B-1157
October 1975

# Texas Persimmon Distribution and Control with Individual Plant Treatments



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# CONTENTS



# SUMMARY

Texas persimmon is a hard-to-kill woody plant infesting South Texas rangeland. Highest infestations occur in a group of 13 counties in south-central Texas from the southern edge of the Edwards Plateau into the northern South Texas Plains. Although usually considered a minor component of range vegetation, Texas persimmon may become one of the primary problems following use of mechanical brush control methods such as chaining and root plowing. It is essentially resistant to conventional herbicides applied as broadcast sprays. The most effective treatment has been application of 12 to 16 pounds of 2, 4, 5-T per 100 gallons of diesel oil as a basal spray in the hottest part of the summer. However, good control of Texas persimmon resulted when silvex + picloram was applied at 2 pounds per 100 gallons as a foliar spray or at 6 pounds per 100 gallons applied as a basal spray from 1971 to 1973. Picloram pellets were more effective in controlling Texas persimmon than were herbicide sprays. The most effective time for application of picloram pellets was in the spring before a rain.

No grass damage was noted from the application of herbicides to the foliage. However, basal applications of picloram and the high rates of the pellets completely controlled grass for 12 to 18 inches around the base of treated plants.

# Texas Persimmon Distribution and Control with Individual Plant Treatments

C. J. SCIFRES*

## INTRODUCTION

Texas persimmon (*Diospyros texana* Scheele), also called "black" and "Mexican" persimmon (Vines, 1960), is a hard-to-kill woody plant infesting Texas rangeland. It is a shrub or small tree usually 6 to 8 feet tall, rarely more than 20 feet. However, a tree 26 feet tall has been reported (Meyer, 1974). Growth form varies from plants which branch near the soil surface (Figure 1) to those with prominent trunks (Figure 2), but only rarely are they single stemmed. Texas persimmon leaves are thick, leathery, dark green and oblong or obovate. The bark usually is hard and characteristically splits and flakes, especially at the base of the main trunks, revealing light grey wood. Little is known of the life history or biological nature of this undesirable species or of its potential to spread. However, some workers feel that Texas persimmon has the potential to become in the next 25 years one of the most serious management problems on millions of acres of Texas rangeland (Hoffman, 1972).

Texas persimmon is dioecious and produces a sour, green fruit which turns black and sweet at maturity. The fruits contain hard, shiny seed about 0.3 inches long. The pulp surrounding the seed is relished by wild-life. Seed germination is improved when the pulp is removed mechanically or if the seed are passed through the digestive tracts of animals.

Texas persimmon is resistant to conventional applications of the commonly-used herbicide, 2,4,5-T [(2,4,5-trichlorophenoxy) acetic acid], as a broadcast spray (Hoffman, 1972). It can be controlled with individual plant treatments of about 16 pounds of 2,4,5-T per 100 gallons of diesel oil applied as a basal spray from July through February. This is almost twice the concentration used to control most troublesome woody plants. However, results with this treatment on Texas persimmon are often erratic.

The season of control of Texas persimmon has been correlated with energy levels in various plant parts. Wilson (1969) studied carbohydrate content of Texas persimmon leaves, stems and roots throughout the season from early April to late November 1969. Carbohydrate content of roots was always higher, regardless of sampling time, than that of stems or leaves. Carbohydrate content of the stems was usually somewhat higher than that of leaves, regardless of season sampled. Carbohydrate levels in roots generally were lowest from the first week in June to the first week in August and rapidly increased to the last of October. Carbohydrate content of roots ranged from 12 percent in early June to over 20 percent in October. Although there was a slight increase in carbohydrates during the middle of May, Texas persimmon plants generally lost carbohydrates rapidly from the first of April to the first of June. Wilson (1969) felt that the low peak of carbohydrate storage and the increase in storage during August and September could be correlated directly with the reaction of Texas persimmon to translocated herbicides.

Texas persimmon plants are relatively easy to defoliate, but roots must be killed for effective control. Removing the tops only results in prolific sprout production from the roots and trunk bases.

Before extensive research on the species could be undertaken, information on distribution, range practices and sites associated with infestations of Texas persimmon, and its response to commonly used brush control methods, was needed. This report in-

*Figure 1. Texas persimmon plant with many branches. Plant developed at ground line resulting in "Bushy" growth form.*

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*Figure 2. Texas persimmon plant with little branching near ground line resulting in "tree-type" growth form.*

cludes results of a survey undertaken to obtain these data. After establishing the extent and severity of the Texas persimmon problem, several herbicides, herbicide combinations and formulations were evaluated for control at various application dates.

## MATERIALS AND METHODS

### Survey of the Problem

Field observations indicated that about a 19-county area in south central Texas supported the most intense infestations of Texas persimmon.[1] A questionnaire was developed and sent to 75 counties including and surrounding the area suspected of supporting the worst infestations of Texas persimmon. Questionnaires were sent to county extension agents who were encouraged to consult with Soil Conservation Service personnel and ranchers before completing the forms. Questions included estimates of the percentage of the land within the county infested with Texas persimmon. Provision was made for denoting only a specific portion of the county if necessary. Completed questionnaires were grouped relative to acreage infested as greater than 70 percent, 50 to 69 percent, 25 to 49 percent, 5 to 24 percent, or 1 to 4 percent, and no infestation. One plant per acre was considered an "infestation" to simplify completion of the questionnaires. These data were used to map the primary distribution of Texas persimmon.

