Site Relations, Regrowth Characteristics, and Control of Lotebush with Herbicides

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Highlight: *Regrowth following top removal of lotebush (*Condalia obtusifolia *(Hook.) Weberb.) seedlings and field transplants followed a typical apical dominance pattern. When 2.5 cm of the stem segments were left intact, sprouting occurred from stem tissues. When stems were completely removed, sprouts originated from root tissues. Lotebush densities on the Texas Experimental Ranch were greater on shallow redland than on deep upland, rolling hill, rocky hill or valley range sites. Aerial application of 2,4,5-T at 1.12 kg/ha was ineffective for control of lotebush, regardless of range site. Basal sprays containing 4 or 8 g/liter of 2,4,5-T + picloram in a diesel oil:water emulsion (1:4) effectively controlled lotebush. Basal sprays of dicamba were less effective than 2,4,5-T + picloram; and 2,4,5-T was ineffective in the emulsion carrier. However, 2,4,5-T in diesel oil reduced the canopies by an average 50 to 70% at 2 years after treatment. At rates greater than 5 g (active ingredient)/m of canopy diameter, monuron pellets reduced lotebush canopies by 85 to 100%. At the same rate, dicamba granules completely reduced the brush canopy and resulted in 86% root kill at 2 years after application. Two g/m of canopy diameter of picloram pellets completely controlled the lotebush.*

Five species of *Condalia* (Rhamanaceae) are recognized by Gould (1969) as occurring on Texas rangeland. Three species, lotebush (*C. obtusifolia* (Hook.) Weberb.), bluewood (*C. obovata* Hook.) and knife-leaf condalia (*C. spathulata* Gray), are the primary problem species when considering range improvement programs. Lotebush has recently been reclassified as *Ziziphus obtusifolia* (T. & G.) Gray (Jones, 1975). Lotebush is a highly-branched spinescent shrub which rarely exceeds 2 m in height. The margins of its ovate, almost oblong, leaves are entire to coarsely serrate. The branches are grayish green with alternate formidable spines. The bark is smooth and light gray to bluish except at the base, where it may be cracked and dark brown.

Also known as "lote," "bluebush," and "chaparral," lotebush occurs in every physiographic province of Texas except the Pineywoods (Gould, 1969). It occurs in association with bluewood in the mixed-brush complex of South Texas; and is a common component of honey mesquite (*Prosopis glandulosa* var. *glandulosa* Torr.) savannas and bushlands in the Rolling Plains of northwestern Texas. In the Rolling Plains, lotebush only rarely develops such infestations that control measures are required to maintain productivity of the range. However, lotebush is a persistent species which resists broadcast application of most herbicides used for range improvement; and, in local areas, may become a serious brush problem.

According to Meyer et al. (1969), ground broadcast sprays of picloram (4-amino-3,5,6-trichloropicolinic acid) at 0.56 to 1.12 kg/ha were only slightly toxic to lotebush. However, Bovey et al. (1970) reported effective control from picloram at 2.24 kg/ha and from 2,4,5-T [(2,4,5-trichlorophenoxy) acetic acid] + picloram at 1.12 kg/ha each aerially applied in the spring. Churchill et al.[1] reported that individual-plant treatments with wetting sprays of 2 to 3 g of 2,3,6-TBA (2,3,6-trichlorobenzoic acid)/ 100 liters of water killed 80 to 100% of the lotebush topgrowth but did not control the roots. Box and White (1969) reported an increase in the abundance in lotebush following burning of South Texas ranges. Presumably, this increase was due to basal sprouting following fire damage to the aerial protions. Neuenschwander and Wright[2] reported that lotebush regrew slowly following prescribed burns for the first 3 years in the Rolling Plains. After the third year, the plants grew rapidly; and regrowth biomass was apparently 70 to 75% of unburned plants by the

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The report is approved by the Director, Texas Agr. Exp. Sta. as TA-11746.

The authors wish to acknowledge R. R. Hahn and D. B. Polk, Jr., former graduate research assistants, for their aid in the conduct of portions of this research. Authors acknowledge support of the Texas Experimental Ranch Committee and Swenson Land & Cattle Co., Inc., and the Pitchfork Ranch, Guthrie, Texas, for their cooperation with the Texas Agr. Exp. Sta., in making this study possible.

Manuscript received April 14, 1975.

[1] Churchill, F. M., B. R. Ray, and C. King. 1969. Mechanical and chemical control of species of yucca and condalia in Jones and Nolan Counties, Texas. Texas Tech Univ. Noxious Brush and Weed Control Res. Highlights. ICASIS Spec. Rep. 33. p. 58-59.

