Brush Control on Forest-Rangelands in East Texas[1]

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Highlight

Herbicides were applied by a truck-mounted sprayer and airplane to stands of mixed brush in East Texas. Mixtures of 2,4,5-T + picloram gave the best brush control. Picloram was the best individual chemical but failed to kill white ash (*Fraxinus americana* L.), saw greenbriar (*Smilax bona-nox* L.) and redbay (*Persea borbonia* (L.) Spreng.) Picoloram only partially controlled American holly (*Ilex opaca* Ait.), blackgum (*Nyssa sylvatica* Marsh.), flowering dogwood (*Cornus florida* L.), red maple (*Acer rubrum* L.), oaks (*Quercus* spp.), and yaupon (*Ilex vomitoria* Ait.). Dicamba, isocil, bromacil, and mixtures of 2,4,5-T had intermediate activity. Paraquat and diquat were least effective for killing woody species. Dense grass stands occurred within 2 years after treatment where the brush had been controlled.

The East Texas timberland area consists of a wide variety of species, most of which are common to the southeastern part of the United States. Control of these woody species allows greater use of the area for rangeland and reforestation. Control of the hardwoods, while leaving the pines (pine-release), is also an important aspect of brush control in the area. Several workers have shown that the optimum time to spray phenoxy herbicides is in May or early June (Box and Burns, 1960; Darrow and Silker, 1959; Elwell, 1954; and Ray, 1959); applications either in April or in the fall were less effective. The degrees of susceptibility of the major woody species to (2,4,5-trichlorophenoxy) acetic acid (2,4,5-T) has been described by Silker and Darrow (1960).

This study was undertaken from 1963 to 1968 to develop better methods for defoliating and controlling East Texas woody plants. Results are presented for ground and aerial applications made from 1963 to 1966.

Materials and Methods

A 100-acre tract of cut-over timberland was selected near Livingston, Texas, having a mixed stand of the following species: American beautyberry (*Callicarpa americana* L.), American beech (*Fagus grandifolia* Ehrh.), American holly (*Ilex opaca* Ait.), blackgum (*Nyssa sylvatica* Marsh.), eastern hophornbeam (*Ostrya virginiana* (Mill.) K. Koch), flowering dogwood (*Cornus florida* L.), saw greenbriar (*Smilax bona-nox* L.), redbay (*Persea borbonia* (L.) Spreng.), red maple (*Acer rubrum* L.), sassafras (*Sassafras albidum* (Nutt.) Nees, shining sumac (*Rhus copallina* L.), southern red oak (*Quercus falcata* Michx.), sweetbay magnolia (*Magnolia virginiana* L.), sweetgum (*Liquidambar styraciflua* L.), water oak (*Quercus nigra* L.), white ash (*Fraxinus americana* L.), and white oak (*Quercus alba* L.). The plants were 12 ft tall or less. Plots 22 by 200 ft were sprayed with a truck-mounted, hydraulically controlled boom sprayer (Meyer et al., 1967) in 1963, 1964, 1965, and 1966. Herbicides were applied at a 10 gpa volume. Two plots were sprayed per treatment.

We applied aerial treatments on an area near Leggett, Texas, that had been divided into 12 five-acre plots. The species present were mostly the same as at Livingston plus the following: American sycamore (*Platanus occidentalis* L.), bitternut hickory (*Carya cordiformis* (Wangenh.) K. Koch), boxelder (*Acer negundo* L.), loblolly pine (*Pinus taeda* L.), southern dewberry (*Rubus trivialis* Michx.), winged elm (*Ulmus alata* Michx.), and yaupon (*Ilex vomitoria* Ait.). Some of the trees were 50 ft tall or more. The plots were sprayed in May, 1966, and they were evaluated June 23, 1967, and October 24, 1968. The herbicides were applied undiluted.

Herbicides used on the truck plots included: the dimethylamine salt of 3,6-dichloro-*o*-anisic acid (dicamba); 6,7-dihydrodipyrido(1,2-*a*:2′,1′-*c*)pyrazinediium salts (diquat); 1,1′-dimethyl-4,4′bipyridinium salts (paraquat); dimethylamine salt of 2,3,6-trichlorobenzoic acid (2,3,6-TBA); 2-ethylhexyl ester of (2,4,5-trichlorophenoxy)acetic acid (2,4,5-T); 2-ethylhexyl ester of (2,4-dichlorophenoxy)acetic acid (2,4-D); 5-bromo-3-isopropyl-6-methyluracil (isocil); 5-bromo-3-*sec*-butyl-6-methyluracil (bromacil); 1,1-dimethyl-3-phenylurea (fenuron); and the potassium salt of 4-amino-3,5,6-trichloropicolinic acid (picloram). A surfactant was added at the rate of 1 pt/100 gal to all sprays applied by truck, consisting of alkylarylpolyoxyethylene glycols, free fatty acids and isopropanol. Sprays were applied at the rate of 10 gpa. Herbicides applied aerially included undiluted formulations of 1½, 3, and 6 gpa rates of the following: the isooctyl ester of picloram + propylene glycol butyl ether ester of 2,4,5-T (2,4,5-T + picloram); n-butyl esters of 2,4,5-T and 2,4-D (2,4,5-T + 2,4-D), the potassium salt of picloram and paraquat. The plane was calibrated to apply 1½ gpa at a 40 ft swath width. Increasing rates were applied by decreasing the swath width to 20 or 10 ft.