Other data requested in the questionnaire included information on association of Texas persimmon with particular range sites, association with range management practices, most common methods used by ranchers for control, an estimate of the relative importance of Texas persimmon as a brush problem in the county, and an opinion as to the possibility of the Texas persimmon problem intensifying in the next 15 years. A section was provided for pertinent information not included in the formal questions. Where possible, specific responses were grouped and presented as percentages of total answers obtained.

### Control Studies

Research on chemical control of Texas persimmon was located near Comfort, Texas in Kendall County. The research area, typical of the Edwards Plateau, was characterized by precipitous slopes and shallow soils with numerous rocky outcrops. In some cases, depth of top soil was less than 0.75 inch in the study area. The rocky outcrops occasionally reach boulder proportions. The stony surface overlies a 1 to 2-inch zone of clay loam to loamy soil with a calcareous underlayer. The heavy clay subsoil is high in gravel content. Principle woody plants of the study area are live oak (*Quercus virginiana* Mill.), several species of juniper (*Juniperus* spp.), and Texas persimmon. Grasses were typified by short-grass species such as Texas grama (*Bouteloua rigidiseta* (Steud.) Hitchc.), common curly mesquite (*Hilaria belangeri* (Steud.) Nash) and Texas wintergrass (*Stipa leucotricha* Trin. and Rupr.). Scattered large plants of sacahuista (*Nolina texana* S. Wats.) were common. The area was stocked with mother cows, calves, ewes and lambs during the course of the study.

Initial herbicide applications were completed on July 9, 1972. From results of that experiment, selected herbicides were applied on November 26, 1972, March 13, 1973 and/or June 7, 1973. Herbicides were applied with a handgun attached to a power sprayer using 150 pounds per square inch with a "size 7" orifice. Delivery rate was 2.21 gallons per minute. Basal treatments were applied in diesel oil carrier

[1]*Personal communication. 1971. G. O. Hoffman, Extension Range Brush and Weed Control Specialist, Texas A&M University (Department of Range Science).*

completely wetting the lower 18 to 24 inches of the stems. Foliar applications were made to completely wet the foliage using a diesel oil:water (1:4) emulsion as carrier. Herbicides were evaluated at 2 pounds per 100 gallons of carrier for foliage and 6 pounds per 100 gallons of carrier for basal treatments.

Herbicides evaluated as foliar or basal treatments on July 9, 1972 were 2,4-D [(2,4-dichlorophenoxy) acetic acid], 2,4,5-T, silvex [2-(2,4,5-trichloropropionic) acetic acid], dicamba (3,6-dichloro-*o*-anisic acid), picloram (4-amino-3,5,6-trichloropicolinic acid), combinations of 2,4-D + dicamba, 2,4,5-T + dicamba, 2,4-D + picloram, 2,4,5-T + picloram, and silvex + picloram. Dry formulations of picloram and karbutilate [*tert*-butylcarbamic acid ester with 3-(*m*-hydroxyphenyl)-1,1-dimethylurea] were applied as pellets based on canopy size at 0.005, 0.011 or 0.022 ounces active ingredient per foot of canopy diameter.[2] Canopy diameters were measured at a height of 4 feet.

During herbicide application, the time required for treatment, the average amount of chemical used, and the size of trees were recorded for reference. It was also recorded whether or not the persimmon plants were male or female, the general condition of the canopy cover, and environmental variables such as air and soil temperature and moisture.

The first study was established as a single plot for each treatment. Each plot contained at least 27 trees which were tagged with permanent numbers. In subsequent studies, 27 trees per plot were utilized with at least duplicate plots of each treatment established in a completely random design. Reaction of Texas persimmon to the herbicide treatments was recorded at either 6 months, 1 year and/or 2 years after treatment. At 6 months after treatment, the degree of defoliation was estimated by two workers. At 1 and 2 years after treatment, degree of defoliation was noted and trees completely defoliated were closely observed for the development of stem or root sprouts. The ground surface was checked for root sprouts within a radius of about 6 feet from the trunk base. At each date of evaluation, degree of grass damage also was noted.

Overall treatment performance was assessed based on average percentage canopy reduction, percentage of trees completely defoliated and not resprouting, and coefficients of variation associated with each of the herbicide treatments. Where appropriate, mean separation tests were used to make treatment comparisons.

## RESULTS

### Extent of the Problem

The primary distribution of Texas persimmon includes part or all of 50 counties in south-central and south Texas (Figure 3). Most intense infestations were reported from a group of 13 counties, including Sutton on the west to Blanco on the east, and Llano on the north to Medina on the south. However, significant infestations were reported from Brewster and Pecos counties in the Trans-Pecos and Williamson county in central Texas. Texas persimmon is probably a minor component of the woody vegetation in all other south-central, south, and southwest Texas counties. It is probably an insignificant part of vegetation north of the tier of counties including Taylor, Callahan and Eastland.

