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16. Abstract

Straw mulch proved more effective in erosion control than re-claimed paper mulch in East Texas. Straw mulch anchored by asphalt or latex was significantly superior to a resin anchored straw mulch. There was no significant difference of bermuda grass seedlings per square foot with latex or asphalt anchors.

Bermuda grass and weeping lovegrass were the most effective species tested for revegetating acid slopes. Addition of phosphate at the rates tested provided no advantage in seedling emergence.

Water-degradable polymer additive to trichloroacetic acid (TCA) at 18 lbs TCA/ft mile was significantly superior to TCA at a 24 lb/ft mile rate 60 days following treatment.

African rue can be herbicidally controlled with glyphosate (3 lb/A) with a fall application or with tebuthiuron (4 lb/A) or Vel-5026 (4 lb/A) with a spring or fall application.

Velpar proved to be an effective herbicide for the general control of unwanted vegetation along roadways. Johnsongrass and alfalfa are resistant to this herbicide. Avoidance of desirable species must be practiced. Rates to 16 lbs/A or 2 lbs/ft mile did not significantly move from the target area when applied to soil. Velpar was over applied on asphaltic medians and movement did occur. If applied to large asphaltic areas care must be taken to prevent excessive applications.

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Mulches, mulch binders, acid soil amendments, vegetation control, roadsides, vegetation management, herbicides, African rue, brush control

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ESTABLISHMENT AND MANAGEMENT OF
ROADSIDE VEGETATION

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Establishment and Management of Roadside Vegetation
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TEXAS TRANSPORTATION INSTITUTE
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SUMMARY

Mulching roadside backslopes improved seedling establishment. Straw mulch proved more effective in controlling erosion than a reclaimed paper mulch. Seedling establishment with a reclaimed paper mulch at 1200 lbs/A was not significantly different from straw mulch at 2T/A or paper mulch at 1800 lbs/A.

Liming of acid soils in East Texas enhanced seedling establishment. Bermuda grass and weeping lovegrass proved superior to sorghum almum for revegetating lime treated acidic soils. Replacement of part of the lime with phosphate did not significantly increase emergence and establishment.

Anchoring of the straw mulch with asphalt or latex proved superior to a resin anchor in East Texas. However, the use of a straw mulch anchored by resin was significantly superior to a no mulch treatment. The latex binder resulted in an average of 9.3, asphalt 7.5, resin 3.5 seedlings/ft^2.

The use of a water-degradable polymer with trichloroacetic acid (TCA) proved to be effective over a longer period of time than the standard rate of TCA, but did not control the revegetation over the growing period. More than one application would be necessary for season long control. Rainfall occurring following application appears to control regrowth. The 18 lb/ft mile (150 lb/A) rate plus water-degradable polymer was the most effective treatment.

African rue was most effectively controlled by N-phosphonomethyl glycine (glyphosate), N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-261]-N, N'dimethyl urea (tebuthiuron), and 1-(5-butyl-, 3,4-thiadiazol-2yl)-3-methyl-5-hydroxy-2-imidozolidinone (Vel-5026). Glyphosate is effective when plants are reaching senescence. Fall applications are most effective. Tebuthiuron and Vel-5026 are effective throughout the growing season. Glyphosate activity is reduced by rainfall within 12 hours following application. Glyphosates' mode of entry into the plant is foliar uptake. The uptake of tebuthiuron and Vel-5026 is primarily by root absorption.

Velpar (3-cyclohexyl-6-(dimethylamino)-1-methyl-5-triazine-2,4 (1H, 3H)-dione) is an effective herbicide for the control of unwanted vegetation along roadsides. Johnsongrass and alfalfa are resistant to this herbicide at the rates applied. Bindweed was adversely affected by treatments above 6 lbs/A or 0.75 lb/ft mile. Five months following application of velpar in South Texas, relative control of unwanted vegetation was excellent. Thirty days following application in Northeast Texas there were no significant differences in the relative control of unwanted vegetation with velpar, TCA, or combinations. TCA will provide a much more rapid "knock-down" of vegetation than velpar; however, velpar will provide a much longer control period. Small plot treatments indicate control may be effective for a period of 8 months or longer.

Although velpar is effective and relatively safe, hazards may exist that have not been defined. Hazards which exist are applications near desirable vegetation and excessive quantities applied to asphaltic surfaces. Movement was observed in one location (District 12). These applications were excessive in that the asphaltic area treated was large with a small amount of vegetation present. Other hazards may exist that have not been defined, such as, movement of the herbicide from repeated applications.

Preliminary findings indicate a fall application of glyphosate at 3 lb/A will control johnsongrass. September and October applications of glyphosate have reduced the density of rhizomatous johnsongrass approximately 90 percent.

IMPLEMENTATION STATEMENT

These studies on establishment and maintenance of desirable vegetation and control of unwanted vegetation have produced results which should be considered in the following categories.

1. Straw or hay mulch is superior to reclaimed-paper for preventing erosion until a vegetative cover has developed.

2. Bermuda grass and weeping lovegrass are the most effective species to reseed acidic soils treated with lime.

3. Addition of phosphate with a reduced quantity of lime did not enhance seedling germination or establishment.

4. Latex may be utilized as an anchor or binder with a straw mulch in East Texas. Utilization of this type of anchor should be based on the cost of materials.

5. A water-degradable polymer added to TCA at a rate of 18 lbs TCA plus 0.9 gallons of polymer in a total volume of 24 gallons applied per foot mile enhanced the control of unwanted vegetation. At the estimated cost of the polymer there would be an increase in the cost of an application. This treatment will not provide season long control.

6. African rue can be controlled by the application of glyphosate as a fall application (Sept. - Oct.) and with tebuthiuron or Vel 5026 (an experimental chemical) with a spring or fall application (June-July and Sept.-Oct.). Apply glyphosate at a 3 lb/A and tebuthiuron or Vel 5026 at a 4 lb/A rate. Glyphosate should be applied

when no rainfall is expected for at least 12 hours.

7. Velpar has been evaluated less than one year after application and results indicate this material is very effective in controlling unwanted vegetation. It does not control johnsongrass or alfalfa at a rate of 0.5 lb/ft mile (4 lbs/A). The chemical was experimentally applied at 8 locations over the State of Texas and little to no movement was recorded when applied to roadway shoulders; however, in Houston when applied to an asphaltic surface, movement did occur. In this application the entire median of I-45 was treated. The width of the median was approximately 24 feet and 20 feet was treated. Vegetation was present in cracks and needed treatment. Under normal application procedures this quantity of material would not be applied. Rates of up to 2.0 lb/ft mile (16 lb/A) were applied to roadway shoulders in Amarillo and no appreciable movement occurred.

Volume of application can be reduced from the standard 24 gal/ft mile with TCA to 12 gal/ft mile with velpar. Reducing the volume applied per foot mile by one-half, the applicator can cover twice the area with the same quantity of solution.

Although velpar effectively controls most vegetation for up to 8 months, care must be exercised in application. This material will kill or severely damage desirable vegetation. Over application on asphaltic surfaces must be avoided as velpar does not adhere to asphalt and will move from the "target site". Repeated applications may result in problems not yet defined.

TCA is caustic and results in oxidation of metals which shorten the life of equipment. Velpar is non-caustic and will minimize the depreciation of equipment. The caustic effect of TCA results in discomfort to personnel working with the chemical. Velpar is a fine powder and highly water soluble, and the dust that results at the time of mixing may annoy an employees nasal passages, but it is not a caustic or highly toxic material.

DISCLAIMER

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INTRODUCTION

Research conducted under Study Number 2-18-74-182 has consisted of vegetation establishment and herbicidal control of undersirable vegetation. Studies of vegetational establishment has been concerned primarily with acidic soils in attempting to determine species adapted, soil amendments, mulches and mulch binders or anchors. Herbicide control of unwanted vegetation has been directed toward general vegetation control as well as control of specific species such as African rue (*Peganum Harmala* L.), bindweed (*Convolvulus incanus* Vahl.) and johnsongrass (*Sorghum halepense* [L.] Pers.). This report will be sectionalized to present each group of studies in an appropriate manner.

PART A: VEGETATION ESTABLISHMENT

Mulches: Any substance spread or left on the soil surface may act as a mulch. There are numerous varieties of mulching material. Mulching will generally shorten the time required to establish a suitable plant to cover by reducing evaporation, moderating soil temperatures, controlling erosion (wind and water), and prevention of crusting of the soil surface.

The effectiveness of a mulch depends on many factors, including the physical and chemical properties of the soil, the characteristics of the mulch; such as color, method of application and roughness; and the topography of the area where the mulch is to be applied. Topographic factors include slope, aspect, and orientation of the soil surface which influence the solar radiation received. Other factors such as steepness of slope, method of application of mulch (depth of mulch), climatic or environmental conditions before, during and following application and soil texture and depth will determine effectiveness of mulch.

Straw or hay mulches have proven to be superior to several manufactured mulches for vegetation establishment on roadsides (McCully and Bowmer, 1967). Straw mulches are susceptible to being carried away by wind and water without an anchoring agent.

Although straw mulches have proven most effective, new mulching materials must be evaluated. A mulch material prepared from reclaimed paper may provide a suitable mulch for vegetation and provide a means of recycling a "man-made" product.

Mulch binders: Straw or hay mulches should be anchored to reduce the probability of removal by wind or water. Chemical agents, such as asphalt, have been used as an anchoring agent. Applications of the anchoring agent have been by (1) injection of the chemical agent into the stream of mulch as it comes from the spreader and (2) as an over-spray following application of the mulch. The injection method has proven more successful in Texas (McCully and Bowmer, 1969). However, Barnett, et al., 1967 reported, that in Georgia all cases where asphalt spray was a part of the treatment, the effectiveness of the mulch was decreased. In Utah, straw mulch anchored with asphalt gave good results, but it was pointed out that this mulch is susceptible to being carried away by wind and water (Cook, et. al., 1970).

Acidic soils: In certain areas of East Texas where extremely acid soil materials have been exposed during road construction, liming rates as high as 50 tons per acre have been applied to establish a grass sod (Miller et. al., 1969). Addition of phosphate with lime ($CaCO_3$) has been suggested as an improved technique to establish a vegetative cover on acid soils (Fleming et. al., 1974). It is difficult to establish and maintain a vegetative cover on the acid backslopes in East Texas. These slopes are unsightly and susceptible to erosion. The high acidity, coupled with the availability of aluminum and other harmful elements, results in conditions deterimental to plant growth. Reserve acidity in the material below the cut surface results in a continuous problem (Miller et. al., 1974).

It is important to use species of plants that are well adapted to the soil, climate, elevation, and exposure for a specific site. Soil considerations include parent material, depth, texture and pH. Acidity is the major factor in the backslopes, identified as Weches and Queen City formations (Geologic Atlas of Texas, Tyler Sheet, 1965). Soil materials more acid than pH 4.5 will not support a plant cover for erosion control (McCully and Stubbendieck, 1972). Some species are more tolerant of acid soils and should be selected for revegetating these sites.

PART B: VEGETATION CONTROL

Vegetation can shorten the life of asphalt pavement as well as create irregular borders along roadside. Vegetation growing around delineator post, under guard railings and near bridge abutments is difficult to mow and create an unsightly appearance. Chemical control of this vegetation can alleviate some problems of mowing, protect the life of the pavement and provide a more pleasing view to passing motorist.

For several years the recommended chemical treatment in Texas for these areas has been a safe herbicide, trichloroacetic acid (TCA) (McCully and Bowmer, 1969). It is difficult to over apply and it remains in the "target area". TCA will provide control of unwanted vegetation from 3 weeks to 2 months following application depending on the environmental conditions (McCully and Bowmer, 1966). It is a fast acting chemical. Action may be observed within 12 hours after application. Although TCA is low in mamalian toxicity some people are affected by its caustic properties. These caustic properties can shorten the life of metal parts on spray equipment.

Low persistance of TCA combined with high rainfall and long growing seasons necessitate multiple applications of herbicide for effective control. AMS (ammonium sulfamate) was later utilized in combination with TCA but more than one application was required to maintain control. AMS also acts as a temporary soil sterilant and has a low order of toxicity to humans and livestock (Crafts and Robbins, 1962).

Water-degradable polymers have been developed which increase the persistence of herbicides through controlled release. They are metal-organic acid polymers which are formulated to release small amounts of herbicides through time in the presence of moisture (Beasley and Collins, 1970).

African rue: African rue is a member of the plant family Zygophyllaceae. It is a bright green, succulent, many branched perennial herb growing about 1 m high. The leaves are alternate, fleshy, and divided into narrow segments. The thick flower petals, usually five, are pure white and entire. The fruit is a leathery capsule containing 45 to 60 dark brown angled seeds. African rue was introduced into the United States about the time of World War I near Deming, New Mexico (Cory, 1949). It was first collected and identified in Texas in 1928 near the town of Pecos.

Heaviest infestations in Texas now occur near Pecos. Even though African rue is poisonous to cattle, sheep and probably horses (Moran, et. al., 1940 and Sperry et. al., 1964), known losses are few. Nevertheless, its potential toxicity should be recognized and the plants controlled.

Sites devoid of vegetation, such as highway shoulders bladed systematically and fields no longer cultivated, are readily invaded by this pest and others. Once established, perennial plants of African rue are not easily controlled and are considered a seed source for infesting adjacent grazing lands.