[2] Neuenschwander, L. F., and H. A. Wright. 1973. Regrowth of lotebush (bluebush) after burning. Texas Tech Univ. Noxious Brush and Weed Control Res. Highlights 4:14.

fifth year. Lotebush was effectively controlled by root plowing followed by raking in South Texas Plains (Dodd, 1968). Lotebush topgrowth was also controlled by roller chopping followed by shredding a year later in the spring followed by burning in late summer (Dodd and Holtz, 1972). Following honey mesquite control, especially in the northern part of Texas, scattered stands of lotebush are occasionally left as the primary brush species. Although it has some value as a food and cover plant for wildlife,[2] most ranchers desire relatively low amounts.

Although lotebush is often mentioned by researchers as an important secondary species in the Texas brush complex, relatively little research has been directed toward the understanding of its regrowth potential, distribution as affected by range site, or methods of controlling scattered plants. Research was conducted from 1969 through 1973 to investigate (a) the regrowth characteristics of lotebush seedlings and sprouts from root section transplanted to the greenhouse; (b) its distribution on several predominant range sites in the Rolling Plains of Texas; and (c) several herbicides, herbicide combinations, and formulations for control of individual plants.

Materials and Methods

Regrowth Characteristics

Greenhouse-grown lotebush seedlings and field transplants of roots and stems were utilized to study origin and development of sprouts following top removal. Seedlings were about 1 year old and 45 cm tall when tops were removed. Two treatments, clipping at 2.5 cm above the cotyledonary nodes and 1.25 cm below ground line (approximately 3.75 cm below the cotyledonary nodes), were each applied to 30 plants. An equal number of plants were not clipped. Two experiments were conducted, one initiated in March and the second in June, 1970. For 90 days after top removal, origin of new branches, number of new branches, branch length, and number of leaves were recorded. Fifty plants were excavated from a rolling hills range site near Guthrie, Texas, in February, 1972. The soil was removed to 15 cm deep and in 16- by 16-cm squares with the lotebush stem in the center. No stem tissue was left intact on 25 of the transplants. Approximately 2.5 cm of the original above-ground stem segments was left intact on the remaining 25 plants. Origin of new branches and branch lengths were recorded for approximately 90 days following transplanting.

Range Site Relationships

In May, 1972, pastures on the Texas Experimental Ranch near Throckmorton were treated with 1.12 kg/ha of 2,4,5-T. The herbicide was aerially applied in 37 liters/ha of a diesel oil:water emulsion (1:4). In August, 1973, reaction of lotebush to the spray was determined on representative deep upland, rolling hill, rocky hill, shallow redland and valley range sites on the ranch. Twenty-five to 40 points, spaced approximately 30 m apart, were established on each range site. At each point, percentage defoliation of the nearest lotebush plant in each quarter was estimated by two workers. Density of lotebush plants within each of the range sites was calculated using distance from the points to the nearest plant in each quarter (Cottam and Curtis, 1956). This method has proven satisfactory for estimating density of other brush species (Beasom and Haucke, 1975; Scifres et al., 1974).

The deep upland site consisted of Abilene, Crawford, Rowena and Tobosa soil series. The soils are dark clays and clay loams, moderate to slowly permeable but well-drained. These soils generally have high fertility levels and high available water capacities, differing mainly in distribution of calcareous material in the soil horizons. The Mereta and Throck soil series were grouped into the rolling hills range site. The dark, grayish brown, highly-calcareous silty clay loam surface ranges in depth from 38 to 50 cm with slopes of 1 to 5%. They are moderately permeable and highly fertile. Rocky hill sites contained primarily Owens-Tarrent complex soils, which are shallow, stoney clays characterized by limestone rocks on the surface. These soils are of generally high fertility with moderate to slow permeability. They occur on deep slopes and rocky ridges where surface runoff is rapid. The shallow redland site consisted of Owens-Vernon soils, which are reddish to olive-brown calcareous clays. Subsoils are underlain by shaley clay, and soil erosion is generally active because of the sparse vegetation and the rapid surface runoff. The valley range site occurred in valleys and depressions adjacent to primary and secondary drainages. Soil depth is greater than 150 cm. Surface soils are dark brown, calcareous clay loams, which are slowly permeable and have a high fertility level.