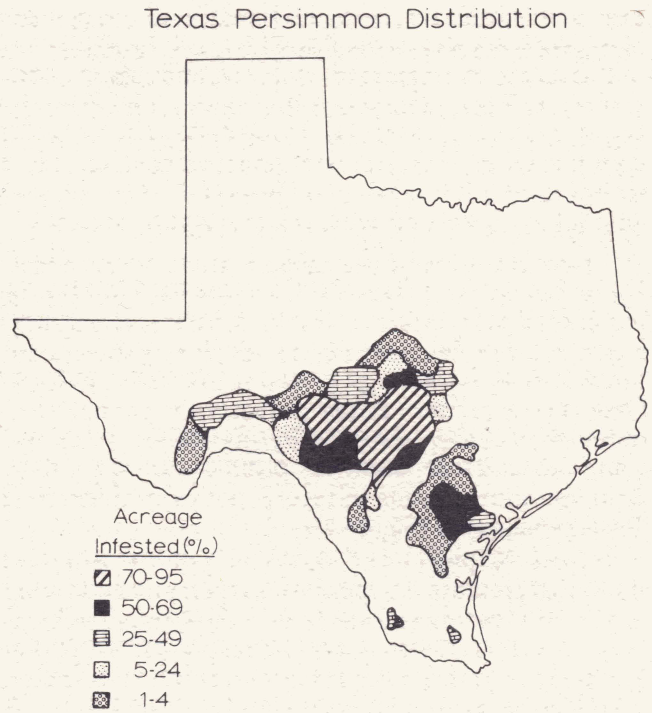


*Figure 3. Map shows distribution of Texas persimmon on Texas rangelands as developed from responses to 1971 survey.*

Most of the responses indicated that Texas persimmon usually inhabited rocky or stony upland soils (Table 1). This was especially true in counties where 50 percent or more of the acreage was infested with Texas persimmon. Such sites have potential for high productivity under proper management, which includes brush control. Only about 20 percent of the respondents felt that Texas persimmon was primarily a problem on bottomland soils. This response was especially

TABLE 1. OPINION OF RESPONDENTS FROM 50-COUNTY AREA AS TO THE ASSOCIATION OF TEXAS PERSIMMON WITH GENERAL RANGE SITES

| Range site | Response (%) |
|---|---|
| Rocky or stony, shallow soils, upland | 66 |
| Deep soils, bottomlands | 21 |
| Site not important | 13 |

[2]*Rates were converted to English system and were originally applied as 0.5, 1 and 2 grams active herbicide per meter of canopy diameter, respectively.*

prevalent from workers near major drainageways along such arteries as the Frio River. All the responses in this category originated from respondents in counties where Texas persimmon is a minor problem infesting 5 to 24 percent of the county's total acreage. In counties where Texas persimmon occurred on only 1 to 4 percent of the acreage, infestations were not considered as associated with any particular range site.

About a third of the respondents observed that Texas persimmon increased in intensity following brush control procedures (Table 2). This is apparently a particular problem when the associated species are controlled by chaining, probably for two reasons. First, many of the Texas persimmon stems bend rather than being uprooted by the chain. Secondly, some stems break allowing prolific root sprouting. Root sprouting results in heavy mottes or thickets of Texas persimmon (Figure 4).

Over 20 percent of the respondents indicated that overgrazing, or poor management following brush control, increased Texas persimmon infestations. Another 22 percent of the respondents felt that Texas persimmon infestations were not associated with management of the rangeland.

The most popular method of controlling Texas persimmon was by basal sprays (Table 3). This is recommended by the Texas Agricultural Extension Service, and has proven most consistent of methods tested (Hoffman, 1972). A few ranchmen apparently use the cut-stump method of treatment, and about 10 percent attempt to control Texas persimmon by grubbing individual plants. Although a few workers attempt to control Texas persimmon by rootplowing or dozing, only limited success has been reported with these methods. About 30 percent of the respondents reported that Texas persimmon did not present a problem sufficient to warrant control efforts in their counties. All of these counties were on the periphery of the infestation (Figure 3).

All respondents were asked to rank the importance of Texas persimmon relative to the other brush control problems in their county. Over half of the respondents from the most heavily infested counties ranked Texas persimmon as their primary brush

TABLE 2. OPINIONS OF RESPONDENTS FROM A 50-COUNTY AREA AS TO ASSOCIATION OF MOST SEVERE TEXAS PERSIMMON INFESTATIONS WITH PARTICULAR RANGE MANAGEMENT PRACTICE OR PROBLEM

| Management Practice or Problem | Response (%) |
|---|---|
| Overgrazing | 22 |
| Any mechanical brush control method | 14 |
| Chaining associated brush | 13 |
| Dozing associated brush | 3 |
| Root-plowing associated brush | 1 |
| Grubbing associated brush | 1 |
| Any procedure to eliminate associated brush | 4 |
| Poor management following brush control | 1 |
| Abandonment of cropland | 3 |
| Infestations not associated with management | 22 |
| No opinion | 16 |

problem. Usually, their reason for ranking Texas persimmon first was lack of an effective and economical control method. Those who ranked Texas persimmon as their second or third most important brush problem listed "cedar" (*Juniperus* spp.), honey mesquite (*Prosopis glandulosa* Torr. var. *glandulosa*) or various species of oak (*Quercus* spp.) as the primary problem. However, the responses were unanimous in listing Texas persimmon as most likely to dominate when other brush species were controlled. As expected, Texas persimmon's rank in importance as a brush problem decreased as the acreage infested decreased.

