Control of Three Major Brush Species on Grazing Lands in the United States, Cuba, and Brazil

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Within the past decade interest in the control of undesirable woody plants on grazing lands of southwestern United States, and Central and South America has grown by leaps and bounds. Development of new herbicides, adaptations of mechanical equipment, and improved techniques of establishing more productive strains and species of grasses all have stimulated grassland improvement. The driving force back of these new developments has been three pronged: (1) the demand for more efficient and economical production of meat, milk and wool; (2) the realization that early methods of coping with brush were inadequate and too costly, and (3) the gradual shift from the production of surplus crops to grassland farming.

This paper reports on methods that have been developed for the control of three major undesirable woody shrubs on rangelands in the southwestern part of United States, in Cuba, and in Brazil. These species include mesquite *(Prosopis juliflora)* in the United States, marabu *(Dichstachys nutans)* in Cuba, and leiteiro *(Taberae montana fuchsiaefolia)* in Brazil.

The Problem

The chief problem facing the ranchman and livestock producer is the selection of control measures that will provide the greatest sustained benefits for the money expended. In the early stages of infestation costly measures may be used to advantage to eliminate a few isolated plants and sparse stands. On the other hand, after extensive areas become heavily infested by well established stands of brush, large numbers of seedlings, and seed in the soil, no one practice is known that will completely eliminate these major brush species. It is usually desirable to select control measures that can be economically justified from the standpoint of the potential productivity of the land to treat the existing infestation, and simularly justifiable measures for retreatment at intervals of 5 to 10 years to control reinfestation by sprout growth, seedlings, seed in the soil, and those brought in by grazing animals, rodents, and birds. For control of dense stands complete renovation treatments often are required.

Ecological Relationships

The key to effective and economic control of mesquite, maribu, leiteiro, and similar undesirable invaders of grassland is the full realization that disturbance by man's activities has released these specialized plants from their natural biological controls. The introduction of large numbers of grazing animals, fencing, watering, and the movement of these animals over long distances has greatly accelerated the spread of mesquite.

In the tropics of Cuba and Brazil, marabu and leiteiro have become serious pests on seeded pastures that once supported a true forest, and these shrubs represent early stages of a gradual return to forest flora by natural succession. Under true forest conditions these species and other invading plants were effectively controlled by severe competition for light, space, water, and nutrients offered by the taller and more highly developed forest trees. However, once the natural forest cover was removed or disturbed these shrubs were released and rapidly encroached on formed pastures due to their well developed root systems, prolific production of hard seed, lateral root propagation, and freedom from utilization by livestock.

Under these conditions it becomes readily evident that these shrubs will always remain a potential hazard on formed pastures, and that control of few scattered invading plants before heavy seed production occurs will result in maximum control at low cost. Once an area becomes heavily infested with old seed-bearing plants, with an abundant supply of seed present in the soil, a control program must be developed not only to kill the existing plants but also one that will prevent rapid reinfestation by seedlings. Under the favorable growing conditions of the tropics failure to control seedlings within a year after treatment of well established plants will result in almost complete failure of the program.

Methods of Control

Control of Invading Stands

For the control of widely scattering plants of mesquite, marabu, and leiteiro basal trunk applications of 1 percent acid of 2,4,5-T ester in diesel fuel have given highly effective kills at relatively low costs (Figure 1). The percentage kill obtained is

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FIGURE 1. In the foreground basal application of 1 percent 2,4,5-T ester in diesel oil has has given good control of leiteiro in Brazil. This method of control is most effective and economical for control of thin open stands of brush. In the background the topwood was removed, but no chemical treatment was applied.

largely governed by the application of sufficient amount of spray solution around the base of the plant to insure physical contact with tissues capable of producing sprout growth as shown by Meadors and Fisher (1953), Hay (1956), and Quinn, *et al.* (1956). Mesquite also may be controlled by basal applications of diesel fuel or kerosene; however, larger amounts are required.

Under conditions where low-cost labor is plentiful, and 2,4,5-T and diesel fuel are relatively costly, cut surface applications have been used successfully. Concentrated solutions of 2,4-D amine and 2,4,5-T ester, 1 to 2 pounds acid per gallon of water or oil are applied to freshly cut stems with a paint brush or mop. This method has been used quite extensively to control invading stands of marabu and leiteiro. Painting the lower 2 feet of the trunk with concentrated solutions of 2,4,5-T ester in oil also has been used. Observations strongly suggest that the effectiveness of the treatment is largely due to the amount of chemical that runs off or is washed down the stem to the basal plant parts.