Herbicides of the substituted urea family such as diuron, tebuthiuron, RP 23465, and monuron (Appendix II) were the most effective of the summer treatments for the control of African rue. Not all of the substituted ureas functioned equally well. Tebuthiuron at 4.0 lb/A performed almost as well as diuron at 40.0 lb/A. Other chemicals showing some promise as a possible treatment for summer application were bromacil, Vel 5026, and bromacil plus diuron (Allen and McCully, 1976).

Other herbicides applied in October were effective on African rue. Glyphosate and tebuthiuron resulted in higher control percentage than any other chemical. Amitrole, bromacil, diuron, RP 23465 and Vel 5026 (Appendix II) were also effective in reducing the number of plants per plot. Surviving plants treated with amitrole were chlorotic and stunted at the time of evaluation (Allen and McCully, 1976).

Johnsongrass (Sorghum halepense [L.] Pers.) is one of the most widespread and frequent grasses in Texas. Johnsongrass may be from 50 to 150 cm (1½ to 5 ft) in height. This perennial reproduces from seed and large scaly rhizomes (Warnock, 1950).

Herbicides containing bromacil applied at 15 to 20 pounds of active ingredient per acre have been reported to control small patches of johnsongrass (Wiese, 1969). Other recommended treatments are dalapon at 10 to 20 pounds per acre, DSMA (disodium methanearsonate) and MSMA (Monodosium methanearsonate) at 3 to 5 pounds per acre, tillage, and combinations of herbicides and tillage. Repeated applications of DSMA, MSMA, and sodium dalapon are required for control of this species. Usually two or three applications at 2 to 3 week intervals are necessary for eradication (Wiese, 1969).

Brush control: With the advent of the new mowing specifications brush encroachment is becoming a serious problem, especially in South Texas. Review of numerous publications concerning control of various species of woody plants the most effective and promising herbicides were selected to be evaluated in the control of various species of woody plants. Picloram and dicamba were selected as base herbicides for others to be evaluated against.

MATERIALS AND METHODS

Problem sites were selected in consultation with the Contact Representative, and specific test locations were organized following on-site inspection and preliminary measurements. Equipment, materials and services were provided by the local maintenance section of the State Department of Highways and Public Transportation.

PART A: VEGETATION ESTABLISHMENT

Mulches: This test was installed during the latter part of June, 1974 at the intersection of Estes Parkway and IH-20 at Longview, Texas (Appendix I, Fig. 10). Plot size was determined by space available. Three replicated plots of each treatment were selected at random. Treatment and plot number are shown in Table 1.

Site preparation consisted of smoothing of the soil surface with a crawler-type tractor (bulldozer). This action was necessary for seed-bed preparation. The soil was tilled to a depth of six inches with a pulvi-mixer. Hulled seed of bermuda grass (*Cynadon dactylon* [L.] Pers.) was applied at a rate of 8 lbs/A through a hydroseeder. Following seeding each plot was mulched with reclaimed paper (1200 and 1800 lbs/A) through the hydroseeder or straw mulch (approximately 3000 lbs/A) through a mulch blower. Asphalt was injected into the straw at a rate of 0.05 gal/yd^2 as the straw was applied.

Mulch binders: Three sites along IH-20 were selected to evaluate the effectiveness of three binders or anchoring agents, including asphalt. All sites were prepared as previously described. Each site was divided into an appropriate number of plots (Appendix I, Fig. 11, 12, and 13). All plots, except three small plots, were mulched with coastal bermuda grass hay. Plots at each site were selected at random for utilization of resin, latex, or asphalt as

Table 1: Reclaimed paper and hay mulch applied to cut slopes in SDHPT, District 10, Tyler, Texas. Treated on June 27, 1974 at the intersection of Estes Parkway and IH-20.

Plot No.	Mulch Type	Rate (lbs/ft^2)
1	Paper	0.028
2	Paper	0.044
3	Paper	0.028
4	Paper	0.044
5	Paper	0.028
6	Hay	0.070
7	Paper	0.044
8	Hay	0.070
9	Hay	0.070

anchoring agent. All agents were injected into the mulch as applied through a mulch blower. The three small plots not mulched were covered with a cellulose netting (Hold-gro).[1/] All plots were seeded with hulled bermuda grass seed.

Acidic soils: Sites were selected along interstate 20 in District 10. Test were installed for treatment are shown in figures 14a, 14b 15, and 16, Appendix I. Each site was divided into plots of appropriate size to evaluate for (1) seed adpatability and (2) effect of phosphate in conjunction with lime ($CaCO_3$) on seedling emergence and establishment. Treatment for each site is shown in Table 2.

Site preparation was performed as in mulching experiment except that after smoothing, lime or lime plus phosphate was applied as described previously. Rates of lime, phosphate and seed species planted are shown in Table 2.

A site near the Sabine River along IH-20 was selected for evaluation of bermuda grass, weeping lovegrass and sorghum almum seed (Appendix I, Fig. 17a and 17b) in 1975. This was a follow-up study of the 1974 experiment. Site preparation was as previously described.

[1/] Mention of a trademark or a proprietary product does not constitute a guarantee or a warranty of the product by the Texas Transportation Institute and does not imply its approval to the exclusion of other products that also may be suitable.

Table 2: Acid soils treated with lime and phosphate as soil amendments. Seeded with 3 species of grasses in SDHPT, District 10, Tyler, Texas on July 16 to 19, 1974.

Site	Plot No.	Seed		Soil Amendments	
		Species[1/]	Rate	Lime (T)	Phosphate (T)
FM-2015X I-20			(lb)		
Ramp 1 FM 2015	1	Soal	0.25		
	2	Cyda	0.40	6.0	0
	3	Ercu	0.05		
Ramp 2 FM 2015	1	Cyda	0.3		
	2	Ercu	0.15	9.6	0
	3	Soal	0.15		
Ramp 3 FM 2015	1	Ercu	0.20		
	2	Soal	0.4	16.0	0
	3	Cyda	0.75		
Ramp 4 FM 2015	1	Cyda	0.5		
	2	Ercu	0.13	10.0	0
	3	Soal	0.25		
Mileage Post 604 I-20	S-1	Soal	1.8		
	S-2	Ercu	0.9	12.0	1 1/2
	S-3	Cyda	3.6		
	S-4	Soal	0.5		
	S-5	Cyda	0.6	9.0	0
	S-6	Ercu	0.2		
	N-1	Ercu	0.9		
	N-2	Cyda	3.6	25.0	0
	N-3	Soal	1.8		

Page 2 Table 2

Site	Plot No.	Seed: Species[1/]	Seed: Rate (lb)	Soil Amendments: Li e (T)	Soil Amendments: Phosphate (T)
FM-2015X I-20					
	N-4	Cyda	3.6		
	N-5	Ercu	0.9	16.5	1 1/2
	N-6	Soal	1.8		
I-20X FM 2015 South Slope (cut) on I-20	1	Soal	2.1	15	0
	2	Ercu	0.1	3	1
	3	Cyda	0.45	3	1
	4	Soal	0.25	3	1
	5	Ercu	1.1	15	0
	6	Cyda	4.2	15	0
		(1) Cyda	0.5		
	7	(2) Ercu	0.13	10	0
		(3) Soal	0.25		

1/ See Appendix III for common and binomial name.

All plots were mulched with coastal bermuda hay anchored with asphalt.

PART B: VEGETATION CONTROL

Water-degradable polymer: Experimental sites were located in State Department of Highways and Public Transportation Districts (SDHPTD) 2 and 17 (Appendix I, Figs. 18 and 19, respectively) in 1974, in Districts 5, 8 and 20 (Appendis I, Figs. 20, 21, and 22, respectively) in 1975, and in District 4 (Appendix I, Fig. 23) in 1976. Applications were made in mid-April in 1974, from April to June in 1975, and in June 1976. Mean annual precipitation ranged from 20 in/yr. in SDHPTD-8, 2, 4, and 5; 40 in/yr. in SDHPTD-17; to 60 in/yr in SDHPTD 20.

Treatments included 12 and 18 lbs/ft. mile rates of TCA with the water-degradable polymer (Tables 3 - 8_. The standard rate of 24 lbs/ft. mile TCA was installed as a control. The water-degradable polymer was added at the rate of 1 gal/50 lb. of TCA in 1974-75 treatments and 1 gal/20 lbs. of TCA in 1976 (Tables 3 - 8).

Treatments were installed on road shoulders. Shoulder treatments included a spray band wide enough to cover the asphalt shoulder plus one foot off the asphalt. The strip off the asphalt was consi-

Table 3: Treatment of TCA experimental spray plots in SDHPT, District 2, Fort Worth, Texas on May 23, 1974.

Plot No.	TCA Treatment 3/ (lbs/ft mile)		Polymer (gal/ft mile)	
	Planned	Actual	Planned	Actual
1	12.0	12.7	0.24	0.25R 1/
2	12.0	12.0	0.24	0.24A 2/
3	12.0	11.1	0.24	0.22A
4	12.0	11.1	0.24	0.22R
5	18.0	17.3	0.36	0.35R
6	18.0	18.7	0.36	0.37A
7	18.0	17.0	0.36	0.34A
8	18.0	18.4	0.36	0.37R
9	24.0	21.4	0.00	0.00-
10	24.0	25.2	0.00	0.00-

1/ Regular Polymer

2/ Anionic Polymer

3/ See Appendix II for accepted chemical name

Table 4: Treatment of TCA experimental spray plots in SDHPT, District 17, Bryan, Texas on May 16-17, 1974.

Plot No.	TCA Treatment[2/] (lbs/ft mile)		Polymer (gal/ft mile)	
	Planned	Actual	Planned	Actual
1	12.0	10.2	0.24	0.20R[1/]
2	12.0	12.4	0.24	0.25R
3	12.0	12.0	0.24	0.24R
4	12.0	12.4	0.24	0.25R
5	18.0	17.9	0.36	0.36R
6	18.0	18.1	0.36	0.36R
7	24.0	22.4	0.00	0.00
8	24.0	25.2	0.00	0.00

1/ Regular polymer

2/ See Appendix II for accepted chemical name

Table 5: Treatment of TCA experimental spray plots in SDHPT, District 5, Lubbock, Texas on June 5-6, 1975.

Plot No.	TCA Treatment[3/] (lb/ft mile) Planned	Actual	Polymer (gal/ft mile) Planned	Actual
1	18.0	18.7	0.36	0.38R[1/]
2	18.0	17.3	0.36	0.35A[2/]
3	12.0	11.6	0.24	0.23A
4	18.0	17.9	0.36	0.36R
5	12.0	11.9	0.24	0.24R
6	24.0	21.6	0.00	0.00
7	12.0	12.0	0.24	0.00
8	24.0	23.8	0.00	0.00
9	18.0	18.2	0.36	0.36R
10	18.0	17.5	0.36	0.35A
11	12.0	11.6	0.24	0.23A
12	12.0	12.5	0.24	0.25R
13	12.0	11.8	0.24	0.23R
14	24.0	25.0	0.00	0.00
15	18.0	18.8	0.36	0.38A

1/ Regular Polymer

2/ Anionic Polymer

3/ See Appendix II for accepted chemical name

Table 6: Treatment of TCA experimental spray plots in SDHPT, District 8, Abilene, Texas on May 5 and 7, 1975.

Plot No.	TCA Applied[4/] (lb/ft mile) Planned	Actual	Polymer (gal/ft mile) Planned	Actual
1	13.0	12.7	0.26	0.25R[2/]
2	17.5	17.1	0.35	0.34A[3/]
3	13.0	12.8	0.26	0.26A
4	24.0	18.6[1/]	0.00	0.00-
5	17.5	17.5	0.35	0.35R
6	13.0	12.7	0.26	0.25A
7	17.5	17.5	0.35	0.35A
8	17.5	17.5	0.35	0.35R
9	24.0	20.3[1/]	0.00	0.00-
10	17.5	17.3	0.35	0.35A
11	24.0	23.0	0.00	0.00-
12	13.0	12.8	0.26	0.26A
13	13.0	12.5	0.26	0.25R
14	17.5	17.5	0.35	0.35R
15	13.0	12.6	0.26	0.25R

1/ Error due to malfunction of equipment

2/ Regular Polymer

3/ Anionic Polymer

4/ See Appendix II for accepted chemical name

Table 7: Treatment of TCA experimental spray plots in SDHPT, District 20, Beaumont, Texas on April 24, 1975.

Plot No.	TCA Treatment[1/] (lbs/ft mile) Planned	Actual	Polymer (gal/ft mile) Planned	Actual
1	24.0	24.9	0.0	0.00
2	12.0	11.8	0.24	0.24
3	18.0	17.3	0.36	0.35
4	12.0	11.9	0.24	0.24
5	0.0	0.0	0.0	0.00
6	18.0	17.3	0.36	0.35
7	0.0	0.0	0.0	0.00
8	0.0	0.0	0.0	0.00
9	12.0	12.0	0.24	0.25
10	12.0	24.0	0.24	0.25
11	18.0	18.7	0.36	0.37
12	24.0	24.0	0.0	0.00
13	24.0	24.1	0.0	0.00
14	18.0	18.0	0.36	0.37
15	12.0	12.0	0.24	0.25
16	18.0	16.3	0.36	0.33

1/ See Appendix II for accepted chemical name

Table 8: Treatment of TCA experimental spray plots in SDHPT, District 4, Amarillo, Texas on June 23, 1976.