Plants were evaluated for percent dead stem tissue in the plots sprayed by truck and for percent defoliation and percent plants killed in the aerial treatments. Ratings are presented as a mean for all plants in the plot. Notes were made on species susceptibility in all plots.

Results and Discussion

Most stem injury, two years after treatment by the truck-mounted sprayer on August 28, 1963, occurred in plots sprayed with dicamba; 2,4,5-T; the highest two rates of isocil; and the highest rate of bromacil (Table 1). However, none of the treatments gave better than 70% control. Normally,

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Table 1. Stem injury (%) of brush in East Texas 2 years after treatment on August 29, 1963.

Chemical	Rate lb/A	Stem Injury a/ September 1965	Chemical	Rate lb/A	Stem Injury a/ September 1965
Dicamba	4	65 a	2,4,5-T	12	20 bcde
Dicamba	8	60 ab	2,4,5-T + 2,4-D	2+2	25 bcde
Dicamba	12	70 a	2,4,5-T + 2,4-D	4+4	20 bcde
Diquat	4	5 ef	2,4,5-T + 2,4-D	6+6	50 abc
Diquat	8	15 cdef	2,4,5-T + dicamba	4+4	50 abc
Paraquat	4	15 cdef	2,4,5-T + paraquat	4+4	45 abc
Paraquat	8	10 def	Isocil	2.5	5 ef
Paraquat + dicamba	4+4	10 def	Isocil	5.0	30 abcde
			Isocil	10.0	45 abc
2,3,6-TBA	4	5 ef	Bromacil	2.5	0 f
2,3,6-TBA	8	15 cdef	Bromacil	5.0	5 ef
2,3,6-TBA	12	15 cdef	Bromacil	10	40 abcd
2,4,5-T	4	40 abcd	Fenuron	5	0 f
2,4,5-T	8	30 abcde	Untreated	--	0 f

a/ Numbers followed by the same letter do not differ at the 5% level using Duncan's multiple range test. Significance based on arc sin transformed data.

Table 3. Stem injury (%) of brush in East Texas by 17 treatments applied in 1965 and 1966 and rated October 24, 1968.[a]

Chemical	Rate lb/A	Date sprayed 20 Apr 1965	26 May 1965	2 Aug 1965	30 Aug 1965	5 May 1966
Picloram	2	35 b	60 bc	40 abc	5 bc	45 b
Picloram	4	90 a	92 a	55 ab	25 a	80 a
Picloram + 2,4,5-T	2+1	--	--	--	--	92 a
Picloram + 2,4,5-T	1+2	--	--	--	--	87 a
Picloram + 2,4,5-T	2+2	--	--	--	--	82 a
Picloram + paraquat	2+4	--	60 bc	35 bc	30 a	--
Picloram + paraquat	4+2	85 a	--	--	25 a	--
Picloram + paraquat	4+4	90 a	85 ab	60 a	--	--
2,4,5-T	2	--	--	--	--	35 b
2,4,5-T	4	--	--	--	--	20 bc
2,4,5-T + picloram + paraquat	2+2+2	--	87 ab	45 abc	25 a	--
2,4,5-T + picloram + paraquat	2+2+2	--	50 cd	60 a	15 ab	--
2,4,5-T + 2,4-D	4+4	50 b	25 d	25 cd	10 b	--
2,4,5-T + paraquat	4+4	--	25 d	15 d	--	--
Dicamba	4	10 c	--	--	--	--
Dicamba + paraquat	4+4	5 cd	--	--	--	--
Untreated	-	0 d	0 e	0 e	0 c	0 c

a/ Numbers followed by the same letter do not differ at the 5 level using Duncan's multiple range test. Significance based on arc sin transformed data.

about 70% control is the minimum expected for satisfactory results. Mixtures of 2,4,5-T + dicamba and 2,4,5-T + paraquat were effective also. The addition of paraquat reduced the activity of dicamba, possibly by desiccating the leaves before adequate translocation could take place.

Diquat and paraquat desiccated the foliage of the herbaceous and most woody plants within 1 week after treatment. Greenbriar, American holly, and redbay, the thicker-leaved species, required about 2 weeks for desiccation. The residual injury from these two compounds was largely only tip die-back. Dicamba and the phenoxy compounds required about 2 weeks to kill the woody plant leaves, while the uracils required about 4 weeks.