Respondents were also asked their opinion as to whether Texas persimmon infestations in their area will increase in intensity, decrease or remain fairly stable for the next 15 years (Table 4). Most respondents from areas with 50 to 95 percent of their acreage infested believed that the Texas persimmon problem will increase in the next 15 years. Their reasons for such an opinion included lack of effective and economical control methods, ecological adaptation of Texas persimmon when other brush species are controlled, and the ability of Texas persimmon to spread into poorly managed rangeland. Some respondents

*Figure 4. This motte or clump of Texas persimmon developed from root sprouting following disturbance of original topgrowth.*

TABLE 3. PERCENTAGE OF RESPONSES FROM 50-COUNTY AREA RELATIVE TO PRESENT USES OF CONTROL METHODS FOR TEXAS PERSIMMON

| Method | Response (%) |
|---|---|
| Basal spray | 42 |
| Cut-stump | 2 |
| Grubbing | 11 |
| Rootplowing | 9 |
| Dozing | 6 |
| No control method used | 30 |

from areas of low Texas persimmon density felt that the problem might increase, but an equal number felt the population was and would remain relatively stable. Several respondents from areas of low Texas persimmon infestation also cited the value of a limited population for wildlife food and cover.

Additional information from respondents where Texas persimmon is a problem included:

1) Until an effective, economical and dependable control procedure is developed, many ranchers do not wish to invest capital in attempting Texas persimmon control. Thus, infested ranges continue to deteriorate and Texas persimmon continues to spread.
2) Mechanical control methods may never prove successful due to the rough rocky terrain of sites now supporting Texas persimmon. Consequently, research should strive to develop effective herbicides for control of this species. Foliar sprays would be most feasible.
3) Present chemical methods, basal sprays of 2,4,5-T in diesel oil, are erratic and may kill from 50 to 100 percent of the plants. Research is needed to develop methods with more reproducible results.

## Control with sprays

Hoffman (1972) and Young et al. (1969) reported the most consistent results from herbicide sprays occurred when Texas persimmon was treated with a

TABLE 4. OPINION OF RESPONDENTS AS TO WHETHER TEXAS PERSIMMON INFESTATIONS WILL INCREASE, DECREASE OR REMAIN STABLE IN THE NEXT 15 YEARS IN THEIR AREAS

| Respondent category [based on present acreage (%) infested] | Percentage of opinions that Texas persimmon infestations will — | | |
|---|---|---|---|
| | Increase | Decrease | Not Change |
| 70-95 | 85 | 0 | 15 |
| 50-69 | 100 | 0 | 0 |
| 25-49 | 67 | 0 | 33 |
| 5-25 | 67 | 11 | 22 |
| 4-5 | 35 | 6 | 59 |

basal spray containing 16 pounds of 2,4,5-T in 100 gallons of diesel oil. This treatment was most effective when applied in July, August or early September. Ranchers have reported complete control when the Texas persimmon tops were removed at ground line and kerosene poured on the cut stumps during August.

Only 2 pounds per 100 gallons of herbicides in diesel oilwater emulsion as foliar sprays and 6 pounds of herbicides per 100 gallons of diesel oil as basal sprays were evaluated in this study. This allowed a more effective separation of herbicide performance. About 1.1 quarts of herbicide spray solution were required per tree for basal application of herbicides. About 2.4 quarts of herbicide solution were required for foliar treatment of the Texas persimmon plant.

A year after treatment, foliar sprays of 2,4-D, 2,4,5-T or silvex at 2 pounds per 100 gallons of solution reduced the Texas persimmon canopy by about 90 percent (Table 5). However, few plants were completely controlled by the sprays. Five percent or less of the Texas persimmon were completely defoliated and not resprouting. Resprouts developed from stems or roots depending on extent of damage to the topgrowth. Where the topgrowth was killed, root sprouts developed within 0.5 to 1 foot of the old stem base. Results from foliar sprays of dicamba were similar to those obtained from 2,4-D and silvex. About 75 percent of the plants sprayed were completely defoliated, but most were resprouting from the stem base or from roots within 0.5 feet of the stem base. Although total canopy reduction with foliar sprays of

TABLE 5. PERCENTAGE REDUCTION OF TEXAS PERSIMMON CANOPIES A YEAR AFTER TREATING INDIVIDUAL PLANTS WITH FOLIAR SPRAYS OF VARIOUS HERBICIDES AND HERBICIDE MIXTURES AT 2 LB/100 GALLONS OF A 1:4, DIESEL OIL:WATER EMULSION ON JULY 20, 1972 NEAR COMFORT, TEXAS[1]

| Treatment | | Population completely controlled[2] (%) | Overall canopy reduction (%) |
|---|---|---|---|
| Herbicide(s) | Combination | | |
| 2,4-D | — | 3 a | 89 cd |
| 2,4,5-T | — | 2 a | 94 d |
| Silvex | — | 5 a | 89 cd |
| Picloram | — | 59 d | 99 d |
| Dicamba | — | 9 ab | 75 bc |
| 2,4-D + picloram | 2:1 | 42 c | 99 d |
| 2,4,5-T + picloram | 1:1 | 40 c | 99 d |
| Silvex + picloram | 1:1 | 72 e | 99 d |
| 2,4-D + dicamba | 1:1 | 18 b | 99 d |
| 2,4,5-T + dicamba | 1:1 | 6 a | 91 cd |
| None | — | 0 a | 0 a |

[1]Means within a column followed by the same letter are not significantly different at the 5% level of probability.