New chemicals which show promise for the control of individual woody plants include Karmex formulations of monuron and fenuron, Meadors and Fisher (1953) and Quinn *et al.* (1956). Water suspensions containing ⅛ to ½ pound active ingredient per gallon have given highly effective kills of mesquite when applied to a 6-inch band of soil around the plant base. For control of marabu and leiteiro rates of ½ up to 2 pounds per gallon are usually required.

Control of Open to Moderate Stands

The most economical control of woody plant infestations that occur in more or less uniform open stands with occasional thickets is usually obtained by large scale equipment that permits overall treatment and retreatment of the grazing area.

Mesquite has been controlled at low cost by aerial application of ⅓ pound acid of a low volatile ester of 2,4,5-T in the spring soon after leaves reach full development. The chemical should be applied in an emulsion containing ½ gallon diesel fuel and approximately 2½ gallons of water per acre in 60-foot swaths when growing conditions are favorable. If the mesquite had been previously chained, bulldozed, or sprayed to destroy old stands, the resultant sprout growth should be allowed to reach a height of at least 4 feet before treating with 2,4,5-T. For sprout control ½ pound acid of 2,4,5-T ester in an emulsion of 1 gallon of diesel fuel and 3 gallons of water per acre should be applied in aerial swaths of 42 feet. The effectiveness and lasting benefits derived from aerial application of 2,4,5-T are largely governed by the stage of growth when treated, plant condition, soil type, and other factors as reported by Fisher, Meadors and Behrens (1956). Extensive field trials show that in most instances, retreatment at intervals of 5 years has destroyed from 40 to 70 percent of the original stands and a very high percentage of seedling plants.

For areas where aerial application of 2,4,5-T is not feasible due to close proximity of susceptible crops more costly control measures must be used. On land with only average potential productivity the brush may be chained and power grubbed. If the land has high potential productivity, or where the land has many species resistant to 2,4,5-T, the use of a root plow followed by seeding to more productive grasses usually is the most effective and desirable means of control.

Chaining alone is effective for destroying the above ground growth of large trees at low cost, but it must be combined with other control methods to give lasting benefits except where sprout regrowth is extremely slow.

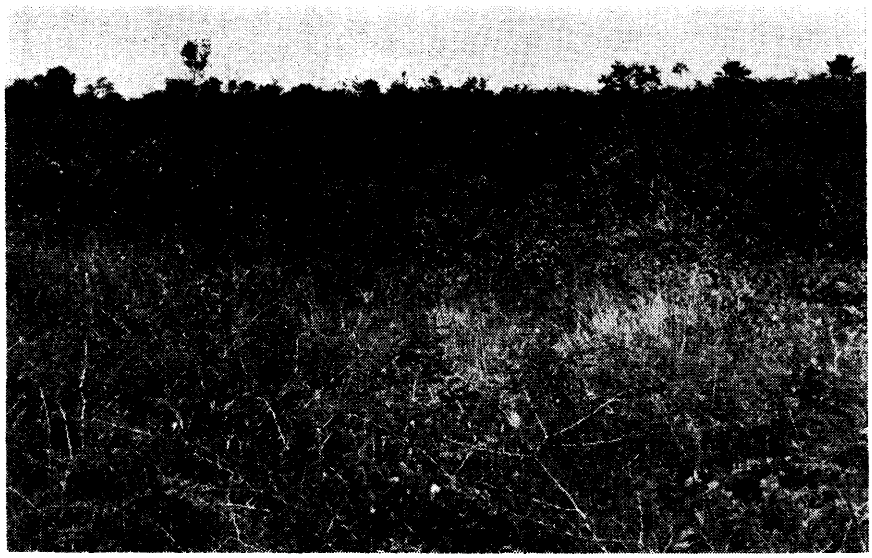

FIGURE 2. Grazing land with high potential productivity heavily infested with marabu *(Dichrostachys nutans)* at Companie Ganaderia Bercerra in the State of Camaquey, Cuba.