		Rate/ft. mile			
		Planned		Actual	
Plot No.	Herbicide[1/] Treatment	Herbicide (lbs/ft mi)	Polymer (gal/ft mi)	Herbicide (lbs/ft mi)	Polymer (gal/ft mi)
1	TCA + Polymer	18.0	0.9	17.87	0.89
2	Velpar	0.50	0.0	0.497	0.00
3	TCA + Polymer	12.0	0.6	11.5	0.57
4	TCA	24.00	0.0	21.5	0.00
5	TCA + Polymer	18.0	0.9	18.2	0.91
6	Velpar	0.50	0.0	0.542	0.00
7	TCA + Polymer	12.0	0.6	11.0	0.55
8	TCA	24.00	0.0	22.5	0.00
9	TCA + Polymer	12.0	0.6	11.5	0.57
10	TCA + Polymer	18.0	0.9	16.4	0.82
11	TCA	24.00	0.0	21.0	0.00
12	Velpar	0.50	0.00	0.497	0.00

1/ See Appendix II for accepted chemical name

dered an open soil test. A vegetation survey was made prior to installation of treatments. The response of vegetation to the imposed treatment was evaluated systematically, and the reaction of each species noted.

Herbicide screening: Preliminary investigations of herbicides for roadside vegetation control were applied in Districts 2, 3, and 17 of the State Department of Highways and Public Transportation. Three replication of five herbicides or combinations were applied in District 2, July 11; in District 17, July 10; and in District 3, September 6, 1974. Four of the chemicals were applied at two rates. Plots in Districts 2 and 17 were divided, and one-half of each plot was retreated on October 11 and 16, 1974, respectively. At the time of retreatment of each one-half plot (150 $ft.^2$), a new area adjacent to the retreatment was treated (150 $ft.^2$) with the same chemical at the same rate. Plots in Districts 2 and 17 were 150 $ft.^2$ in size with treatments in July, July plus October, and October. The July plus October plots were treated twice while the July and October plots were single treatments.

At each treatment time, 300 $ft.^2$ of roadway shoulder was treated. All formulations were applied in a total volume of 200 gal/A with a hand sprayer equipped with a cone-type adjustable nozzle.

In District 3 plots were treated on September 6, 1974, using the same procedure as in District 2 and 17. No retreatments were applied in District 3.

African rue: Experimental plots 300 $ft.^2$ in size were established in Pecos and Ward counties of SDHPTD-6. Treatments are shown in Tables 9 and 9b. Liquid formulations were applied in a total volume of 200 gal/A with a 2 gal hand sprayer equipped with a cone-type adjustable nozzle. Granular herbicides were broadcast by hand. Treatments were installed in July, 1974 and in October, 1974. Three replications were used at each treatment location. African rue and other plant species present in the experimental plots were counted prior to treatment and periodically following herbicide application.

Conditions for plant growth at the time of the summer application were poor. Soil moisture was low and the atmospheric temperature high. Conditions at the time of fall applications were much improved with good soil moisture and warm temperatures; however, most of the plants were nearing maturity.

In 1975, the most promising herbicides from the 1974 treatments were applied to define the most effective date and rate of application (Tables 10a, 10b, and 10c).

The experimental site selected was north of Fort Stockton, Texas Plot size was 300 $ft.^2$. Treatments are shown in Table 10a, 10b, and 10c. All herbicides applied were liquid formulations and were applied as described for African rue treatments in 1974.

Velpar-TCA Treatments: Experimental sites were located in

Table 9a: Treatment of experimental herbicide spray plots in SDHPT, District 6, Odessa, Texas on July 25, 1974.

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
1	2,4-D + Dicamba	2 1	400
2	Bromacil	8	396
3	Diuron	40	398
4	Methazole	2	397
5	Diuron	40	420
6	Dicamba (Granular)	40	396
7	Check	0	392
8	Vel 5026	4	390
9	Dicamba (DMA)	2	381
10	Bromoxynil	2	370
11	Vel 5052	4	362
12	Check	0	355
13	Check	0	351
14	2,4,5-TP	2	348
15	2,4-D	2	340
16	Picloram	2	283

Page 2 Table 9a

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
17	Vel 5052	4	269
18	RP 23465	6	254
19	Asulox	6	233
20	Vel 5028	4	198
21	Dicamba (DMA)	2	173
22	Bromacil Diuron	3 3	163
23	Bromoxynil	2	159
24	Check	0	157
25	2,4,5-TP	2	164
26	Check	0	161
27	Monuron	1 1/2	152
28	Bromacil	8	152
29	2,4-D Dicamba	2 1	135
30	Asulox	6	117
31	Karbutilate	10	107
32	RP20630	6	125
33	Fenac	18	124
34	2,4-DP	2	117
35	2,4-D	2	119

Page 3 Table 9a

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
36	RP20810	6	115
37	2,4-DB	0.4	111
38	Picloram	2	131
39	2,4-DP	2	157
40	Dicamba (Granular)	40	171
41	Tebuthiuron	4	206
42	Methazole	2	127
43	Amitrole	4	242
44	Methazole	2	274
45	Check	0	281
46	RP23465	6	284
47	2,4-DB	0.4	250
48	Karbutilate	10	152
49	RP20810	6	182
50	Dicamba	40	168
51	Picloram	2	141
52	Bromacil Diuron	3 3	110
53	Tebuthiuron	4	162

Page 4 Table 9a

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
54	2,4-DB	0.4	122
55	Glyphosate	3	225
56	Amitrole	4	99
57	RP20630	6	107
58	Vel 5028	4	145
59	Monuron	1 1/2	184
60	Bromacil Diuron	3 3	161
61	RP23465	6	132
62	Methazole	2	102
63	Fenac	18	115
64	Amitrole	4	133
65	Glyphosate	3	100
66	Methazole	2	151
67	Fenac	18	188
68	Vel 5026	4	162
69	Check	0	124
70	Glyphosate	3	51
71	Check	0	63
72	2,4-DP	2	98

Page 5 Table 9a

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
73	Bromacil	8	101
74	Karbutilate	10	121
75	Monuron	1 1/2	166
76	RP20810	6	125
77	2,4-D	2	105
78	RP20630	6	75
79	Asulox	6	106
80	Tebuthiuron	4	80
81	Vel 5026	4	86
82	Check	0	126
83	2,4,5-TP	2	142
84	2,4-D Dicamba	2 1	200
85	Diuron	40	200
86	Bromoxynil	2	195
87	Vel 5028	4	178
88	Methazole	2	60
89	Vel 5052	4	128
90	Dicamba (DMA)	2	78

1/ See Appendix II for accepted chemical name

Table 9b: Treatment of experimental herbicide spray plots in SDHPT, District 6, Odessa, Texas on October 2, 1974.

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
91	Fenac	18	143
92	Vel 5052	4	107
93	RP20810	6	98
94	Monuron	1 1/2	25
95	Tebuthiuron	4	25
96	Methazole	2	25
97	Dicamba (granular)	40	37
98	Asulox	6	52
99	Vel 5026	4	52
100	2,4,5-TP	2	39
101	2,4-D & Dicamba	2+1	48
102	RP23465	6	38
103	Bromacil - Diuron	3+3	36
104	Bromoxynil	2	22
105	Amitrole	4	18
106	RP20810	6	17
107	Glyphosate	3	8
108	Diuron	40	11

Page 2 Table 9b

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
109	2,4,5-TP	2	23
110	Fenac	18	36
111	RP23465	6	29
112	2,4-DB	2	29
113	Bromacil + Diuron	3+3	43
114	2,4-D + Dicamba	2+1	15
115	RP23465	6	24
116	Bromacil	8	18
117	Check	0	26
118	RP20630	6	30
119	Bromoxynil	2	26
120	2,4,5-TP	2	31
121	2,4-D	4	14
122	Diuron	40	31
123	Tebuthiuron	4	24
124	Methazole	2	15
125	not treated		28
126	Bromacil & Diuron	3+3	28
127	Picloram	2	30

Page 3 Table 9b

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
128	Monuron	1 1/2	38
129	RP20810	6	32
130	Bromacil	8	28
131	Amitrole	4	31
132	Check		32
133	RP20630	6	34
134	Bromoxynil	2	26
135	Vel 5052	4	25
136	RP20630	6	21
137	Glyphosate	3	27
138	Dicamba (DMA)	2	31
139	Check	0	27
140	Methazole	2	35
141	Glyphosate	3	20
142	Dicamba (DMA)	2	31
143	Fenac	18	43
144	Vel 5026	4	27
145	Dicamba (granular)	40	21
146	Check	0	24

Page 4 Table 9b

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
147	Vel 5026	4	21
148	Glyphosate	3	18
149	2,4-D + Dicamba	2+1	24
150	Vel 5052	4	32
151	Asulox	6	63
152	2,4-DB	2	44
153	Dicamba (granular)	40	40
154	Picloram	2	65
155	2,4-DB	2	35
156	2,4-D	4	33
157	Asulox	6	44
158	Monuron	1 1/2	48
159	Tebuthiuron	4	24
160	Bromacil	8	67

1/ See Appendix II for accepted chemical name

Table 10a: Treatment of experimental herbicide spray plots in SDHPT, District 6, Odessa, Texas on May 15, 1975.

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
1	Bromacil	8	106
2	Diuron	10	233
3	Tebuthiuron	4	175
4	Glyphosate	6	198
5	Tebuthiuron	4	218
6	Amitrole	4	222
7	RP23465	3	176
8	Glyphosate	3	129
9	Check	0	110
10	Bromacil	8	101
11	Bromacil + Diuron	6+6	186
12	RP23465	12	170
13	Glyphosate	3	122
14	Vel 5026	2	193
15	Bromacil	8	194
16	Vel 5026	4	235
17	Tebuthiuron	2	166

Page 2 Table 10a

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
18	Vel 5026	4	114
19	Amitrole	2	259
20	Vel 5026	8	386
21	Bromacil + Diuron	6+6	162
22	RP23465	12	206
23	Bromacil	4	144
24	Amitrole	2	295
25	Glyphosate	1 1/2	259
26	Bromacil + Diuron	1 1/2 + 1 1/2	181
27	Vel 5026	8	289
28	Bromacil + Diuron	3+3	234
29	Bromacil + Diuron	6+6	157
30	RP23465	6	212
31	Glyphosate	1 1/2	219
32	Vel 5026	2	307
33	Tebuthiuron	8	228
34	Bromacil	16	142
35	Glyphosate	1 1/2	116
36	Amitrole	4	181

Page 3 Table 10a

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
37	RP23465	3	98
38	Bromacil + Diuron	1 1/2 + 1 1/2	115
39	Bromacil	4	183
40	Vel 5026	2	230
41	Tebuthiuron	2	115
42	RP23465	6	121
43	RP23465	6	120
44	Diuron	10	175
45	Glyphosate	6	119
46	Amitrole	8	172
47	Tebuthiuron	4	136
48	Bromacil	4	200
49	Glyphosate	6	97
50	Amitrole	4	230
51	Check	0	234
52	Bromacil + Diuron	3+3	249
53	Bromacil	16	118
54	Amitrole	2	240
55	Amitrole	8	262

Page 4 Table 10a

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
56	Tebuthiuron	8	247
57	Amitrole	8	201
58	Glyphosate	3	203
59	RP23465	3	317
60	Bromacil	16	197
61	Vel 5026	4	323
62	Tebuthiuron	2	227
64	Tebuthiuron	8	327
65	Vel 5026	8	329
66	Bromacil + Diuron	1 1/2 + 1 1/2	241
67	RP23465	12	298
68	Check	0	217
69	Diuron	10	401
70	Bromacil + Diuron	3+3	226

1/ See Appendix II for accepted chemical name

Table 10b: Treatment of experimental herbicide spray plots in SDHPT, District 6, Odessa, Texas on July 16, 1975.

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
81	Amitrole	4	103
82	Bromacil	8	189
83	Amitrole	8	284
84	Bromacil + Diuron	3+3	204
85	Tebuthiuron	4	117
86	Velpar	2	143
87	Glyphosate	3	235
88	Vel 5026	8	339
89	Diuron	10	392
90	Tebuthiuron	8	293
91	Vel 5026	2	183
92	Tebuthiuron	4	183
93	Vel 5026	2	250
94	Bromacil + Diuron	6+6	245
95	Bromacil	8	181
96	Tebuthiuron	2	175
97	Glyphosate	3	139
98	Velpar	2	301

Page 2 Table 10b

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
99	Bromacil	4	115
100	Amitrole	8	127
101	Glyphosate	3	231
102	Tebuthiuron	4	283
103	Check	0	281
104	Bromacil	16	281
105	Bromacil + Diuron	1 1/2 + 1 1/2	211
106	Velpar	8	201
107	Amitrole	8	240
108	Velpar	2	313
109	Bromacil + Diuron	3+3	140
110	Amitrole	2	286
111	RP23465	6	197
112	RP23465	3	196
113	Amitrole	2	303
114	Amitrole	4	219
115	Vel 5026	8	239
116	Diuron	10	311
117	Bromacil	16	236

Page 3 Table 10b

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
118	Velpar	4	369
119	RP23465	12	356
120	Velpar	4	210
121	Tebuthiuron	2	468
122	Velpar	8	141
123	Glyphosate	6	190
124	Bromacil + Diuron	1 1/2 + 1 1/2	172
125	RP23465	6	125
126	Bromacil + Diuron	6+6	201
127	Vel 5026	2	402
128	Bromacil + Diuron	1 1/2 + 1 1/2	288
129	Check	0	262
130	Vel 5026	4	257
131	Velpar	4	72
132	Glyphosate	1 1/2	197
133	Check	0	140
134	Bromacil	8	157
135	Glyphosate	6	169
136	Bromacil + Diuron	3+3	187