Species resistant to dicamba were greenbriar and red maple. In the 2,3,6-TBA plots American beech, white ash, and shining sumac survived. American beech, white ash, sweetgum, blackgum, and greenbriar resprouted in the 2,4,5-T plots. In the uracil plots greenbriar, American beech, white ash, and sumac were resistant.

Table 2. Stem injury (%) of brush in East Texas one and two years after application at two dates in 1964.

Chemical	Rate lb/A	Date treated: Sprayed April 22, 1964 — Rated April 20, 1965 a/	Sprayed April 22, 1964 — Rated May 11, 1966	Sprayed July 9, 1964 — Rated July 7, 1965	Sprayed July 9, 1964 — Rated July 12, 1966
2,4,5-T	4	80 abc	20 cd	40 cd	25 c
2,4,5-T	8	82 abc	65 ab	70 b	45 b
2,4,5-T	12	60 bc	40 bc	65 bc	45 b
2,4,5-T + 2,4-D	6+6	75 abc	35 bc	60 bc	60 b
Picloram	4	92 ab	70 ab	65 bc	60 b
Picloram	8	100 a	92 a	90 a	90 a
Paraquat + dicamba	4+4	45 cd	5 cd	20 de	0 d
Paraquat + 2,4,5-T	4+4	15 de	0 d	45 bc	20 c
Paraquat + picloram	4+4	95 ab	88 a	50 bc	20 c
Paraquat + bromacil	4+4	5 e	5 cd	15 ef	15 c
Dicamba	5	--	--	10 efg	0 d
Bromacil	10	--	--	45 bc	45 b
Paraquat	4	20 de	5 cd	5 fg	5 d
Paraquat	8	10 de	0 d	--	--
Untreated	-	0 c	0 d	0 g	0 d

a/ Numbers followed by the same letter do not differ at the 5% level using Duncan's multiple range test. Significance based on arc sin transformed data.

On plots sprayed by truck on April 22 and July 9, 1964, picloram killed the most stems in both the ratings, 1 and 2 years after spraying, although some of the 2,4,5-T; 2,4,5-T + 2,4-D; and bromacil treatments were not less effective statistically (Table 2). Paraquat and dicamba were ineffective. In most instances the ratings 2 years after treatment were about 20% less than those made 1 year after. However, the 8 lb/acre picloram treatment maintained good brush control.

Picloram controlled the shining sumac, American beech, oaks, and sassafras but not greenbriar or white ash. Picloram killed the sweetgum and blackgum tops, but some of both had resprouted.

Results of truck-sprayed plots treated on April 20, May 26, August 2, and August 30, 1965, and May 5, 1966, and rated October 24, 1968, are presented in Table 3. Picloram and mixtures of picloram with 2,4,5-T and praquat killed more stems than other herbicides. Also, 2,4,5-T effectively substituted for some of the picloram in the picloram + 2,4,5-T 1+2 and 2+2 lb/acre mixture treatments. Treatments made in April and May were much more effective than those made in August.

In the plots sprayed in April and May 1965, and May 1966, picloram effectively controlled eastern hophornbean, shining sumac, and American beautyberry; partially controlled American holly, blackgum, flowering dogwood, red maple, southern red oak, sweetgum, white oak and yaupon; and ineffectively controlled redbay, white ash, and greenbriar. Treatments of 2,4,5-T killed most sumac and some sweetgum, southern red oak, white oak, yaupon, blackgum, and flowering dogwood, but they were ineffective on redbay, white ash, American holly, greenbriar, red maple, and American beautyberry.

Grass stands were poor on untreated areas and on plots receiving ineffective brush control (Fig.

FIG. 1. Truck-sprayed treatments at Livingston, Texas, photographed October 24, 1968. Left. Untreated. Right. Picloram + paraquat at 4+2 lb/acre, April 20, 1965.

1-left). Grass recovery generally was slow the first year after treatment with picloram, but dense stands, particularly little bluestem (*Andropogon scoparius* Michx.), were present after 2 years (Fig. 1-right).

Paraquat failed to kill any woody plants in the aerial treatments applied at Leggett, Texas, in May, 1966, and rated June 23, 1967, and October 24, 1968 (Table 4). Paraquat killed the foliage at the top and lower edges of the trees indicating that poor coverage and little translocation probably occurred.

Picloram as the potassium salt at 3, 6, and 12 lb/acre killed 30, 70, and 85% of the plants, respectively (Fig. 2). By October 24, 1968, regrowth of white ash, black willow, bitternut hickory, and greenbriar had occurred in the 3 lb/acre picloram plot. The sweetgum stems had been killed, but some plants had resprouted from the roots. The higher picloram rates killed more sweetgum and

Table 4. Plants killed (%) and stem injury (%) of brush in plots airplane treated May 1966, on East Texas timber-in plots airplane treated May 1966, on East Texas timberland species using undiluted and unformulated herbicides.

