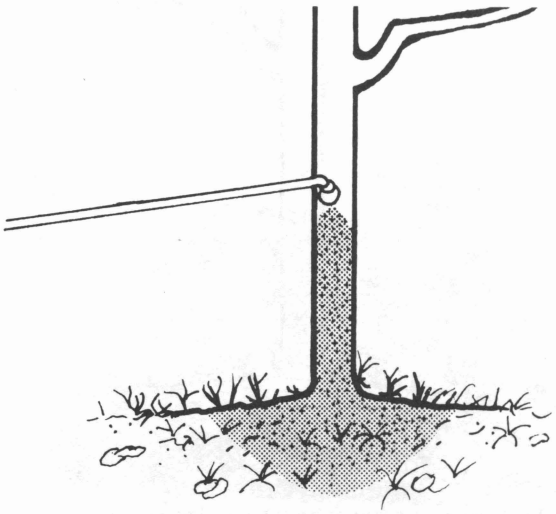

Figure 16. Conventional basal bark application of herbicide for maintenance control.

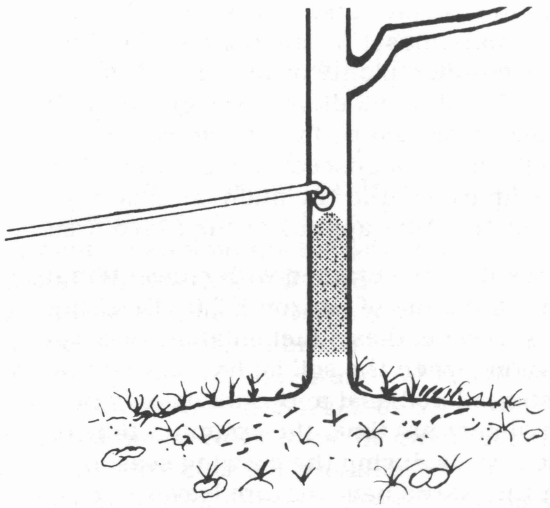

Figure 17. Low-volume basal bark herbicide application for maintenance control.

Low volume basal treatment uses a mixture containing 25 percent herbicide and 75 percent diesel fuel oil. The mixture is applied to the lower 12 to 18 inches of the trunk to wet the trunk but not to the point of runoff (Figure 17). The higher herbicide concentration allows for more penetration of herbicide through the bark of the plant.

Streamline basal treatment is the application of a mixture of 25 percent herbicide and 75 percent diesel fuel oil or 10 percent penetrant and 65 percent diesel fuel oil. The mixture is sprayed in a band (3 to 4 inches wide) completely around the trunk near ground level or at the line dividing young (smooth) and mature (corky or rough) bark (Figure 18). A straight stream nozzle gives the band width required. Addition of a penetrant improves ease of coverage around the trunk and may increase penetration of the herbicide through the bark.

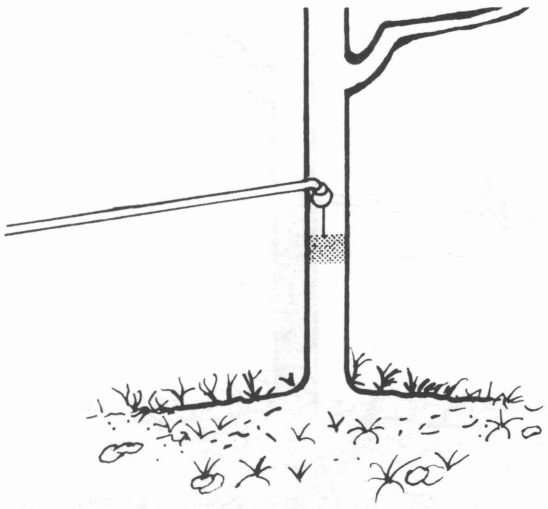

Figure 18. Streamline basal bark herbicide application for maintenance control.

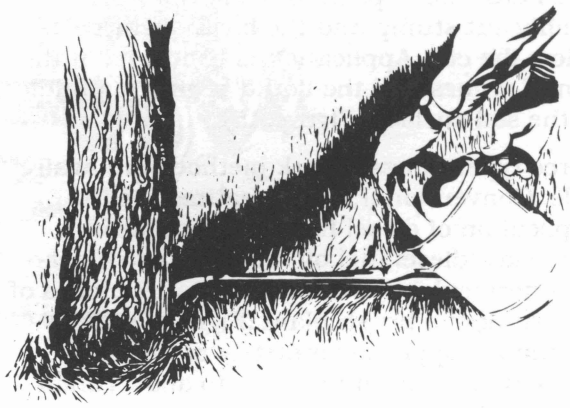

Figure 19. Basal bark pour application for maintenance control

Best results with low-volume basal and streamline basal applications have been obtained on plants with trunks less than 4 inches in diameter and with smooth bark. Conventional basal treatment works well on single-stemmed plants or plants with few trunks. If the trunk diameter is greater than 5 inches, it should be frilled (axe cuts through the bark spaced no more than 4 inches apart around the mainstem) and the herbicide mixture applied to the frilled area.