[2]Completely controlled refers to 100% canopy reduction and no signs of new sprout development.

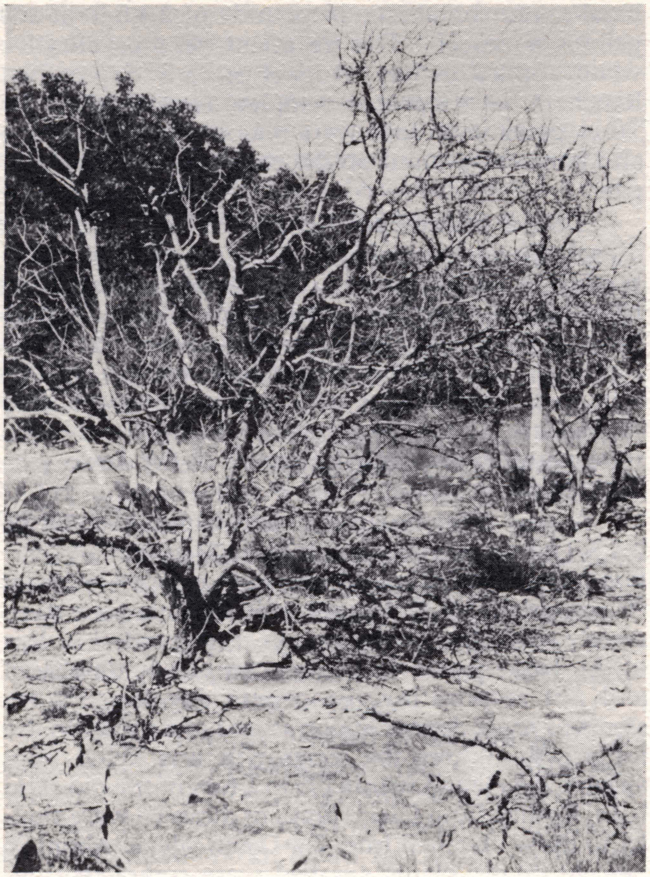

*Figure 5. Silvex + picloram (1:1) at 2 pounds per 100 gallons of diesel oil:water emulsion was the most effective herbicide combination studied for control of Texas persimmon.*

silvex was similar to that of 2,4-D or 2,4,5-T, about 5 percent of the plants completely defoliated had not developed regrowth a year after treatment.

Picloram alone as a foliar spray reduced the Texas persimmon canopy by 99 percent a year after treatment (Table 5). About 60 percent of the Texas persimmon plants were completely defoliated and not resprouting. The combination of picloram with silvex, 2,4,5-T or 2,4-D reduced the Texas persimmon canopy by 99 percent a year after treatment. However, the silvex + picloram combination (1:1) was the most successful treatment of those applied as foliar sprays in July, 1972, relative to percentage of plants failing to develop regrowth (Figure 5). Scifres (1972) reported the synergistic action of silvex and picloram as broadcast sprays for sand shinnery oak (*Quercus havardii* Rydb.) control. Over 70 percent of the Texas persimmon plants treated with silvex + picloram and 40 percent or more of the plants treated with 2,4,5-T + picloram or 2,4-D + picloram were completely defoliated and not resprouting after application of the foliar sprays.

Dicamba reduced the Texas persimmon canopy by about 75 percent a year after treatment in July, 1972 (Table 5). However, only 8 percent of the plants were completely defoliated and not resprouting. Dicamba + 2,4-D (1:1) tended to be slightly more effective than either herbicide alone. The application of 2,4,5-T + dicamba (1:1) as a tank mix was similar to results obtained with 2,4,5-T or dicamba alone. The added effectiveness of 2,4,5-T and dicamba has been noted on sand shinnery oak (Scifres, 1972), honey mesquite (Scifres and Hoffman, 1972) and Macartney rose (*Rose bracteata Wendl.*) (Scifres, 1974) where the herbicides were applied as broadcast sprays.

Application of picloram or combinations of phenoxy herbicides with picloram in June 1973 were generally more effective as foliar sprays than as basal treatments (Table 6). Picloram alone applied to the foliage reduced the Texas persimmon canopy by 99 percent, and 62 percent of the plants were completely defoliated and not resprouting after foliar treatments with picloram. However, basal application of 6 pounds of picloram in 100 gallons of diesel oil reduced the Texas persimmon canopy by only about 50 percent. Less than 35 percent of the Texas persimmon plants were completely defoliated and not resprouting a year following basal applications of picloram in June, 1973.

The foliar treatments were also less variable than the basal treatments with picloram. For instance, average percentage defoliation from foliar applications varied ±2 percent from the average whereas defoliation with basal treatments varied ±39 percent from the average. The same relationships held with the 2,4-D + picloram combinations which deviated ±17 percent from the average whereas basal treatments varied ± 39 percent.