Control of Individual Plants

Individual-plant herbicide treatments were evaluated from 1969 to 1972 near Guthrie, Texas, approximately 97 km west of the Throckmorton study site. Herbicides, herbicide mixtures, and formulations evaluated as basal sprays for control of individual lotebush plants were 2,4,5-T + picloram (1:1) applied at 4 or 8 g/liter of diesel oil:water emulsion (1:4). Spray solutions were applied to the base of the lotebush plants to runoff using hand sprayers. Dry herbicides evaluated included monuron (3-(*p*-chlorophenyl)-1,1-demethyl urea) pellets, dicamba granules and picloram pellets. Dry herbicides were applied to the soil at the base of lotebush plants. Rates of treatment were determined by size of the canopies at 1 m above ground line. Application rates based on active ingredient were 0.5, 1.25, 2.0, 2.75, 3.5, 4.25, 5.0, and 5.75 g/m of canopy diameter.

Results and Discussion

Regrowth Characteristics

At 30 days after clipping stems 2.5 cm above soil line, 90% of the lotebush plants had sprouted. This regrowth probably coincides with the "first spurt" noted by Neuenschwander and Wright[2] following prescribed burning. The greenhouse seedlings usually developed two branches from stem tissue immediately below the cut. New branches usually formed at 0.5-cm intervals down the stem tissue to soil line. At 90 days after clipping above the cotyledonary node, from two to six branches had formed on each seedling. Branch lengths ranged from 7 to 14 cm and decreased in length from the apical sprout downward. Each resprouted plant produced an average of 46 leaves.

Root tissue sprouted when essentially all stem tissue was removed. From one to four buds, 3 to 5 cm long, formed from root tissue. The potential of lotebush to regrow vegetatively upon disturbance explains its resistance to mechanical top removal. Although rate and extent of regrowth is usually not as great as with species such as honey mesquite (Scifres and Hahn, 1972), lotebush has the capability to sprout from root tissue when total stem removal occurs.

Field transplants of lotebush required about 30 days for the first sprouts to appear. About 40% of the transplants sprouted during the study period. As with the seedlings, branch origin apparently was regulated by apical dominance. If live stem segments remained, growth of lateral buds formed the new branches. Two branches usually formed beneath the original cut on the stem. On those plants from which the majority of the stem tissues had been removed, bud formation occurred from root tissue. However, it appeared that callous tissue formation had to precede branch formation. On plants which had not sprouted, callous tissue formation over the original cut was incomplete and the original root-stem sections deteriorated.

Range Site Relationships

Previous research in the Rolling Plains of Texas (Scifres et al., 1974) has indicated that population density of honey mesquite was influenced by range site and grazing management system. In general, the range site/grazing management system which was apparently the most productive for plant growth supported the more dense, vigorous stands of honey mesquite. Lotebush populations in the same area were aggregated rather than randomly distributed. The density of lotebush was not greatly affected by range site on the Texas Experimental Ranch (Table 1). Of the sites studied, only the shallow redland site differed significantly in lotebush density. The ecological site relationships which contributed to the different stand densities were not clear. However, general observations in the Rolling Plains area indicate that the shallow redland site usually supports denser stands of lotebush.

Table 1. Density (plants/ha) of lotebush by range site on the Texas Experimental Ranch, Throckmorton in July, 1972.

Range site	Density[a]
Deep upland	12.5
Rolling hill	7.2
Rocky hill	11.9
Shallow redland	30.9
Valley	8.1

[a]Difference between densities of any two sites had to exceed 12.2 plants/ha for significance at the 95% confidence level.

The rate of 2,4,5-T (1.12 kg/ha) aerially applied to the lotebush on the Texas Experimental Ranch was twice that normally used for range restoration in the Rolling Plains. However, none of the plants were root killed by the spray. There was no apparent site influence on the level of defoliation of lotebush by 2,4,5-T sprays. Defoliation estimates ranged from 60 to 70% and were highly variable within any site. Root kill of honey mesquite at 2 years after the spray varied from 28 to 46% on the same sites.[3]

Control of Individual Plants

Response of lotebush to the individual-plant treatments did not differ significantly between years, so the data were averaged for discussion. Average canopy diameter of plants in the study area was about 1.35 m. By 30 days after application of picloram pellets, lotebush plants treated with 0.5 g/m of canopy diameter had begun to defoliate. Degree of defoliation increased with increasing rate of herbicide and was almost complete where more than 3.5 g/m of canopy diameter had been applied. At 2 years after treatment, picloram pellets at 2 g/m of canopy diameter had completely controlled the lotebush (Fig. 1). Where 0.5 g/m of canopy diameter was applied, canopy reduction exceeded 60% and foliage of surviving plants was chlorotic.