Best results are obtained with conventional basal treatments of Grazon ET in diesel fuel oil or kerosene, diesel fuel oil alone or kerosene alone when the soil is dry. Low-volume and streamline basal applications may be made almost anytime; the optimum time of application is during the growing season when the plants have mature leaves.

Backpack sprayers and small "pump-up" (compressed air) sprayers work well for the basal bark treatment techniques. The conventional basal treatment may be accomplished by pouring from a can with a long spout (Figure 19).

Liquid herbicides used for broadcast application may also be applied to individual plants in a high-volume foliar application. The herbicides are usually mixed with water as the carrier. The mixture is sprayed to thoroughly wet the foliage (until the mixture begins to drip from the leaves of the treated plant). A power sprayer, backpack sprayer or a "pump-up" sprayer may be used (Figure 20).

Figure 20. Handgun on a power sprayer used for high-volume foliar application of herbicides.

A mechanical device for use on rubber-tired farm tractors applies herbicide to individual plants in a high-volume foliar application (Figure 21). The equipment, available under the tradename Brush Robot™, sprays only when the unit is in contact with a brush plant. Thus, an area with a thin stand of brush may be treated with the speed of a broadcast treatment but without broadcasting herbicide over the entire area. This usually results in less herbicide used per acre. The treated plants receive a volume similar to that from a power-handgun sprayer, which results in a higher degree of brush control than broadcast treatment. The Brush Robot™ uses the same herbicide mixtures used for high-volume foliar application. It is best suited for thin stands of brush having a stem height (usually 1 1/2 to 6 feet tall) and flexibility that effectively triggers the spray nozzles and also allows the tractor to pass over without breaking the plant's mainstem.

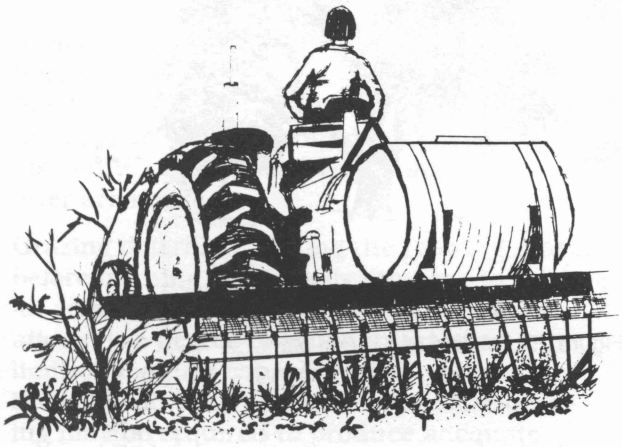

Figure 21. Brush Robot™ for mechanically applying herbicides to individual plants.

Liquid herbicides may be wiped onto brush plant leaves with the carpeted brush roller (Figure 22). It utilizes 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. The herbicide solution is wiped onto leaves and

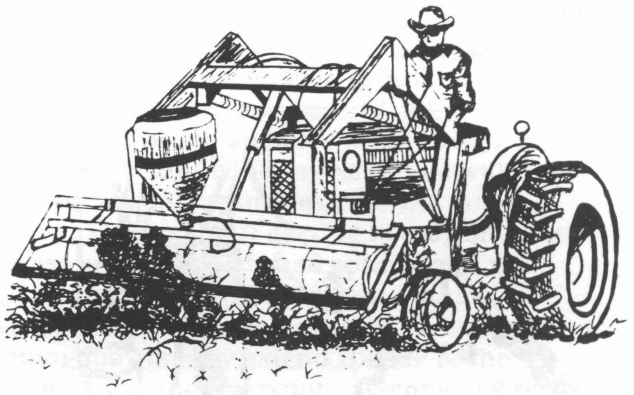

Figure 22. Carpeted brush roller used to wipe herbicides onto brush plants.

twigs as the rotating cylinder passes over the plant, usually at 1 to 2 feet of height (depends on height of 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 the degree of kill is greater. 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 Range Office, Department of Rangeland Ecology and Management, Room 225 Animal Industries Building, Texas A&M University, College Station, Texas 77843-2126.

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.

Soil-applied herbicides are available in liquid and pelleted formulations. Apply measured

quantity of pelleted herbicide, determined by plant size, species and soil type on the ground under the plant canopy (Figure 23) of individual brush plants. No special equipment is generally required for individual plant applications. Rainfall is necessary for dissolving the pellets and moving the herbicide into the soil.

Figure 23. Hand application of pelleted herbicide for maintenance control.