Application of a 1:3 combination of 2,4-D + picloram in June, 1973 was not as effective as picloram alone (Table 6). Therefore, the amount of picloram applied apparently is the critical factor. Not only does substitution of one-fourth of the picloram with 2,4-D reduce the level of control but, as mentioned previously, results are more variable. However, application of the 2,4-D + picloram mixture in water + 0.5 percent surfactant to Texas persimmon foliage did not reduce the level of control as compared to results from the diesel oil:water emulsion. Using water as carrier, average canopy reduction was 92 ± 16 percent and 27 percent of the plants were completely defoliated and not resprouting a year after treatment.

Results obtained from foliar applications of 2,4,5-T + picloram in June 1973 were not as effective as those resulting from application of the same rate in July 1972 (Table 5). Treatment with 2,4,5-T + picloram was no more effective than 2,4-D + picloram in controlling the Texas persimmon canopy (Table 6). Silvex + picloram tank mixed in a 1:1 ratio was the most effective phenoxy + picloram combination with applications in June. Foliar applications of silvex + picloram in June 1973 resulted in a completely reduced Texas persimmon canopy a year after treatment. Over 85 percent of the Texas persimmon plants had not developed resprouts either from roots or basal stem segments the year after foliar application

TABLE 6. PERCENTAGE CANOPY REDUCTION OF TEXAS PERSIMMON A YEAR AFTER TREATING INDIVIDUAL PLANTS IN JUNE 1973 WITH PICLORAM AND PICLORAM + PHENOXY HERBICIDE COMBINATIONS NEAR COMFORT, TEXAS[1]

| Treatment | | | | Population completely controlled[2] (%) | Overall canopy reduction (%) |
|---|---|---|---|---|---|
| Herbicide(s) | Combination ratio | Rate (lb/100 gallons) | Application method | | |
| Picloram | — | 2 | Foliar | 62 d | 99 c |
| Picloram | — | 6 | Basal | 34 c | 54 a |
| 2,4-D + picloram | 1:3 | 2 | Foliar | 38 c | 89 bc |
| 2,4-D + picloram | 1:3 | 6 | Basal | 14 a | 38 a |
| 2,4,5-T + picloram | 1:1 | 2 | Foliar | 14 a | 76 b |
| 2,4,5-T + picloram | 1:1 | 6 | Basal | 29 bc | 38 a |
| Silvex + picloram | 1:1 | 2 | Foliar | 88 e | 100 c |
| Silvex + picloram | 1:1 | 6 | Basal | 19 ab | 89 bc |

[1]Means within a column followed by the same letter are not significantly different at the 5% level of probability.

[2]Completely controlled refers to 100% canopy reduction and no signs of new sprout development.

of silvex + picloram. The application of silvex + picloram as a basal treatment was no more effective than the other herbicide combinations applied in the same manner (Table 6). Although not significantly different from foliar applications relative to total canopy reduction of Texas persimmon, more than 80 percent of the plants treated with the combination were resprouting by a year after application.

One of the more effective herbicide basal spray treatments, at nearly two years after application, was 2,4,5-T + picloram in a 1 to 4 combination (Table 7). Picloram combined with 2,4,5-T was generally more effective than the application with dicamba. However, 2,4-D was equally effective with either picloram or dicamba.

There was little difference in the reaction of Texas persimmon to basal applications of silvex, picloram, or silvex + picloram at 6 pounds per 100 gallons of diesel oil relative to time of application (Table 8). Basal sprays of silvex appeared to be slightly more effective when applied during the spring (March) than during the winter or summer based on average canopy reduction. However, the percentage of the population completely defoliated and not resprouting was less than 10 percent regardless of season of application. As in experiments discussed previously, the combination of silvex and picloram was more effective, regardless of month of treatment, than either herbicide used alone at the same rate (Table 8). Interactions were calculated as described by Scifres (1972). Regardless of the month of treatment, the silvex + picloram was synergistic for Texas persimmon control. Also, the combination of silvex + picloram was not noticeably affected by season of application. In contrast to studies with other herbicides, the herbicide combination appeared to be slightly more effective during the cooler months than during the summer.

## Control with Pelleted Herbicides

Hoffman (1972) reported excellent results from the application of about 1 gram of active picloram as 10 percent pellets for every centimeter of stem diameter of Texas persimmon.[3] The most effective date of application was October. This treatment resulted in 96 percent control of Texas persimmon at a year after treatment with no damage to desirable sod grasses. In our studies, picloram pellets were applied based on amount of active ingredient per foot of canopy diameter. The Texas persimmon plants have canopy diameters ranging from 2 to 15 feet. Average canopy diameter was 7.5 feet based on 71 trees measured in the plots treated with the pellets.

Averaged across application dates of November, March, and June, there was no difference in canopy reduction of Texas persimmon by the picloram pellets (Table 9). Applying 0.005 ounce per foot of canopy

[3]*Roughly equivalent to 0.1 ounce per inch of stem diameter.*

TABLE 7. PERCENTAGE REDUCTION OF TEXAS PERSIMMON 23 MONTHS AFTER TREATING INDIVIDUAL PLANTS WITH BASAL SPRAYS OF VARIOUS HERBICIDES AND HERBICIDE MIXTURES AT 6 LB/100 GALLONS OF DIESEL OIL ON JULY 20, 1972 NEAR COMFORT, TEXAS[1]

| Treatment | | Population completely controlled[2] (%) | Overall canopy reduction (%) |
|---|---|---|---|
| Herbicide(s) | Combination ratio | | |
| 2,4-D | — | 5 a | 76 c |
| 2,4,5-T | — | 5 a | 79 cd |
| Dicamba | — | 6 a | 57 b |
| 2,4-D + picloram | 2:1 | 14 b | 91 de |
| 2,4,5-T + picloram | 1:1 | 32 c | 82 cde |
| 2,4,5-T + picloram | 1:4 | 46 d | 96 e |
| 2,4-D + dicamba | 1:1 | 22 bc | 80 cd |
| 2,4,5-T + dicamba | 1:1 | 6 a | 38 a |
| None | — | 0 a | 38 a |

[1]Means within a column followed by the same letter are not significantly different at the 5% level of probability.