Page 4 Table 10b

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
137	Tebuthiuron	2	350
138	Velpar	8	227
139	Tebuthiuron	8	228
140	Glyphosate	1 1/2	257
141	Tebuthiuron	8	96
142	RP23465	12	125
143	Check	0	71
144	Glyphosate	6	157
145	Amitrole	4	142
146	RP23465	3	71
147	Check	0	89
148	Bromacil	4	58
149	Diuron	10	88
150	Bromacil	4	86
151	Bromacil	16	78
152	RP23465	12	37
153	RP23465	6	43
154	Bromacil + Diuron	6+6	77
155	Amitrole	2	149

Page 5 Table 10b

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
156	Vel 5026	4	54
157	RP23465	3	47
158	Vel 5026	4	38
159	Glyphosate	1 1/2	98
160	Vel 5026	8	101

1/ See Appendix II for accepted chemical name

Table 10c: Experimental herbicide spray plots in SDHPT, District 6 Odessa, Texas on September 11, 1975

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
161	Vel 5026	4	99
162	Tebuthiuron	2	116
163	Amitrole	4	101
164	Velpar	2	79
165	Glyphosate	1 1/2	182
166	Diuron	10	80
167	Bromacil	4	117
168	Bromacil	8	81
169	RP23465	3	123
170	Amitrole	2	127
171	Tebuthiuron	2	241
172	Glyphosate	3	147
173	Tebuthiuron	4	280
174	Check	0	221
175	Velpar	4	191
176	Diuron	10	181
177	Glyphosate	6	177

Page 2 Table 10c

Plot No.	Herbicide[1/] Treatment	Rate llbs/A	Number of Plants (Pha)
178	Bromacil + Diuron	1½ + 1½	203
179	Check	0	200+
180	Glyphosate	0	239
181	Velpar	8	340
182	Bromacil	4	256
183	Diuron	20	248
184	Tebuthiuron	8	233
185	Glyphosate	3	209
186	Velpar	2	114
187	Tebuthiuron	2	187
188	Velpar	8	235
189	RP23465	12	204
190	Amitrole	4	136
191	Glyphosate	1½	57
192	Amitrole	8	92
193	RP23465	3	98
194	Bromacil + Diuron	6 + 6	120
195	Vel 5026	2	132
196	RP23465	12	88

Page 3 Table 10c

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
197	Bromacil + Diuron	6 + 6	64
198	Diuron	20	87
199	Amitrole	8	40
200	Vel 5026	4	57
201	RP23465	6	122
202	Velpar	4	158
203	Vel 5026	4	63
204	Bromacil	8	59
205	Tebuthiuron	8	68
206	Bromacil	8	57
207	Check	0	77
208	Tebuthiuron	4	100
209	Glyphosate	6	112
210	RP23465	3	166
211	Vel 5026	2	96
212	Bromacil	16	92
213	RP23465	6	63
214	Bromacil + Diuron	1½ + 1½	120
215	RP23465	6	121

Page 4 Table 10c

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
216	Amitrole	8	132
217	Diuron	20	155
218	Tebuthiuron	4	240
219	Bromacil + Diuron	6 + 6	275
220	Vel 5026	2	143
221	RP23465	12	178
222	Amitrole	2	191
223	Velpar	2	188
224	Bromacil	16	223
225	Bromacil + Diuron	3 + 3	260
226	Diuron	10	205
227	Bromacil	16	231
228	Glyphosate	6	229
229	Velpar	4	230
230	Glyphosate	3	180
231	Tebuthiuron	8	91
232	Bromacil + Diuron	3 + 3	N/C*
233	Velpar	8	155
234	Bromacil + Diuron	1½ + 1½	137

Page 5 Table 10c

Plot No.	Herbicide[1/] Treatment	Rate lbs/A	Number of Plants (Pha)
235	Armitrole	2	153
236	Bromacil	4	112
237	Amitrole	2	101
238	Bromacil + Diuron	3 + 3	92
239	Check	0	32
240	Check	0	

* Not counted

1/ See appendix II for accepted chemical name

SDHPTD-17, 21, 8, 5, 19, 4, 12. Applications were made in District 17 in Dec. 1975; District 21 in April; Districts 5, 8, and 19 in May; Districts 4 and 12 in June, 1976. Mean annual precipitation ranged from 20 in/yr in Districts 21, 5, 8, 4; 40 in/yr in District 17; 50 in/yr in District 12; to 60 in/yr in District 19. The growing period (frost-free) ranges from 190 days in District 4 to 300 days in District 21. The altitude of the experimental locations range from 0 to 300 ft. in District 12 to 3000 to 3800 ft. above sea-level in District 4.

Treatments by location are shown in Tables 11 thru 17. Plots and plot size by location are shown in Appendix I, Figs 23 to 29-b.

Prepavement treatments: Experimental sites were located in SDHPTD-11 and 25 (Appendix I, Fig 30, 31). Plot size was determined and date of application are shown in Table 18 in District 11 and Table 19 in District 25.

Johnsongrass: Experimental plots 300 $ft.^2$ in size were selected in SDHPTD-8 to evaluate herbicides for the control of johnsongrass. Three replications of dalapon (6 lbs/A), glyphosate (4 lbs/A), RP-23465 (6 lbs/A), Asulam (6 lbs/A), and Vel-5026 (4 lbs/A) were applied on May 13, July 18, and October 1, 1975. All treatments were applied in an aqueous solution in a total volume of 200 gal/A with a 2 gal. hand sprayer equipped with a cone-type adjustable nozzle. John-

Table 11: Treatment of experimental herbicide spray plots in SDHPT, District 17, Bryan, Texas on December 3-5, 1975

Plot No.	Herbicide[1/] Treatment	Treatment Rate (lb/ft. mile) Planned	Actual
1	Velpar	0.50	0.48
2	Velpar + TCA	0.375 + 12.0	0.373 + 11.9
3	Velpar	0.75	0.75
4	Velpar + TCA	0.25 + 12.0	0.23 + 11.4
5	TCA	24.0	23.1
6	Velpar	0.5	0.49
7	Velpar + TCA	0.375 + 18.0	0.375 + 18.0
8	Velpar + TCA	0.25 + 12.0	0.26 + 13.0
9	Velpar + TCA	0.375 + 12.0	0.371 + 11.9
10	Velpar + TCA	0.25 + 12.0	0.25 + 12.0
11	Velpar + TCA	0.375 + 18.0	0.375 + 18.0
12	TCA	24.0	22.5
13	Velpar	0.75	0.75
14	Velpar + TCA	0.25 + 18.0	0.25 + 18.0
15	Velpar	0.5	0.5
16	Velpar	0.75	0.74
17	Velpar + TCA	0.375 + 18.0	0.375 + 18.0

Page 2 Table 11

Plot No.	Herbicide[1/] Treatment	Treatment Rate (lb/ft. mile) Planned	Actual
18	Velpar + TCA	0.375 + 12.0	0.38 + 12.3
19	Velpar + TCA	0.25 + 18.0	0.25 + 18.0
20	Velpar + TCA	0.25 + 18.0	0.24 + 17.9
21	TCA	24.0	22.6

1/ See Appendix II for accepted chemical name

Table 12: Treatment of experimental herbicides spray plots in SDHPT, District 21, Pharr, Texas on April 29-30 and May 4, 1976.

Plot No.	Herbicide[1/] Treatment	Treatment Rate (lb/ft. mile) Planned	Actual
1	Velpar	0.50	0.51
2	Velpar	0.75	0.49
3	Velpar + TCA	0.25 + 18.00	0.24 + 11.6 0.25 + 17.6[2/]
4	TCA	24.00	23.3
5	Velpar + TCA	0.25 + 12.00	0.253 + 12.1
6	Velpar + TCA	0.375 + 18.00	0.344 + 16.5
7	TCA	24.00	23.75
8	Velpar	0.50	0.51
9	Velpar + TCA	0.375 + 12.00	0.36 + 11.6
10	Velpar + TCA	0.25 + 18.00	0.25 + 18.0
11	Velpar + TCA	0.375 + 18.00	0.39 + 18.9
12	Velpar + TCA	0.25 + 12.00	not treated
13	Velpar + TCA	0.25 + 18.00	0.255 + 18.4
14	Velpar	0.50	0.47
15	Velpar	0.75	0.63
16	Velpar + TCA	0.375 + 12.00	0.37 + 11.9
17	Velpar + TCA	0.25 + 12.00	0.255 + 18.4

Page 2 Table 12

Plot No.	Herbicide[1/] Treatment	Treatment Rate (lb/ft. mile) Planned	Actual
18	Velpar + TCA	0.375 + 18.00	0.42 + 11.9
19	Velpar + TCA	0.375 + 12.00	0.38 + 12.3
20	Velpar	0.75	0.75
21	TCA	24.00	25.00

1/ See Appendix II for accepted chemical name

2/ Plot 3 was treated twice

Table 13: Treatment of experimental herbicides spray plots in SDHPT, District 8, Abilene, Texas on May 3-4 , 1976.

Plot No.	Herbicide[1/] Treatment	Treatment Rate (lb/ft. mile) Planned	Actual
1	Velpar	0.50	0.50
2	TCA	24.00	22.50
3	Velpar + TCA	0.25 + 18	0.276 + 19.87
4	Velpar	0.75	0.89
5	Velpar + TCA	0.25 + 12	0.326 + 15.6
6	Velpar + TCA	0.375 + 18	0.39 + 18.7
7	Velpar	0.75	0.88
8	Velpar + TCA	0.25 + 18	0.29 + 21.0
9	Velpar	0.75	0.75
10	Velpar + TCA	0.25 + 12	0.15 + 6.9
11	Velpar + TCA	0.375 + 18	0.375 + 18.0
12	Velpar + TCA	0.25 + 18	0.125 + 9.0
13	Velpar	0.50	0.46
14	TCA	24.00	26.00
15	Velpar + TCA	0.375 + 12	0.55 + 17.75
16	Velpar + TCA	0.375 + 18	0.350 + 17.25
17	Velpar	0.50	0.54

Page 2 Table 13

Plot No.	Herbicide[1/] Treatment	Treatment Rate (lb/ft. mile) Planned	Actual
18	Velpar + TCA	0.375 + 12	Not treated
19	Velpar + TCA	0.25 + 12	0.28 + 13.5
20	TCA	24.00	22.50
21	Velpar + TCA	0.375 + 12	0.42 + 13.5

1/ See Appendix II for accepted chemical name.

Table 14: Treatment of experimental herbicides spray plots in SDHPT, District 5, Lubbock, Texas on May 6, 1976.

Plot No.	Herbicide[1/] Treatment	Treatment Rate (lb/ft. mile) Planned	Actual
1	Velpar	0.5	0.47
2	TCA	24.00	24.70
3	Not treated		
4	Velpar	0.75	0.64
5	Velpar + TCA	0.25 + 12.00	0.24 + 11.7
6	Velpar + TCA	0.375 + 18.00	0.32 + 15.3
7	Velpar	0.75	0.78
8	Not treated		
9	Velpar	0.75	0.78
10	Velpar + TCA	0.25 + 12.00	0.21 + 10.00
11	Velpar + TCA	0.375 + 18.00	0.34 + 16.3
12	Not treated		
13	Velpar	0.50	0.49
14	TCA	24.00	22.70
15	Velpar + TCA	0.375 + 12.00	0.25 + 8.0
16	Velpar + TCA	0.375 + 18.00	0.33 + 15.8
17	Velpar	0.50	0.53

Page 2 Table 14

Plot No.	Herbicide[1/] Treatment	Treatment Rate (lb/ft. mile) Planned	Actual
18	Velpar + TCA	0.375 + 12.00	0.41 + 14.8
19	Velpar + TCA	0.25 + 12.00	0.23 + 11.0
20	TCA	24.00	21.30
21	Velpar + TCA	0.375 + 12.00	0.41 + 14.8

1/ See Appendix II for accepted chemical name

Table 15: Treatment of experimental spray plots in SDHPT, District No. 19, Atlanta, Texas on May, 1976.

Plot No.	Herbicide[1/] Treatment	Treatment Rate (lb/ft. mile) Planned	Actual
1	Velpar	0.50	0.495
2	TCA + Velpar	12.0 + 0.25	13.1 + 0.31
3	Velpar	0.50	0.43
4	Velpar	0.75	0.86
5	TCA + Velpar	18.0 + 0.37	17.5 + 0.36
6	TCA + Velpar	12.0 + 0.37	12.1 + 0.37
7	TCA + Velpar	12.0 + 0.25	11.7 + 0.27
8	TCA	24.0	18.5
9	Velpar	0.75	0.84
10	TCA + Velpar	18.0 + 0.37	17.5 + 0.36
11	TCA	24.0	24.3
12	Velpar	0.5	0.48
13	TCA	24.0	21.1
14	TCA + Velpar	12.0 + 0.37	11.1 + 0.31
15	TCA + Velpar	12.0 + 0.25	12.0 + 0.28
16	Velpar	0.75	0.86
17	TCA + Velpar	18.0 + 0.37	17.4 + 0.36
18	TCA + Velpar	12.0 + 0.37	11.6 + 0.36

1/ See Appendix II for accepted chemical name

Table 16: Treatment of experimental herbicides spray plots in SDHPT, District 4, Amarillo, Texas on June 22-23, 1976.