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 (Figure 24). 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 (Figure 25) 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 (or killing 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 under each treated plant. 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

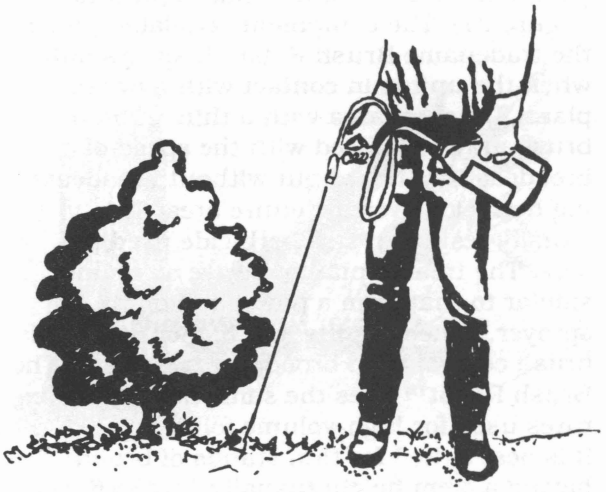

Figure 24. Soil application with an exact delivery spotgun for maintenance control.

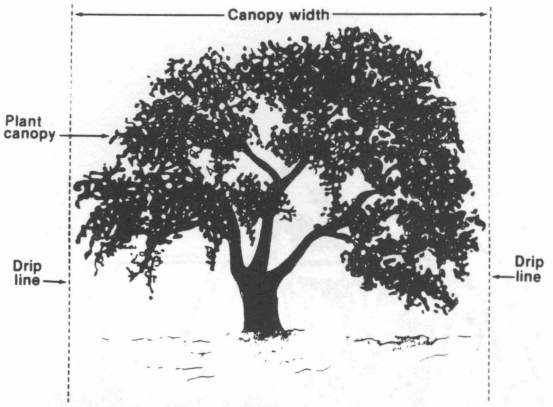

Figure 25. Dripline of a brush plant.

period of active root uptake as the plants grow.

Care must be taken when applying soil-active herbicides near desirable trees and shrubs. To prevent injury to desirable plants, these herbicides should be applied no closer than three times the canopy diameter of the desirable plant and never uphill where water may carry lethal amounts to the vicinity of desirable plants.

Prescribed Burning

The primary goal of prescribed burning is to suppress brush. Fire usually does not kill many woody species because most woody plants are capable of resprouting. Most Texas brush species resprout from buds on the stem base and below the soil surface on roots or on rhizomes. Thus, the effect of fire on these plants is similar to that of any method of top removal, such as mowing or shredding.

Prescribed burning has the following advantages over other brush management techniques:

1. Increased palatability, utilization and availability of forages
2. Improved distribution of grazing animals
3. Satisfactory results on soils and terrain where other methods may not succeed
4. Minimal soil disturbance
5. Absence or reduced amount of herbicide
6. Compatibility with wildlife habitat requirements of many game species
7. Suppressed parasite populations
8. Lower costs (compared with other methods)

A major constraint to effective prescribed burning is the amount and distribution of fine fuel required to carry the fire. Generally, from 2,500 to 3,000 pounds per acre of evenly distributed grass, dead leaves and litter are needed.

Grazing deferment during the growing season before burning is normally required to achieve an adequate fine fuel load. In many situations, the degree of brush infestation limits the area's capability to support a fire. Some brush control treatment before burning may be required to produce adequate amounts and distribution of fine fuel. Therefore, prescribed burning often is used in combination with other brush management practices and as a maintenance measure. Pricklypear control is accomplished with a reduced rate of Grazon PC when used following a prescribed burn.

Biological Methods

Biological brush control is appealing, but because natural enemies (such as insects or diseases) must attack only the target plant species and are difficult to control, few successful methods have been used in Texas. The most successful has been the use of goats. Because they are browsers, goats can control plants such as oaks, greenbriar, sumac, hackberries and several of the South Texas mixed brush species. When browse availability is limited, however, goats will consume significant quantities of forbs and grasses. Thus, careful grazing management is necessary to provide brush control and prevent damage to desired forbs and grasses. Using goats after mechanical treatments or burning may greatly extend the life of the treatment even to the point of completely removing some species such as shinoak. Although goats have been used extensively in Texas to control brush, problems with predators have restricted their use in many parts of the state.

Summary

Brush may be efficiently managed by utilizing these methods in a planned approach. An effective brush management plan may be developed by following these steps:

1. Establish objectives for the ranch that include rangeland, livestock and wildlife resources.
2. Conduct inventory of resources (determine brush problem and potential response to brush management).
3. Identify feasible brush control alternatives.
4. Estimate treatment costs and responses.
5. Conduct economic analyses.
6. Select brush control alternative.
7. Implement plan and monitor results (replan and revise plan as needed).

Acknowledgment

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