[2]Completely controlled refers to 100% canopy reduction and no sprout development.

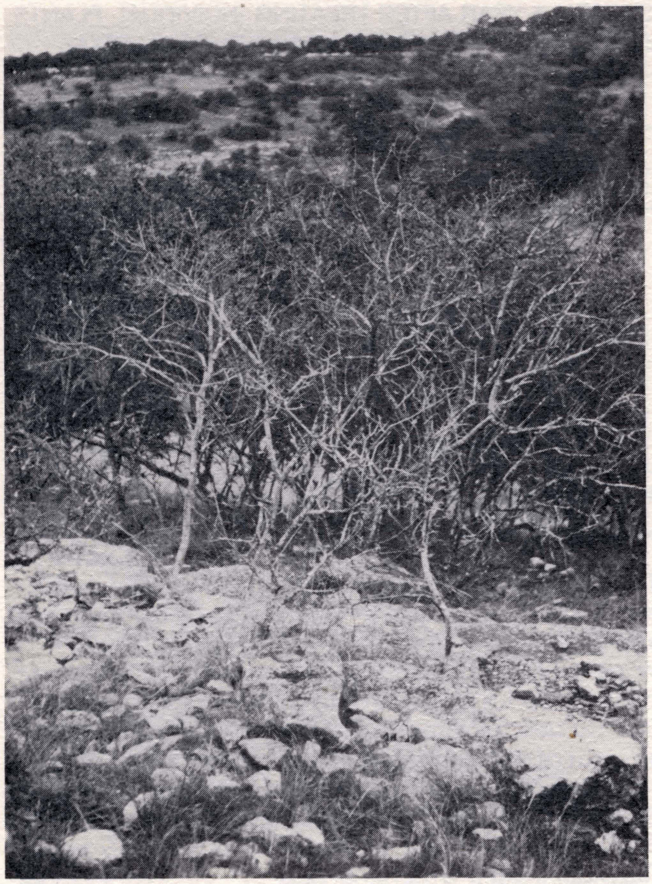

*Figure 6. Application of 0.022 ounce of picloram pellets per foot of canopy diameter to the base of the plants resulted in excellent control of Texas persimmon.*

diameter was less effective than 0.011 or 0.022 ounces. Most consistent results occurred when at least 0.022 ounces of picloram pellets were applied per foot of canopy diameter (Figure 6). Based on an average tree size of 7.5 feet canopy diameter, about 0.165 ounces active ingredient (1.65 ounces of the 10 percent pellets) were required per tree. One pound of the active ingredient would treat nearly 100 of the average size trees. Application of picloram pellets in March, just before spring rains, controlled more Texas persimmon than November or June applications (Table 9). Only in March was the 0.044 ounce of picloram pellets per foot of canopy diameter evaluated. This treatment completely controlled the Texas persimmon. Canopies were completely reduced at a year after treatment and no resprouts were found on the plants.

Where 0.022 ounce per foot of canopy diameter of picloram was applied to the average size Texas persimmon, grasses were completely controlled within a 2-foot radius of the base of the treated plant (Figure 7). A year was usually required for grass recovery where the high rate was applied. Where 0.044 ounce per foot of canopy diameter was applied, grass as far as 15 feet downslope in strips 3 feet wide was completely controlled.

TABLE 8. PERCENTAGE CANOPY REDUCTION OF TEXAS PERSIMMON AND PERCENTAGE POPULATION COMPLETELY CONTROLLED WHEN CHECKED IN JUNE 1974 (A YEAR OR MORE AFTER APPLICATION). SEPARATE SETS OF PLOTS WERE TREATED ON THREE DATES WITH BASAL APPLICATION (6 LB/100 GALLONS OF DIESEL OIL) OF SILVEX, PICLORAM AND THEIR COMBINATION IN 1:1 RATIO IN 1972 AND 1973 NEAR COMFORT, TEXAS

| | Month of Treatment[1] | | |
|---|---|---|---|
| Herbicides | November | March | June |
| | Overall canopy reduction (%) | | |
| Silvex | 40 a | 59 b | 42 a |
| Picloram | 67 b | — | 54 ab |
| Silvex + picloram | 97 c | 93 c | 89 c |
| | Population completely controlled (%)[2] | | |
| Silvex | 4 d | 4 d | 6 d |
| Picloram | 37 f | — | 17 e |
| Silvex + picloram | 70 h | 58 gh | 49 fg |

[1]Means followed by the same letter are not significantly different at the 5% level.

[2]Completely controlled refers to 100% canopy reduction and no sprout development.