Plot No.	Herbicide[1/] Treatment	Treatment Rate (lb/ft. mile) Planned	Actual
1	Velpar	0.75	0.749
2	Velpar	0.50	0.541
3	Velpar	0.75	0.749
4	Velpar	1.00	1.057
5	Velpar	0.75	0.708
6	Velpar	0.50	0.640
7	Velpar	2.00	2.064
8	Velpar	2.00	2.064
9	Velpar	1.00	1.091
10	Velpar	1.00	1.091
11	Velpar	2.00	2.157
12	Velpar	1.50	1.374
13	Velpar	1.50	1.531
14	Velpar	1.50	1.531
15	Velpar	0.50	0.373
16	Check	0.00	0.00
17	Check	0.00	0.00
18	Velpar	1.50	1.667

1/ See Appendix II for accepted chemical name

Page 2 Table 17

Plot No.	Herbicide[1/] Treatment	Treatment Rate: Planned (lb/ft mile)	Treatment Rate: Planned (gal/ft mile)	Treatment Rate: Actual (lbs/ft mile)	Treatment Rate: Actual (gal/ft mile)
17	Not treated		0	0.00	0.0
18	Velpar	0.5	3	0.53	3.3

1/ See Appendix II for accepted chemical name

Table 17: Treatment of experimental herbicide spray plots in SDHPT, District 12, Houston, Texas on July 14, 1976.

Plot No.	Herbicide[1/] Treatment	Treatment Rate: Planned (lb/ft mile)	Planned (gal/ft mile)	Actual (lbs/ft mile)	Actual (gal/ft mile)
1	Velpar	0.5	12	0.48	11.5
2	Velpar	0.75	12	0.71	11.5
3	Velpar	0.5	12	0.50	12.0
4	Velpar	0.75	12	0.71	11.5
5	Velpar	0.5	12	0.50	11.5
6	Velpar	0.75	12	0.71	11.5
7	Velpar	0.75	6	0.80	6.4
8	Velpar	0.75	6	0.80	6.4
9	Velpar	0.5	6	0.53	6.0
10	Velpar	0.75	6	0.80	6.4
11	Velpar	0.5	6	0.52	5.5
12	Not treated		0	0.00	0.0
13	Not treated		3	0.00	0.0
14	Not treated		0	0.00	0.0
15	Velpar	0.5	6	0.54	6.5
16	Velpar	0.5	3	0.47	3.5

Table 18: Prepavement treatment with herbicides for vegetation control in SDHPT, District 11, Lufkin, Texas on June 15, 1976.

Plot	Herbicide[1/]	Application Rate (lbs/ft. mile)	
No.	Treatment	Planned	Actual
1[2/]	Prometone	6.0	4.9[2/]
2	Prometone	6.0	5.3[2/]
3	Bromacil	2.4	2.7
4	Bromacil	2.4	2.7
5	Velpar	1.2	1.5
6	Prometone	6.0	6.4
7	Bromacil	2.4	2.8
8	Velpar	1.2	1.4
9	TCA	24.0	22.9
10	Prometone	6.0	5.6
11	TCA	24.0	23.0
12	Velpar	1.2	1.3

1/ See Appendix II for accepted chemical name

2/ Treated followed by sweeping then asphalt emulsion applied

Table 19: Prepavement treatment with herbicides for vegetational control in SDHPT, District 25, Childress, Texas on June 8-10, 1976.

Plot No.	Herbicide[1/] Treatment	Treatment Rate (lbs/ft. mile) Planned	Actual
1	TCA	24.0	19.2[2/]
1	TCA	24.0	23.9
2	Prometone	6.0	4.9[2/]
3	TCA	24.0	24.0
4	TCA	24.0	23.6
5a	Prometone	6.0	5.6
5b	Prometone	6.0	6.0
6	Prometone	6.0	5.7

1/ See Appendix II for accepted chemical name

2/ Foreign object (rubber from hose or impeller) obstructed flow rate. When observed on Plot 2 chemical could not be unloaded grass and other plant species present in the experimental plots were counted prior to treatment and periodically following herbicide applications.

Growing conditions generally were favorable for growth. Following the July application 0.44 inches of rainfall occurred. Ten days following the May application 1.20 inches of rainfall occurred. Warm season plants were maturing at the time of the October application. Species present in the plots included johnsongrass, silver bluestem, red three-awn, wavyleaf thistle, and western ragweed.

Brush Control: An experimental location was selected in SDHPTD-21 (Appendix I, Fig. 32) to initiate research in the control of undesirable woody plants present in the right-of-way along our roadways. Six of the most promising herbicides were selected for initial evaluation; however, due to equipment failure one of the chemicals was not applied. Treatments were applied in May, 1976. All treatments were at 2 lbs/A rate.

One group of plots were treated as a broadcast treatment (Table 20). These plots were 2500 $ft.^2$. Another group of plots were treated as a canopy treatment. Plot size was 5000 $ft.^2$. The radius of each woody plant was determined and the quantity of herbicide applied on the basis of the number of square feet under the canopy (Table 20). The area ($ft.^2$) under the canopy was determined and the quantity of herbicide determined and placed under the drip-line of the canopy.

Table 20: Herbicidal treatments for control of woody plant species in SDHPT, District 21, Pharr, Texas. All treatments were applied at a 2 lb/A rate on April 7-8, 1976

Plot		Plant Number Present/Plot By Species[2/]												
No.	Treatment[1/]	Prgl	Coho	Acbe	Acri	Poau	Lefr	Acfa	Xagl	Paac	Bagl	Opsp	Jasp	Krgl
1	Picloram canopy	7	2	1										
2	Tebuthiuron crown	3	6		2	1	1							
3	Vel-5026 broadcast	11												
4	Vel-5026 crown	9	2			1		1						
5	Picloram broadcast	6						1						
6	Check	9	2			4								
7	Dicamba crown	13						1						
8	Velpar broadcast	16		1				1						
9	Vel-5026 canopy	18												
10	Dicamba canopy	23						1						
11	Tebuthiuron broadcast	6	2	4	4	4		8	64					
12	Picloram broadcast	1		3	6	7		3	72	3				
13	Velpar broadcast	3				1		2	149					
14	Vel-5026 broadcast	1	1			4		14	115					
15	Picloram canopy	0	2											
16	Velpar crown	43	3	1		1								
17	Tebuthiuron canopy	28	2	1		5								
18	Vel-5026 canopy	65	1	3	1		2							
19														
20	Picloram crown	39		3	1							1		

Page 2 Table 20

Plot No.	Treatment[1/]	Plant Number Present/Plot by Species[2/] Prgl	Coho	Acbe	Acri	Poau	Lefr	Acfa	Xagl	Paac	Bagl	Opsp	Jasp	Krgl
21	Vel-5026 broadcast	32	1	1		2			3					
22	Dicamba crown	34		1	29			2						
23	Picloram canopy	11		4	22	2								
24	Vel-5026 canopy	8		1	11	4		1				2		
25	Tebuthiuron crown	4	1	3	6	1	2					1		
26	Picloram crown	4	1	2	12	8	10							
27	Velpar crown	14		6	7	14	6	31			1			
28	Check	0	2		5	4	2	25			3			
29	Dicamba broadcast	37	1			1			11			3		
30	Vel-5026 crown	68	5	10	8			1				3	9	
31	Tebuthiuron crown	116	2	3	7		4					9		
32	Check	48	1	1	1	1						16	Present	
33	Dicamba crown	85		7	27									
34														
35	Vel-5026 crown	13		2	46	3		1						
36	Dicamba canopy	9			59	17								
37	Check	8	2		4	1								
38	Tebuthiuron canopy	8	2	2	7	5								1
39	Dicamba broadcast	4	2		1	6		1	81			1	10	
40	Velpar crown	16				23	24	1						
41	Dicamba canopy	142	1	3	5	2		12					9	
42	Tebuthiuron broadcast	33	4						13					
43	Picloram crown	43	1	3	1	3								

Page 3 Table 20

Plot No.	Treatment[1/]	Prgl	Coho	Acbe	Acri	Poau	Lefr	Acfa	Xagl	Paac	Bagl	Opsp	Jasp	Krgl
44	Picloram broadcast	33	2		16	1		2	3			5		16
45	Tebuthiuron broadcast	18	5						1					4
46	Tebuthiuron canopy	24			1	1		1				3		1
47														
48	Velpar broadcast	3		4	3	2			29			1	Present	
49	Dicamba broadcast	6		27	19	3			56					

1/ See Appendix II for accepted chemical name

2/ See Appendix III for common and binomial name

The last group of plots were treated as a crown treatment. The area (ft^2) under the canopy was determined and the quantity of herbicide was placed at or near the crown (base) of each plant.

The chemical, velpar was not included in the canopy treatment due to the size of the formulated material. All treatments applied were pelleted herbicides. The chemical which was not applied was a liquid formulation.

RESULTS AND DISCUSSION

PART A: VEGETATION ESTABLISHMENT

Mulches: Straw mulch anchored with asphalt proved more effective in preventing erosion than reclaimed paper mulch. Paper mulch is as effective in bermuda grass seedling establishment as straw mulch 109 days following seeding and mulching (Table 21). There was no advantage in utilizing the heavier rate of paper mulch in respect to seedling establishment. Although no quantative determination was made of the total amount of erosion, it was evident by observation that erosion occurred on slopes mulched with reclaimed paper. A slope mulched with reclaimed paper in South Texas substantiated these observations. The frequency and density of bermuda grass seedlings were similar in all treatments.

Acidic soils: Treatment of acid slopes with lime or lime plus phosphate did not affect the number of bermuda grass seedlings per square foot (Table 22). Addition of phosphate did affect the seedling

Table 21: The effect of mulch type on the density and frequency of bermuda grass seedlings in District 10, State Department of Highways and Public Transportation, Tyler, Texas.

Mulch Type	Plants/ft.^{2} 1/
Straw (hay) plus Asphalt binder	6.7 a
Reclaimed paper	
1800#/A	6.5 a
1200#/A	6.3 a

1/ Means within each column followed by the same letter are not significantly different at the 5% level of confidence.

Table 22: Effect of lime and lime plus phosphate on emergence of three grass species in District 10, State Department of Highways and Public Transportation, Tyler, Texas

	No. of Seedlings/ft.^{2} 1/		
	Lime		Lime + Phosphate
	Treatment Date		Treatment Date
Grass species	6/27/74	9/19/75	6/27/74
Bermuda grass	10.9 a	11.5 a	10.5 a
Weeping lovegrass	8.1 a	8.3 a	6.3 b
Sorghum almum	2.0 b	2.8 b	1.7 c

1/ Means within each column followed by the same letter are not significantly different at the 5% level of confidence

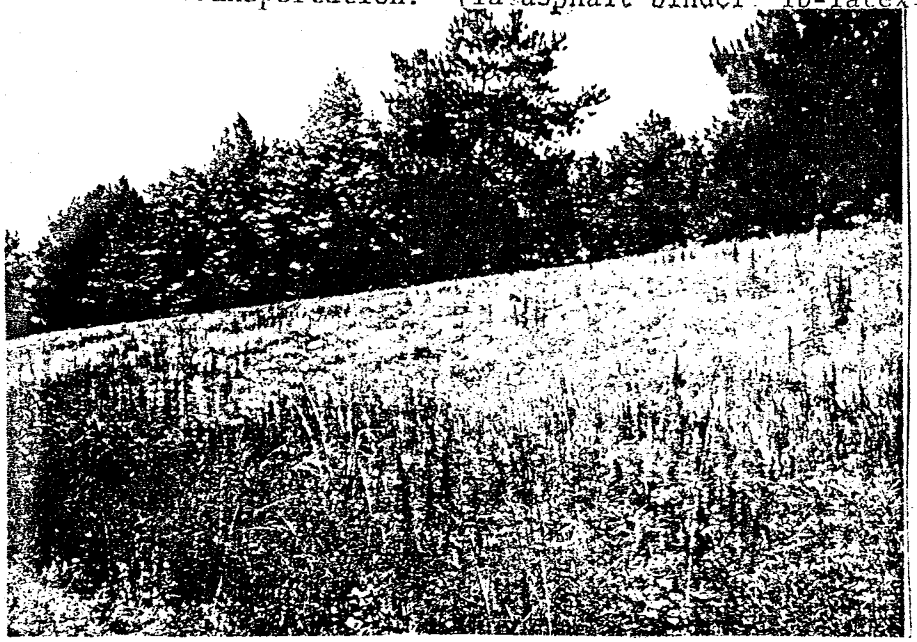
establishment of weeping lovegrass. There was a reduction of seedings per square foot when a portion of the agricultural lime was replaced with phosphate (Table 22).

Sorghum almum, an annual species, will not perform satisfactorily for revegetation of acid soils (Table 22). The frequency and density of this species was too low to prevent erosion. The use of phosphate did not enhance its establishment. Bermudagrass and weeping lovegrass are the species best adapted to revegetating acid slopes in East Texas. There was no advantage to incorporation of phosphate with lime in neutralizing the acid soils in these test.

Mulch binder or anchor: The use of asphalt as a binder or anchor for straw has been utilized for a number of years by the State Department of Highways and Public Transportation. With the continual rise in the cost of asphalt this experiment was undertaken to find a substitute binder or anchor for straw mulch. The materials selected for testing were resin, latex and asphalt. The latex binder proved to be as effective as asphalt in seedling establishment (Table 23). There was no significant difference in the seedlings per square foot 100 days following seeding and mulching (Fig. 1a, 1b and 1c). The latex material at the rate applied did not degradate as rapidly as did asphalt under the conditions that prevailed in East Texas. The resin binder with a straw mulch proved to be superior to a no mulch treatment; however, it was significantly inferior to asphalt or latex

Figure.1. Effect of asphalt, latex and resin binders on establishment of vegetation in District 10, State Department of Highways and Public Transportation. (1a-asphalt binder, 1b-latex binder, and 1c-resin binder.)

metal plate



1a

1b

1c

Table 23: Population density of bermuda grass (*Cynadon dactylon*) 100 days following seeding on highway cut banks along I-20 in District 10, State Department of Highways and Public Transportation, Tyler, Texas.