Control of marabu in open to moderate stands has been attempted by aerial application of 2,4-D, 2,4,5-T and mixtures of these two chemicals. From the results obtained it appears that annual applications of 1 to 2 pounds of 2,4,5-T will be required to gradually exhaust the root reserves of well established plants (Hays, 1956).

More promising control in Cuba has been obtained by the removal of the topwood by chaining or chopping and then treating the sprout growth with wetting sprays containing 4 pounds acid of 2,4,5-T ester in 100 gallons of water. In most instances, however, the high potential productivity of the land merits the use of root plows and seeding to highly productive grasses such as colonial guinea, *(Panicum maximum)*, jaragua *(Hyparrhenia ruffa)*, and pangola *(Digitaria decumbens)*.

Control of leiteiro in open to moderate stands on grazing lands in Brazil is largely a matter of using individual plant treatments. Basal trunk applications of 1 percent acid of 2,4,5-T in diesel fuel show the most promise. Foliage applications of growth regulator chemicals have not been effective. Other methods of control that have been used with some success include spot treatment with root plows followed by individual plant treatment. In some instances a combination of basal trunk treatment and hand grubbing of seedlings has given good control.

Control of Dense Stands

Once the infestation of these undesirable sprouting shrubs becomes dense the grazing land is almost devoid of all palatable forage and impenetrable to livestock. Under these conditions it usually is necessary to use mechanical measures to destroy the dense woody growth. Then chemicals, or a combination of chemical and mechanical measures may be used to control regrowth and seedlings.

For dense stands of mesquite on highly productive sites, chaining, followed by root plowing and seeding to highly productive grasses, offers an excellent opportunity to greatly increase the carrying capacity of the land. On land that has only average potential productivity mesquite may be controlled effectively and economically by first chaining to destroy the above ground growth. Somewhat later, usually 2 to 4 years, the sprout growth should be controlled by aerial application of 2,4,5-T. Repeated treatments at intervals of 4 to 6 years will control sprout growth and greatly increase the carrying capacity of the land. Where 2,4,5-T cannot be used safely the land will need to be either power grubbed or root plowed and seeded to adapted grasses.

The control of dense stands of marabu and leiteiro is closely similar to that of mesquite. In most instances, the original infestation of shrubs must be destroyed by a combination of burning, chaining and root plowing, and then the land is seeded to highly productive grasses such as colonial guinea and jaragua (Figures 2 and 3). In Brazil, where farm labor is often plentiful, the land after root plowing or girdling and burning is planted to clean tilled crops such as cotton, rice, corn, and others for a period of 3 to 5 years. During this period the stumps, roots and supply of seed in the soil are gradually destroyed, and then pasture grasses are established. Thereafter control of undesirable woody plant species may be obtained effectively and economically by the timely use of chemicals and other practices that will maintain a dense vigorous cover of grass.

Control of Mixed Brush

The control of mixed brush on soils of relatively low productivity is rapidly becoming an important problem to livestock raisers in Brazil. The method used in clearing highly productive land by cutting, burning, and growing intensively cultivated crops such as cotton, rice, and corn, is seldom justified because of low yield of crops. Moreover, without fertilization, the two highly prized fattening grasses, colonial guinea and jaragua, seldom develop sufficient growth and vegetative cover under grazing to retard rapid re-

infestation by brush plants. Gordura, or molasses grass *(Melinis minutiflora),* thrives on these poorer soils; however, it seldom provides sufficient cover to offer serious competition to the establishment and development of brush plants. In addition, it does not withstand burning. There is some indication that sempre verde *(Panicum maximum* var. *gongyloides)* might be used to advantage under these conditions.

Since the mixed brush complex generally occupies less productive land, the control measures selected must be either less intensive and more economical, or the productivity of the land must be improved through the use of fertilizers and other soil amendments to justify the heavy investment of major clearing operations. Low cost control measures such as chaining followed by seeding to Gordura and annual rolling with a heavy-duty rolling cutter offer some promise of increasing grass production and gains of livestock. The production of grass could be increased materially at reduced cost if the sprout growth following the use of the chain or the cutter could be effectively controlled with aerial application of chemicals.