Karbutilate pellets were evaluated in only one experiment, conducted in March 1973. Herbicide symptoms developed more slowly with karbutilate than with picloram. The foliage characteristically became chlorotic before leaf drop. The 0.005 ounce of karbutilate per foot of canopy diameter did not affect the Texas persimmon plants based on evaluation 15 months after treatment. Where 0.011 ounce of karbutilate per foot of canopy diameter was applied, canopy reduction averaged 62 percent and 13 percent of the plants were completely controlled. Where 0.022 ounce per foot of canopy diameter was applied, defoliation averaged 95 percent and about 70 percent of the plants were completely controlled. Therefore, the higher rates of karbutilate were roughly equivalent to picloram for Texas persimmon control.

## DISCUSSION

Texas persimmon control is usually erratic even with high application rates of 2,4,5-T as an individual plant treatment. Therefore, three variables were considered in evaluating herbicide performance in this study; average canopy reduction, variation in canopy reduction within a treatment, and percentage of the population completely controlled.

The phenoxy herbicides, 2,4-D, 2,4,5-T and silvex reduced Texas persimmon canopies from 75 to 95 percent. However, in no case were more than 10 percent of the plants completely controlled. This occurred, presumably, due to the high rates of phenoxy herbicides required for Texas persimmon control. Di-

*Figure 7. Although picloram pellets were excellent for control of Texas persimmon, grass damage was evident for a year after their application.*

camba, alone or combined with 2,4-D or 2,4,5-T, also reduced the Texas persimmon canopies but rarely controlled over 20 percent of the population. Invariably, basal applications of these herbicides were less effective than foliar treatments.

To evaluate the performance of herbicide combinations, the method of calculating expected performance of the combination based on performance of the individual components as outlined by Scifres (1972) was employed. Results from application of foliar sprays, whether considering level of canopy reduction or percentage of plants completely controlled, indicated that 2,4-D + picloram, 2,4,5-T + picloram, 2,4-D + dicamba or 2,4,5-T + dicamba combinations were "additive." Additivity indicates that performance of the herbicides in mixtures could be anticipated by control level resulting from use of either component alone at the same application rate. Synergism results when the combination of herbicides controls more plants than would be expected based on performance of the herbicides applied alone. In considering canopy reduction, the silvex + picloram combination was usually additive. However, based on percentage of plants completely controlled, results from the combination were synergistic. This reaction occurred regardless of season or year of application. Also, the relatively low rates of the combination in this study resulted in good levels of Texas persimmon control.

That picloram and combinations containing picloram were more effective as foliar than as basal sprays is difficult to explain in view of the performance of the pellets. Picloram is usually readily taken up by the roots of many species of woody plants as evidenced by control levels resulting from pellet applications. Therefore, it was expected that basal application, which applied 1.5 times more picloram to each plant, would be more effective than foliar treatments.

Picloram pellets were equal to silvex + picloram sprays for Texas persimmon control. Pellets offer some advantage in application of herbicides in remote areas although high rates of the pellets should not be applied to steep slopes.

TABLE 9. PERCENTAGE CANOPY REDUCTION OF TEXAS PERSIMMON AND PERCENTAGE POPULATION COMPLETELY CONTROLLED WHEN CHECKED IN JUNE 1974 (A YEAR OR MORE AFTER APPLICATION). SEPARATE SETS OF PLOTS WERE TREATED ON THREE DATES WITH VARIOUS RATES OF PICLORAM PELLETS IN 1972 AND 1973 NEAR COMFORT, TEXAS[1]

| Application rate (oz/ft can diam) | Month of treatment | | | |
|---|---|---|---|---|
| | November | March | June | Avg. |
| | Overall canopy reduction (%) | | | |
| 0.005 | 69 a | 81 abc | 72 a | 74 r |
| 0.011 | 78 ab | 96 de | 84 bc | 86 s |
| 0.022 | 95 de | 99 e | 87 cd | 94 s |
| Date avg. | 81 x | 92 x | 81 x | |
| | Population completely controlled (%)[2] | | | |
| 0.005 | 10 f | 19 f | 21 f | 17 o |
| 0.011 | 46 gh | 55 h | 35 g | 45 p |
| 0.022 | 75 i | 89 j | 48 h | 71 q |
| Date avg. | 44 lm | 54 m | 35 l | |

[1]Means followed by the same letter are not significantly different at the 5% level. Within an evaluation category, rate x date means, rate or date averages can be compared.

[2]Complete control refers to 100% canopy reduction and *no signs of sprout development.*

The more effective individual plant treatments described in this study should have promise for control of light infestations of Texas persimmon or as follow up to broadcast methods where Texas persimmon is a component of mixed brush. Also, there are many areas, especially in the Edwards Plateau, where broadcast methods are not feasible due to the terrain.

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## ACKNOWLEDGMENTS


Cooperation of Mr. Casper Real, Real Ranch, Comfort, Texas in furnishing land and assistance for this research is greatly appreciated. Mr. G. O. Hoffman, Extension Brush and Weed Control Specialist, cooperated in the problem survey. Herbicides for the study were furnished by AmChem Co., Velsicol Chemical Co., The Dow Chemical Co. and FMC Corp. J. L. Mutz and H. G. McCall aided in plot installation and evaluation.





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**Publication**

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