Treatment	Plants/ft.^{2} 1/
Straw Mulch plus Resin binder	3.5 b
Straw mulch plus Latex binder	9.3 a
Straw mulch plus Asphalt binder	7.5 a
No mulch or binder	1.0 c

1/ Means within each column followed by the same letter are not significantly different at the 5% level of confidence

as a binder with straw mulch (Fig. 1a, 1b., 1c and Table 23). Erosion control was unsatisfactory in the no mulch treatments. The latex binder at the concentration used under the conditions of East Texas can be used to replace asphalt as an anchor for a straw mulch.

PART B: VEGETATION CONTROL

Water-degradable polymer: Two rates TCA were combined with a water-degradable polymer and compared with the standard state herbicide rate for relative effectiveness. Individual species were evaluated by treatment and grouped into grass or forb categories for an average effect. Comparisons were made between open soil and asphalt treatments.

Herbicidal damage was assessed by visual estimation for each species. A ranking system of 1 to 5 was employed. Criteria related for each rank were:

1 = Slight to no noticeable effect including yellowing of leaves with leaf tips burned.

2 = Kill of tender leaves and stems. Grasses, basal leaves not dead. Broadleaves, green basal leaves or plants may be stunted.

3 = Green visible but not dominant. Regrowth from lower stems or root crowns.

4 = Live tissue evident only with close inspection.

5 = No evidence of live tissue.

Trials for evaluation of a water-degradable polymer were conducted in SDHPT Districts 2 and 17 in 1974, Districts 5, 8 and 20 in 1975 and in District 4 in 1976. The most effective treatment over time was 18 lbs of TCA/ft mile plus polymer at all locations. There was a significant difference in control 60 days following treatment (Table 24) but 65 to 104 days following treatment no significant difference was detected (Table 25 and 26).

Results in District 2 indicate that TCA or TCA plus polymer were more effective than at other locations. In an attempt to define a parameter that may indicate a reason for this occurrence the precipitation of each area was evaluated. Rainfall at all locations except District 2, 30 days prior to treatment exceeded 4 inches. In District 2, rainfall 30 days prior to treatment was 2.14 inches. Although rainfall following treatment until reported evaluation was approximately the same as other locations except in District 20, which was much greater, there was no period of rainfall reported that exceeded two day duration in District 2. In District 2, eighteen days following treatment 1.17 inches of rainfall occurred. At all other locations extended periods of rainfall occurred. For example, in District 17, there were 2 periods when rainfall occurred for 3 successive days; in District 5, there was 1 period of 3 successive days and 2 periods of 4 successive days of rainfall, and in District 20, there were at least 3 periods of 3 successive days and 2 periods of 4 successive days of rainfall.

Table 24. Relative effectiveness of TCA and TCA plus water-degradable polymer for control of unwanted vegetation 60 days following treatment in Districts 17, 8 and 5, State Department of Highways and Public Transportation.

Chemical	TCA (lbs/ft. mile)	Polymer (gal/ft. mile)	Relative Control[1/] Dist 17	Dist 8	Dist 5
TCA	24	0.0	1.5 b	1.4 b	1.7 b
TCA + Polymer	18	0.9	2.5 a	2.3 a	2.8 a
TCA + Polymer	12	0.6	1.6 b	1.4 b	1.5 b

1/ Means within each column follwed by the same letter are not significantly different at the 5% level of confidence

Table 25: Relative effectiveness of TCA and TCA plus water-degradable polymer for control of unwanted vegetation 65 days following treatment in State Department of Highways and Public Transportation District No. 2, Fort Worth, Texas.

	Rate		
	TCA	Polymer	
Chemical	(lbs/ft. mile)	(gal/ft. mile)	Relative Control 1/
TCA	24.0	0.0	2.6 a
TCA + Regular Polymer	18.0	0.36	3.0 a
TCA + Anionic Polymer	18.0	0.36	3.0 a
TCA + Regular Polymer	12.0	0.24	2.5 a
TCA + Anionic Polymer	12.0	0.24	2.7 a

1/ Means within each column followed by the same letter are not signifficantly different at the 5% level of confidence

Table 26: Relative effectiveness of TCA and TCA plus water-degradable polymer for control of unwanted vegetation 104 days following treatment in State Department of Highways and Public Transportation District No. 20, Beaumont, Texas

Chemical	Rate: TCA (lbs/ft. mile)	Rate: Polymer (gal/ft. mile)	Relative Control1/
TCA	24.0	0.0	1.3 a
TCA + Regular Polymer	18.0	0.36	1.5 a
TCA + Anionic Polymer	18.0	0.36	1.4 a
TCA + Regular Polymer	12.0	0.24	1.3 a
TCA + Anionic Polymer	12.0	0.24	1.3 a

1/ Means within each column followed by the same letter are not significant at the 5% level of confidence

The rainfall prior to treatment or the number of days of rainfall following treatment may determine the effectiveness and duration of control of unwanted vegetation when using TCA.

In District 4 during 1976, TCA plus water-degradable polymer, TCA, and velpar were evaluated. At this location the rate of polymer, was increased, but the results followed those of previous years (Table 27). Bermudagrass, johnsongrass and summer-cypress were the major species which avoided control of TCA and TCA plus polymer 74 days following treatment (Fig. 2a and 2b). Velpar treatments were significantly superior 74 days following treatment (Fig. 2c, 2d and Table 27).

Total TCA effectiveness was greatest at the 60-day evaluation and decreased in effectiveness thereafter. Prostrate spurge, summer-cypress, frog fruit, and yellow nut-grass, showed little evidence of TCA damage. Common bermudagrass, KR bluestem, silverleaf nightshade, western ragweed, upright prairie coneflower, dallis grass and johnsongrass (See Appendix III) were affected for a period of up to 60 days. Regrowth was evident in these species as well as in other perennials. Annual species were generally effectively controlled for at least 90 days. Annual species evaluated were carelessweed, goosefoot, stinkgrass, mares' tail, bitterweed, sunflower, pepperweed, wooly plaintain, prairie bishop, prairie rosegentain, rescuegrass, little

Figure 2. Effect of TCA (24 lb/ft mile) and velpar (0.5 lb/ft. mile) on vegetation 74 days following treatment in District 4, State Department of Highways and Public Transportation. (2a-TCA(24 lb/ft mile and 2c-velpar (0.5 lb/ft. mile) plots at time of treatment; 2b-TCA and 2d-velpar plots; 74 days following treatment).

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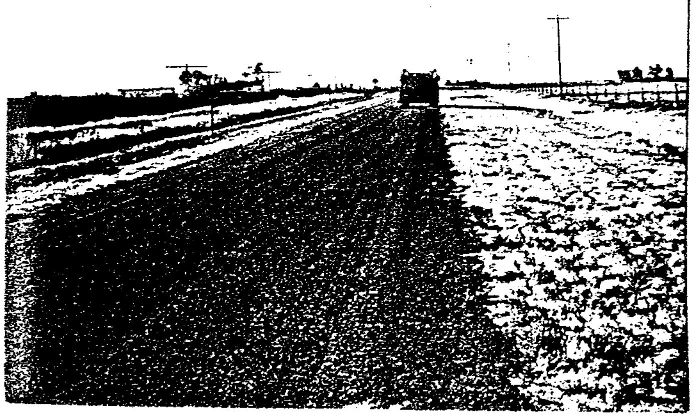
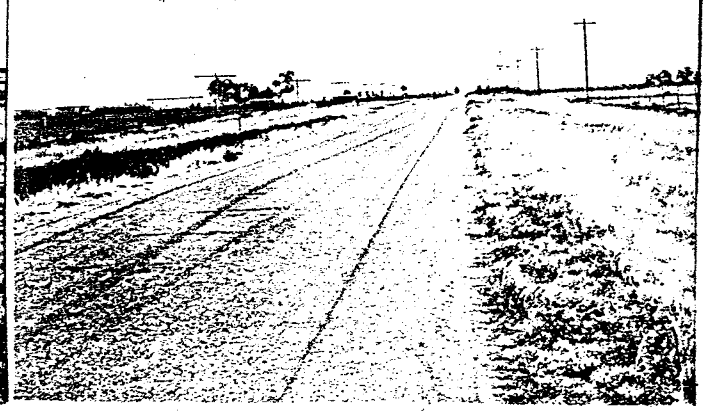
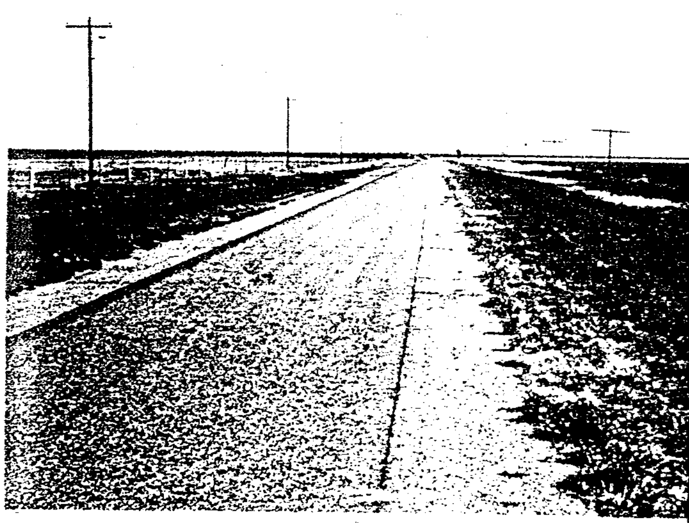


2a



2b



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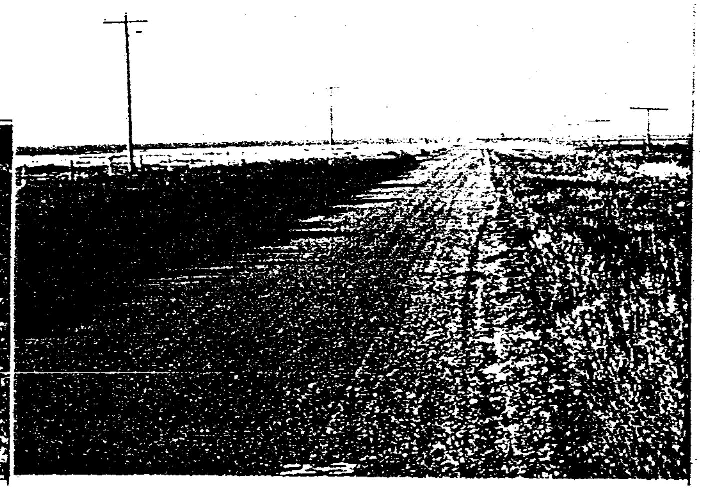

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Table 27: Relative effectiveness of TCA, TCA plus water-degradable polymer and Velpar for general control of unwanted vegetation 74 days following treatment in State Department of Highways and Public Transportation District No. 4, Amarillo, Texas.

Chemical	Rate: TCA (lbs/ft. mile)	Rate: Polymer (gal/ft. mile)	Relative Control Rating[1/]
TCA	24.0	0.0	1.3 b
TCA + Polymer	18.0	0.9	2.0 b
TCA + Polymer	12.0	0.6	1.3 b
Velpar	0.5	0.0	4.0 a

1/ Means within each column followed by the same letter are not significantly different at the 5% confidence level

barley, plains coreopsis, and toadflax (See Appendix III).

Herbicide screening: Evaluations were made in the spring of 1975, nine months following the July application. Evaluations criteria was the percentage reduction in plants by species. Reinfestations were considered as no control. Criteria for evaluation is shown in footnote 1, Table 28.

All herbicides proved to be effective in temporarily controlling unwanted vegetation however duration of control varied. Velpar and bromacil plus diuron controlled vegetation for a longer period of time than other chemicals. Glyphosate provided short duration control. Glyphosate provided good control initially, but plots were reinfested with plants when conditions were favorable for seed germination.

Plots treated in the late spring followed by a fall treatment produced better overall control for all chemicals and rates. Velpar at 4 lbs/A has controlled vegetation more effectively than other treatments. All herbicide were ineffective in the control of johnsongrass resulting in lower evaluation in Districts 2 and 17 (Table 28).

Vegetation in fall treated plots were most effectively controlled with velpar; however, bromacil plus diuron was effective. Although velpar was evaluated as most effective, it does not control alfalfa. At the time of evaluation this was the only species present in velpar plots in District 3. There was no johnsongrass present in any plots in District 3 at the time of application. In District 2 and

Table 28: Evaluations of herbicides for potential utilization along roadside for control of unwanted vegetation.

		Relative Control[1/]									
		Time and location of herbicide applications									
		July			July & October			October			September
		Texas Highway Districts									
Chemical[2/]	kg/h Rate	17	2	$\bar{x}$	17	2	$\bar{x}$	17	2	$\bar{x}$	3
Bromacil	3.4	4	6	5.0	5	6	5.5	4	3	3.5	7
Bromacil plus diuron	3.4	3	6	4.5	5	6	5.5	4	6	5.0	8
Bromacil plus diuron	6.8	4	6	5.0	5	6	5.5	4	6	5.0	9
Glyphosate	2.25	1	1	1.0	1	1	1.0	1	1	1.0	1
Glyphosate	4.5	1	1	1.0	1	1	1.0	1	1	1.0	1
Tebuthiuron	3.4	3	3	3.0	4	6	5.0	4	4	4.0	3
Tebuthiuron	6.8	3	4	3.5	4	6	5.0	4	6	5.0	6
Velpar	2.25	4	6	5.0	5	6	5.5	5	6	5.5	9
Velpar	4.5	4	6	5.0	8	6	7.0	7	6	6.5	9

1/ 0-1 = 10% 1-2 = 20% 2-3 = 30% 3-4 = 40%
4-5 = 50% 5-6 = 60% 6-7 = 70% 7-8 = 80%
8-9 = 90%

2/ See Appendix II for accepted chemical name

17 johnsongrass resulted in poorer results as compared to District 3.