Dicamba granules were not as effective as picloram pellets. At the highest rate (5.75 g/m of canopy diameter), canopy reduction was less than 50% at 30 days after application. However, by 2 years after herbicide application, rates of at

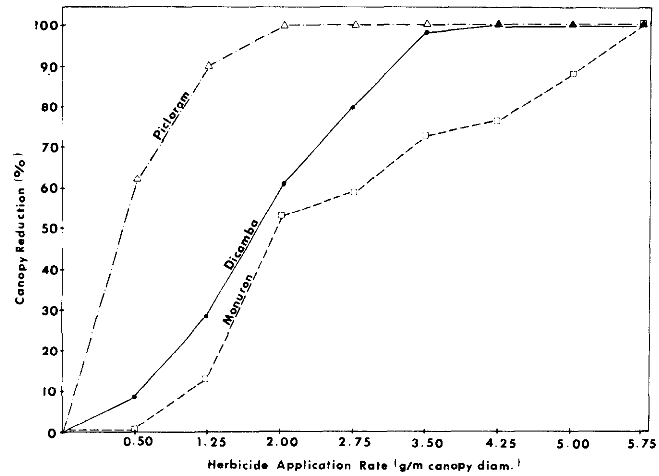

Fig. 1. *Average canopy reduction 2 years after the application of various rates of monuron pellets, dicamba granules, or picloram pellets in the Rolling Plains of Texas.*

least 4.25 g/m of canopy diameter completely reduced the lotebush canopies (Fig. 1) and 86% of the population had not resprouted. After application of at least 5.0 g/m of canopy diameter, there was no resprouting. This high rate, as with picloram, controlled all vegetation within a 0.5 m radius of the treated stem for a year following treatment.

Monuron pellets were less effective than either picloram pellets or dicamba granules. The highest rate of monuron reduced the canopies by only 30% at 1 month after treatment. By 2 years after treatment, the high rate had completely eliminated the lotebush canopies, but about 50% of the population had developed regrowth.

Basal sprays containing 4 or 8 g of 2,4,5-T/liter of the diesel oil:water emulsion did not reduce the lotebush canopies (Table 2). The same rates of 2,4,5-T in diesel oil reduced canopies by 50 to 69% at 2 years after treatment, but all treated plants were resprouting. Dicamba (dimethylamine salt) applied at 4 or 8 g/liter of diesel oil:water emulsion reduced lotebush canopies by about 50%. In a 1:1 combination, 4 g/liter of 2,4,5-T + picloram reduced lotebush canopies by 64% at 2 years after treatment and root killed 20% of the plants. The same herbicide at 8 g/liter reduced the lotebush canopies by 91% and killed 60% of the plants. The 2,4,5-T + picloram combination was the most effective individual plant treatment for control of lotebush.

Conclusions

Lotebush provides excellent habitat for upland game birds

Table 2. Canopy reduction (%) of lotebush 2 years after treatment in May, 1969, or June, 1970, in the Rolling Plains of Texas with basal sprays of various herbicides at two application rates (g/liter).[a]

		Rates[b]	
Herbicide	Carrier	4	8
2,4,5-T	Diesel oil	50 b	69 c
2,4,5-T	Diesel oil:water	0 a	1 a
Dicamba	Diesel oil:water	49 b	50 b
2,4,5-T + picloram (1:1)	Diesel oil:water	64 bc	91 d
None	Diesel oil	8 a	

[a]Means represent averages of the 2 years of treatment.
[b]Means followed by the same letter are not significantly different at the 95% confidence level.

[3]Unpublished data. Kothmann, M. M., and C. J. Scifres.

and other wildlife. It occurs in aggregated stands and, usually, in low densities such that broadscale control efforts may not be justified from an economical or ecological standpoint. However, stands have been noted by the authors which are so dense that management efficiency is substantially reduced. In such cases, thinning of the lotebush population with individual-plant treatments would be desirable.

Lotebush is a proliferic root sprouter capable of rapid regeneration upon top removal. Therefore, mechanical control methods which completely uproot the plants, such as grubbing, apparently offer more promise for control than those which only remove the topgrowth. Although lotebush occurs in scattered stands over most range sites of the Rolling Plains, it was most abundant on shallow redland sites on the Texas Experimental Ranch. Since high application rates of broadcast-applied herbicides have not given effective control and lotebush tends to occur in scattered stands, individual plant treatments may be best for control. Basal applications of 2,4,5-T + picloram, picloram pellets at 2 g/m canopy diameter or dicamba granules at 4.25 g/m canopy diameter applied to the base of the plants may be most effective for its control where deemed desirable by the land manager.

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