Early results of aerial application of 1 pound acid of 2,4,5-T ester in 4 to 5 gallons of a 1:3 oil-water emulsion per acre on regrowth following the use of a heavy duty brush cutter has increased the production of grass from 1,200 to over 18,000 pounds of grass per acre (Figure 4). In these tests it was estimated that the cost of controlling mixed brush in this manner was approximately one-half that of repeated mechanical treatments. The aerial treatments were most effective when applied from November to January after the heavy flush growth occurred following the onset of rains in October. Applications made before the woody species developed heavy foliage following fall rains or after January, when the plants ceased to make visible growth, were much less effective from the standpoint of lasting benefits and increased grass production. Repeated treatments likely will be necessary to maintain effective control of the brush; however, a vigorous stand of properly managed grass will aid in the over-all program.

FIGURE 3. Grazing land previously infested with marabu that was chained, root plowed, and seeded to pangola grass. Annual application of 2,4-D -- 2,4,5-T brush killer has given good control of marabu seedlings and broad leaf weeds at Companie Ganaderia Becerra in Cuba.

Attempts to clear mixed brush with mechanical equipment and hand labor followed by cropping to rice and corn with use of fertilizers and other soil amendments offers some hope. Moreover, the use of fertilizers on newly planted colonial guinea, jaragua, and sempre verde offers some promise of clearing mixed brush and forming pastures at costs that may be economically justified.

Clearing Forest Land and Forming of Pastures

This problem consists primarily of controlling woody plants growing more or less under natural conditions in the state of Matto Grosso and to a lesser extent in Sao Paulo. With present known chemicals and mechnical control methods there is little hope of clearing land as effectively and economically as by the farm colony system. It would appear that chemical control of brush will play its greatest role in controlling invading plants on formed pastures after the heavy growth of woody plants has been removed. Admittedly, repeated application of chemicals might control the forest growth; however, the land would still need seeding, chaining, or rolling to permit production of grass. Some limited trials might be undertaken, but at present prices of chemicals, mechnical equipment, and low cost of common labor there is little hope of reducing the cost of clearing over the farm colony system.

Control of Reinfestation

The benefits of brush control on grazing lands will soon be lost, regardless of methods used, unless steps are taken to prevent reinfestation. Experience has shown that land cleared of mesquite by hand grubbing, one of the most effective methods known, will develop light to

moderate stands of mesquite within a period of 10 to 15 years. On land that is root plowed and seeded to grasses the lasting benefits will largely depend on management of the grassland and control of reinfestation. Thus, constant vigil must be maintained to prevent reinfestation. Aerial application of 2,4,5-T at intervals of 5 years will not only give control of seedling mesquite but also will control other undesirable broadleaf plants and further increase the productivity of grasslands.

In the case of marabu, following the establishment of grasses, immedate steps must be taken to destroy the rapid growth of seedlings and sprouts from remaining roots. Annual application of 1 pound acid of a mixture of 2,4-D and 2,4,5-T has prevented rapid reinfestation of the grazing lands. For light infestations individual plant treatment may be used to advantage.

Since foliage treatment of leiteiro is not effective, individual plant treatment must be used to control reinfestation by widely-scattered plants. On land previously infested with heavy stands of leiteiro the most effective control consists of growing clean-tilled crops for a period of 3 to 5 years to control sprout growth and destroy seed present in the soil prior to the establishment of grass.

Benefits of Control

The value of brush control on grazing lands depends largely on the potential productivity of the land and the kind and amount of brush. For instance, under conditions where rainfall is limited, grazing trials by the Texas Agricultural Experiment Station at Spur show that control of open to moderate stands of mesquite increased steer gains an average of 34 pounds per head during the summer months. Moreover, on sites where the soils are deep and fertile, and moisture conditions are favorable the carrying capacity of the land has been increased three-fold or more by the control of mesquite and establishment of highly productive pasture grasses. On the other hand, where brush infests land that is low in potential productivity due to low rainfall, poor soils, topography, or other reasons, only limited benefits may be expected from the control of brush.

In Cuba control of marabu together with sodding to colonial guinea grass has increased the carrying capacity of the land from practically nothing up to one animal to 4 acres. Similar results have been obtained in Brazil in the control of dense stands of leiteiro and mixed brush. Other benefits derived from control of brush include the increased ease of handling livestock, lower death losses of grazing animals, and the opportunity to use more efficient pasture and livestock management practices.

FIGURE 4. Experimental application of 2,4-D and 2,4,5-T for control of mixed brush on Fazenda Cambuhy, Matao, State of Sao Paulo, Brazil. This area previously had been chained and seeded to molasses grass.

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