African rue: Experimental spray plots treated in 1974 were reported (Allen, McCully, and Dean, 1976). These plots were reevaluated in June of 1976, approximately 2 years following the initial applications. The percentage control of African rue has modified very little (Table 29) since the 1975 evaluation. The most effective herbicides are reported with the majority of the treatments showing a small percentage improvement in control 2 years following treatment. Fall treatments are generally the most effective.

During 1975, eight herbicides were applied at 3 rates and 3 dates as shown in Tables 10a, b and c (Appendix I). Tebuthiuron and Vel-5026 proved to be the most effective chemical for control of African rue when applied in May. Bromacil at 16 lbs/A treatment was not significantly different from tebuthiuron or Vel-5026 at 4 lbs/A rate (Table 30).

Tebuthiuron (8 lb/A) was the most effective herbicide with a July application, although it was not significantly different from tebuthiuron at the 2 or 4 lb/A rates. Vel-5026 at 4 or 8 lb/A rate was not significantly different from tebuthiuron at the 2 or 4 lb/A treatment as was bromacil (16 lb/A) and velpar (8 lb/A) (Table 30).

The September application is included in this report, but due to environmental conditions that followed the treatments its validity is questionable. Application of the herbicides was completed near 5 pm on

Table 29: Effect of time on the activity of 8 herbicides for control of African rue.

Herbicide[2/]	Rate	Percentage Control[1/]			
		Time of Application			
		7/25/74		10/2/74	
		Time of evaluation		Time of evaluation	
Treatment	(lb/A)	5/23/75	6/2/76	5/23/75	6/2/76
Amitrole	4.0	6.4	7.8	65.0	81.0
Bromacil	8.0	52.9	56.7	81.0	77.0
Bromacil + Diuron	3.0+3.0	51.3	38.3	41.2	60.3
Diuron	40.0	93.9	92.7	74.0	87.3
Glyphosate	3.0	15.6	20.1	92.5	97.3
RP23465	6.0	37.8	26.3	53.3	66.0
Tebuthiuron	4.0	84.1	95.7	90.3	97.3
Vel 5026	4.0	76.2	73.7	71.7	88.3

1/ Represents the means of 3 replications

2/ See Appendix II for accepted chemical name

Table 30: Control of African rue in District 6, State Department of Highways and Public Transportation at 3 treatment dates and rates. Each number represents 3 replications.

	Percentage Control of African Rue by Treatment Date 1/								
	May 15			July 16			September 11		
	Treatment Rate 2/								
Chemical 3/	Low	Med	High	Low	Med	High	Low	Med	High
Amitrole	25.0^{g}	33.0^{fg}	36.6^{f}	26.2^{m}	47.6^{k}	58.3^{ij}	26.6^{i}	---	60.4^{de}
Bromacil	51.2^{e}	63.3^{d}	85.0^{ab}	72.0^{efg}	80.4^{cd}	66.0^{ghi}	71.2^{bc}	65.7^{cd}	77.0^{ab}
Bromacil + Diuron	62.8^{d}	62.0^{d}	64.5^{d}	63.2^{hij}	71.5^{efgh}	85.3^{bcd}	51.7^{ef}	69.5^{bc}	66.0^{cd}
Diuron	65.8^{d}	---	---	70.8^{fgh}	---	---	40.3^{gh}	45.7^{fg}	---
Glyphosate	30.0^{fg}	32.0^{fg}	51.1^{d}	15.6^{n}	46.7^{k}	79.0^{de}	---	---	---
RP23465	49.1^{e}	55.0^{e}	76.8^{c}	64.1^{ghij}	77.5^{def}	91.5^{ab}	57.6^{cd}	53.9^{ef}	58.3^{cd}
Tebuthiuron	33.5^{fg}	86.5^{ab}	91.0^{a}	91.4^{ab}	92.8^{ab}	98.4^{a}	66.2^{cd}	71.9^{bc}	81.3^{a}
Velpar	---	---	---	35.6^{L}	71.9^{efg}	89.2^{b}	57.7^{cd}	71.2^{bc}	78.6^{ab}
Vel-5026	79.7^{bc}	78.3^{bc}	90.8^{a}	57.5^{j}	88.1^{bc}	89.2^{b}	58.0^{cd}	75.8^{ab}	---

1/ Means within each column followed by the same letter are not significantly different at the 5% level of confidence

2/ See table 10 for treatment rates

3/ See Appendix II for accepted chemical name

September 11, 1975, when it began to rain. At 8:00 a.m. the morning of September 12, 1975 the area had received 2.20 inches of rainfall. The data was statistically analyzed with the glyphosate treatments excluded (Table 30). Glyphosate is a foliar applied herbicide that is water soluble and rainfall would remove it from the foliage thereby preventing absorption. The treatment proved to be a failure under these conditions. The other herbicides are soil applied and are effective with root uptake. The quantity of precipitation resulted in run-off from the treated areas thereby resulting in movement and dilution of the herbicides. The rates applied with respect to the target area are therefore erronous (Table 30).

Experimental data collected from 1974 and 1975 treatments indicate the glyphosate (Fig. 3a), tebuthiuron (Fig. 3b) and Vel-5026 (Fig. 3c) are the most effective chemicals to control this species.

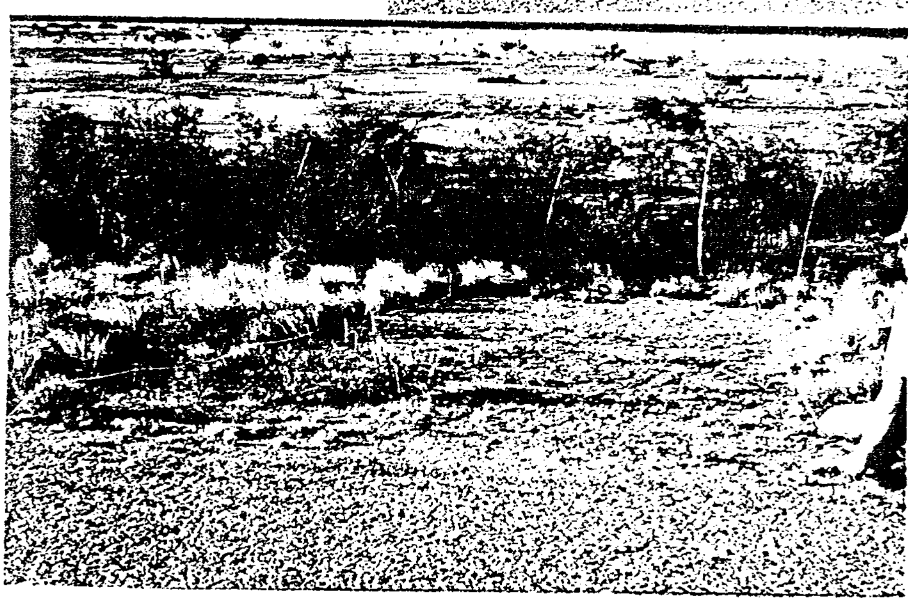
Velpar - TCA Treatments: Small plot treatments for screening herbicides during 1974-75 indicated velpar may be a herbicide that could be utilized by the State Department of Highways and Public Transportation for the control of undesirable vegetation. Experimental locations were established in Districts 17, 21, 8, 5 and 19 to evaluate the effectiveness and safety of velpar and combinations of velpar with TCA. In District 4, an experimental location was established to evaluate 5 rates of velpar ranging from 0.5 to 2.0 lbs/ft. mile (4 to 16 lbs/A). In District 12 an experimental location was established to

Figure 3. Effect of glyphosate, tebuthiuron and Vel-5026 on African rue approximately 20 months following treatment in District 6, State Department of Highways and Public Transportation. (3a-glyphosate, 3b-tebuthiuron, and 3c-Vel-5026).

metal plate

3a

3b



3c

valuate the volume of diluent and its effect on control.

Herbicidal damage was assessed by visual estimation for each species. A ranking system of 1 to 5 was employed. Criteria related for each rank were described previously in discussion of the water-degradable polymer.

In District 17, the chemicals were applied in December 1975. Bermudagrass was the most troublesome plant species with respect to density and frequency. Velpar functioned as well as expected with a winter-time application. The density of bermudagrass was so great that a repeat application will be necessary to provide acceptable control of this perennial species. Statistically velpar at a rate of 0.75 lbs/ft. mile was not significantly different from velpar at 0.5 lbs/ft mile or velpar plus TCA when the rate of velpar was 0.375 lb/ft mile (Table 31) 200 days following treatment.

No excessive movement was evident of any treatment during the course of this study. There were no desirable species near the target areas and no damage was evident beyond the treatment site.

In District 21 the major problem species was buffelgrass. Silverleaf nightshade and western ragweed was present in all test plots. Bermudagrass was present but not a major problem species at this location. Velpar at 0.5 and 0.75 lbs/ft. mile were significantly more effective than TCA or combinations (Figs. 4a-4f and Table 32), 154 days following treatment. Johnsongrass was present in most experi-

Figure 4. Effect of TCA (24 lb/ft mile) and velpar (0.5 and 0.75 lb/ft mile) on vegetation in District 21, State Department of Highways and Public Transportation. (4a-TCA, 4c-velpar (0.5 lb), and 4d-velpar (0.75 lb) plots at treatment time; 4b-TCA, 4d-velpar (0.5 lb) and 4f-velpar (0.75 lb) plots; 154 days following treatment).

4a

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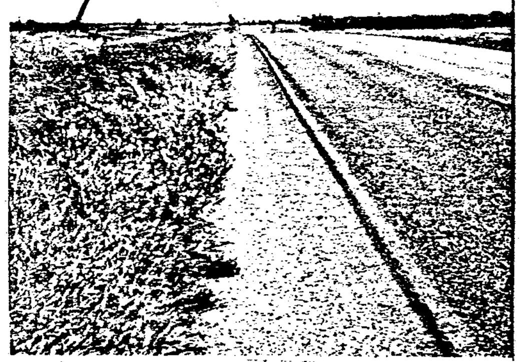

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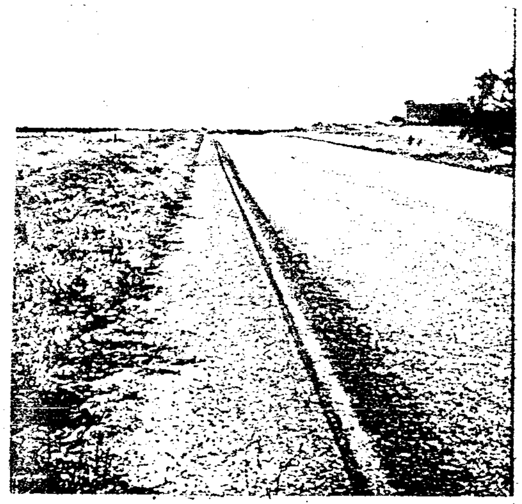

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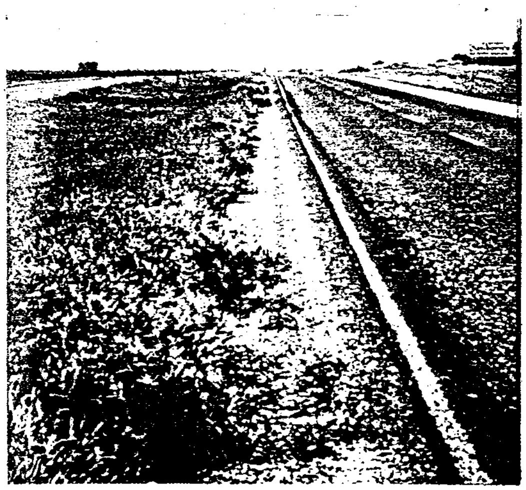

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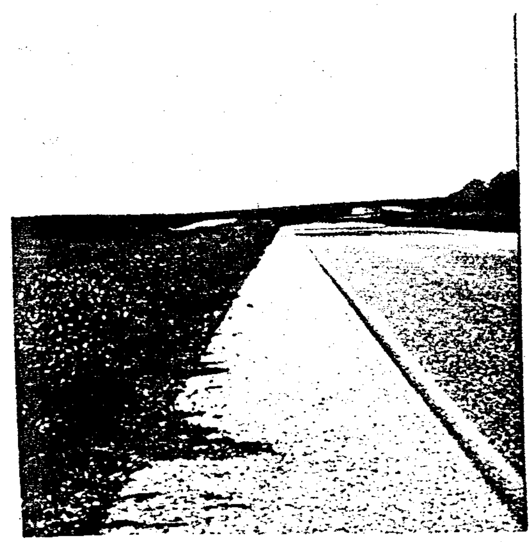


4f

Table 31: Relative effectiveness of TCA, TCA plus Velpar, and Velpar for general control of unwanted vegetation 200 days following treatment in State Department of Highways and Public Transportation District No. 17, Bryan, Texas.