Chemical	Rate lb/A	Spray volume gpa	Date rated: June 23, 1967 Plants killed	Date rated: June 23, 1967 Stem injury	Date rated: October 24, 1968 Stem injury
Paraquat	3	1.5	0	10	10
Paraquat	6	3	0	10	0
Paraquat	12	6	0	5	0
Picloram	3	1.5	30	50	85
Picloram	6	3	70	85	85
Picloram	12	6	85	90	95
2,4,5-T + 2,4-D	6+6	1.5	30	50	65
2,4,5-T + 2,4-D	12+12	3	30	50	75
2,4,5-T + 2,4-D	24+24	6	85	95	85
2,4,5-T + picloram	6+1.5	1.5	40	70	80
2,4,5-T + picloram	12+3	3	85	90	90
2,4,5-T + picloram	24+6	6	95	99	90

FIG. 2. Aerial plots sprayed at Leggett, Texas, in May 1966, and photographed October 24, 1968. (Left) Untreated on left and treated with 12 lb/acre picloram salt on right. The tall living trees in the picloram plot are white ash and bitternut hickory. (Right) Picloram + 2,4,5-T esters 1.5 + 6 lb/acre. A living loblolly pine is present in the background, and living oaks are present at the right.

all of the greenbriar, but they seemed to have little effect on the ash. Excellent grass recovery occurred in all picloram plots.

The 2,4,5-T + 2,4-D mixtures killed 30, 30, and 85% of the woody plants at 6+6, 12+12, and 24+24 lb/acre rates, respectively. On October 24, 1968, the 6+6 lb/acre plot had living water oak, loblolly pine, boxelder, white ash, winged elm, and sweetgum plants. The 12+12 lb/acre plot had living white ash, bitternut hickory, white oak, winged elm and sweetgum. The 24+24 lb/acre plot killed the pine, but neither the bitternut hickory nor the sweetgum.

Mixtures of 2,4,5-T and picloram esters at 6+1.5, 12+3, and 24+6 lb/acre were highly effective. They killed 40, 85, and 95% of the plants, respectively (Fig. 2). This mixture was better than the 2,4,5-T + 2,4-D mixture. On the ratings made October 24, 1968, the 2,4,5-T + picloram 6+1.5 lb/acre mixture gave about 80% control; however, white ash, sweetgum, black willow, greenbriar, bitternut hickory, boxelder, eastern hophornbean, loblolly pine, and dewberry plants were alive. At the 12+3 lb/acre rate of 2,4,5-T + picloram there was more injury on the pine, but the white ash and bitternut hickory were tolerant. Some sweetgum had resprouted from the roots. At 24+6 lb/acre of 2,4,5-T + picloram the pine had been killed. White ash trees were alive. The terminal 3 or 4 ft of several American sycamore trees had been killed, but the trees had prolifically resprouted from the lower stems. Some sweetgum plants had resprouted from the roots.

Good grass stands occurred on October 24, 1968, where the woody plants had been controlled effectively.

The results from these experiments show that mixtures of 2,4,5-T + picloram are the most effective overall treatments per pound of herbicide for the East Texas timberland area. However, further research is needed to delineate the most effective 2,4,5-T + picloram mixture, particularly on the understory species. Picloram is the most effective individual chemical in that it controlled the most woody species. Species not controlled included: white ash, bitternut hickory, and redbay. Greenbriar and sweetgum also have some tolerance. Picloram was more toxic to loblolly pine and American beautyberry than were the phenoxy herbicides. Essentially similar results were reported by Nation and Lichy (1964).

The picloram applications in April and May were superior to those applied later in the summer. The same was true for the phenoxy herbicides. This may have resulted from two aspects. First, the trees might have been more physiologically active in the spring than in the fall, thus making them more sensitive to the herbicide. Second, the herbicide would be more likely to be leached into the root zone before breaking down in the cooler, rainy spring period than in the warmer, drier summer period.

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Nominations for ASRM Officers

The chairman of the 1970 Nominating Committee is J. Russell Penny, 3249 Clairidge Way, Sacramento, Calif. 95821. One of the duties of this committee is to receive nominating petitions from the membership at large as provided in the bylaws.

Nominations (for president elect or director) by petition shall be subject to the following conditions: (1) each petition shall name but one candidate to each office; (2) all candidates nominated by petition must be eligible to hold elective office; (3) the petition shall bear the signatures of at least 25 voting members of the Society who at the time of signing such petition are eligible to vote by having paid their current dues; (4) petitions must be in the hands of the nominating committee by June 1.

It is recommended that persons to be nominated by petition for any office be contacted beforehand to ascertain their willingness to be nominated and to serve if elected.