	Rate (lbs/ft. mile)		
Chemical	TCA	Velpar	Relative Control[1/]
TCA	24.0	0.0	1.00 c
TCA + Velpar	18.0	0.375	2.33 a b
TCA + Velpar	18.0	0.25	1.67 b c
TCA + Velpar	12.0	0.375	2.17 a b
TCA + Velpar	12.0	0.25	1.67 b c
Velpar	0.0	0.50	2.67 a b
Velpar	0.0	0.75	3.00 a

1/ Means within each column followed by the same letter are not significantly different at the 5% level of confidence

Table 32: Relative effectiveness of Velpar, TCA, and combinations of Velpar and TCA for general control of roadside vegetation in State Department of Highways and Public Transportation, District No., 21, 154 days following treatment.

Chemical	Rate lbs/ft. mile	Rating[1/]
TCA	24.0	1.1 c
TCA + Velpar	18.00 + 0.25	2.0 b c
TCA + Velpar	18.00 + 0.375	2.7 b
TCA + Velpar	12.00 + 0.25	2.0 b c
TCA + Velpar	12.00 + 0.375	2.7 b
Velpar	0.5	4.4 a
Velpar	0.75	4.8 a

1/ Means within each column followed by the same letter are not significantly different at the 5% confidence level

mental plots. Velpar or TCA is ineffective in controlling this species at the rates applied. The presence of this species results in lower evaluations of the velpar and TCA treatments. Johnsongrass will show some herbicidal effects up to 30 days following treatment. Buffelgrass was effectively controlled for 154 days with velpar at 0.5 or 0.75 lbs/ft. mile. Seedlings which emerged following initial buffelgrass control were lethally affected up to 5 months after treatment.

There was little to no movement of any herbicide from the target area. All desirable vegetation near the experimental site was avoided to prevent damage. No evident damage occurred to any desirable vegetation.

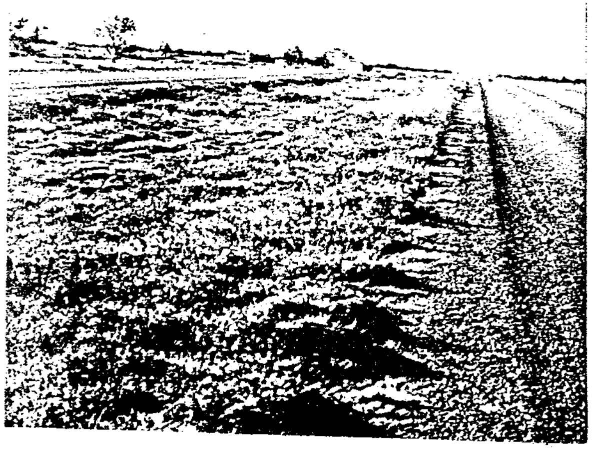
In Districts 5 and 8 velpar and velpar plus TCA was significantly more effective than TCA treatments (Table 33), 54 days following treatment. Effectiveness of these treatments did not reach expectations (Figs. 5a-5d). In District 8, more than one-half inch of precipitation occurred immediately following application and may have diluted the herbicide to some degree deeming it less effective. However, no great movement of the herbicide was detected in adjoining vegetation. The dilution factor may have negated herbicidal response outside the experimental plot. Control 54 days following treatment in District 5 was somewhat improved over that in District 8; however, it was not as effective as expected (Figs. 6a, 6b and 6c). Control with velpar improved 74 days following treatment (Fig. 6c).

Figure 5. Effectiveness of TCA (24 lb/ft mile) and velpar (0.5 lb/ft mile) for vegetation control in District 8, State Department of Highways and Public Transportation, 54 days following treatment. (5a-TCA and 5c-velpar plots at treatment time; 5b-TCA and 5d-velpar plots; 54 days following treatment.

metal plate

5a

5b



5c

5d

Figure 6. Effectiveness of velpar (0.5 lb/ft mile) 54 and 74 days following treatment in District 5, State Department of Highways and Public Transportation. (6a-at treatment time, 6b-54 days following treatment and 6c-74 days following treatment).

metal plate

6a

6b

6c

Table 33: Relative effectiveness of TCA, TCA plus Velpar, and Velpar for general control of unwanted vegetation 54 days following treatment in District 8 and 5, Abilene and Lubbock, Texas, State Department of Highways and Public Transportation.

	Rate (lbs/ft. mile)		Relative Control[1/]	
Chemical	TCA	Velpar	Lubbock	Abilene
TCA	24.0	0.0	2.0 b	2.1 c
TCA + Velpar	18.0	0.375	3.2 a	3.07 a b
TCA + Velpar	18.0	0.25	---	2.7 b
TCA + Velpar	12.0	0.375	3.3 a	3.1 a b
TCA + Velpar	12.0	0.25	2.2 b	2.3 c
Velpar	0.0	0.50	3.3 a	3.3 a
Velpar	0.0	0.75	4.0 a	3.4 a

1/ Means within each column followed by the same letter are not significantly different at the 5% level of confidence

In District 19, evaluation of control of unwanted vegetation 30 days following treatment resulted in no significant difference between treatments (Figs. 7a-7d and Table 34). These results indicate that for control of vegetation for 30 days, TCA is as effective as velpar. TCA is probably more effective at less than 30 days while velpar will provide a longer tenure of control.

In District 4, five rates of velpar were applied to define the most hazardous level of the herbicide and its effect on vegetation of the area. All desirable vegetation was avoided to prevent damage. Many perennial species were present including bindweed, blueweed, johnsongrass, bermudagrass, and western ragweed (See Appendix II). The most troublesome annual species present was summer-cypress. At 0.5 lbs/ft. mile rate, bindweed was not effectively controlled 72 days following treatment. A rate of 0.75 lbs/ft. mile or higher proved to be significantly more effective (Table 35). Apparent movement of the herbicide occurred, but upon closer inspection the apparent movement always occurred at sites where bindweed extended away from the treated area. Bindweed was affected as much as four feet from the treated area. This may have been physical movement by water or movement of the herbicide within the plant system. The effectiveness of velpar as a lethal herbicide for bindweed will be evaluated in the spring of 1977. Seventy-two days following treatment at the higher rates indicate a good control of this species (Figs. 8a-8f). Johnsongrass was more

Figure 7. Effectivess of TCA (24 lb/ft mile) and velpar (0.5 lb/ft mile) for controlling vegetation 30 days following treatment in District 5, State Department of Highways and Public Transportation. (7a-(TCA) and 7c-(velpar) plots at treatment time and 7b-(TCA) and 7d-(velpar) plots 30 days following treatment).

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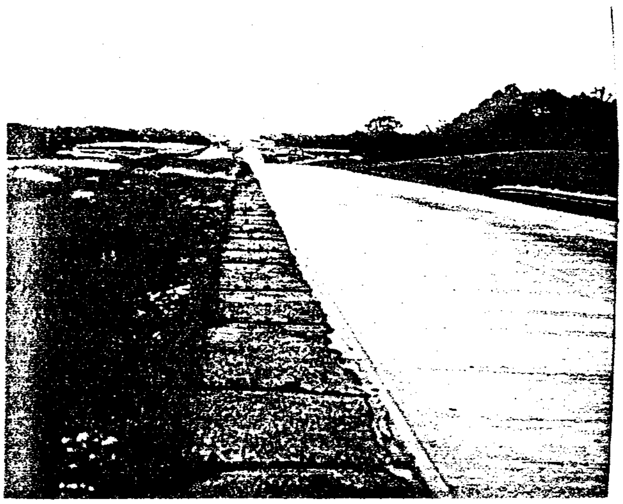
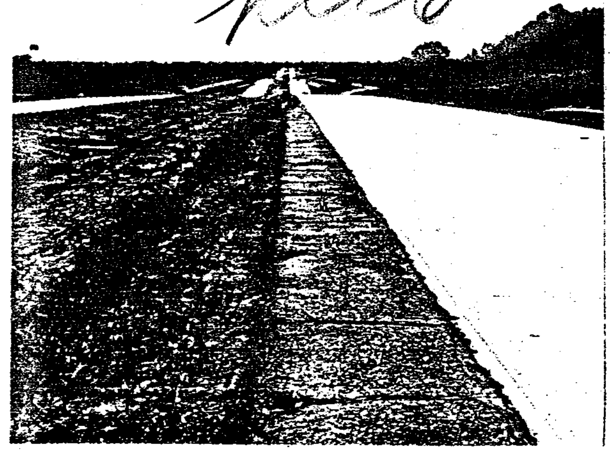


7a



7b

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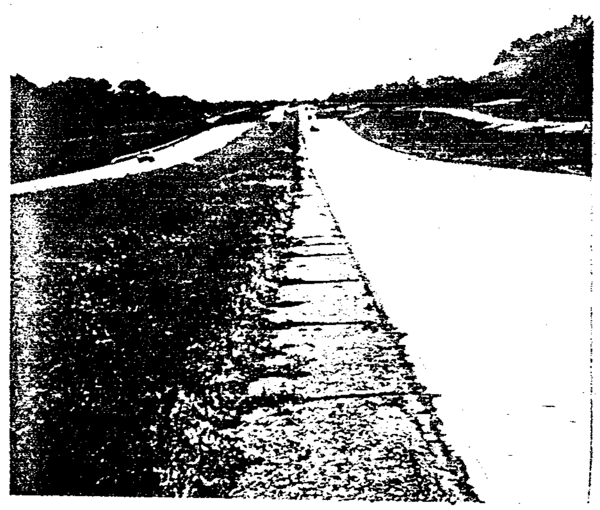
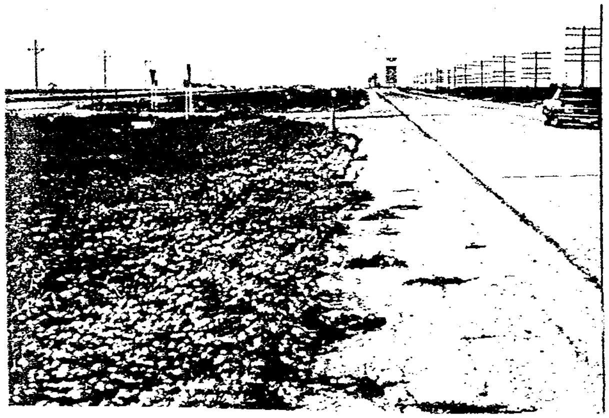
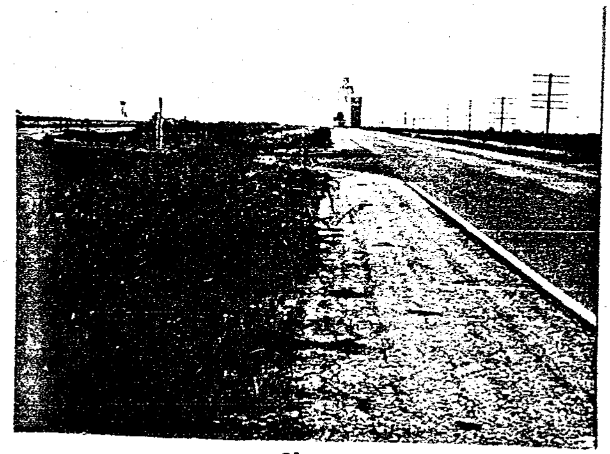


7d

Figure 8. Effectiveness of three rates of velpar on the control of bindweed growing in asphaltic shoulders in District 4, State Department o Highways and Public Transportation (8a-0.75 lb/ft. mile, 8c-1.0 lb/ft. mile, 8e-1.5 lb/ft. mile plots at treatment time and 8b-0.75 lb/ft. mile, 8d-1.0 lb/ft. mile, 8f-1.5 lb/ft. mile; 72 days following treatment).



8a



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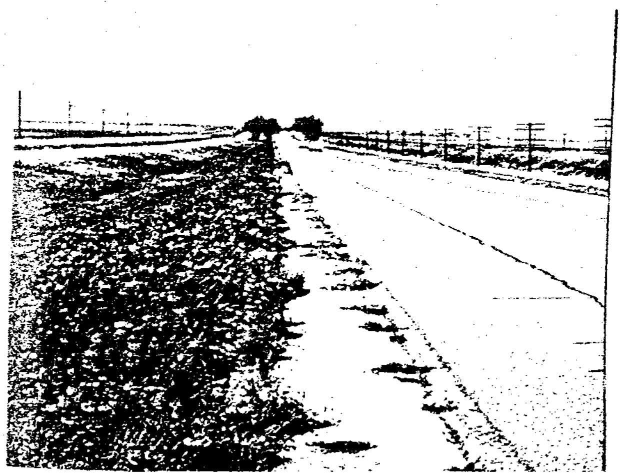

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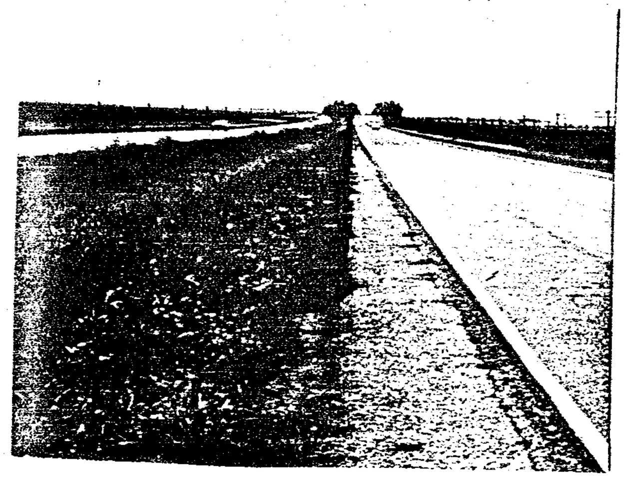

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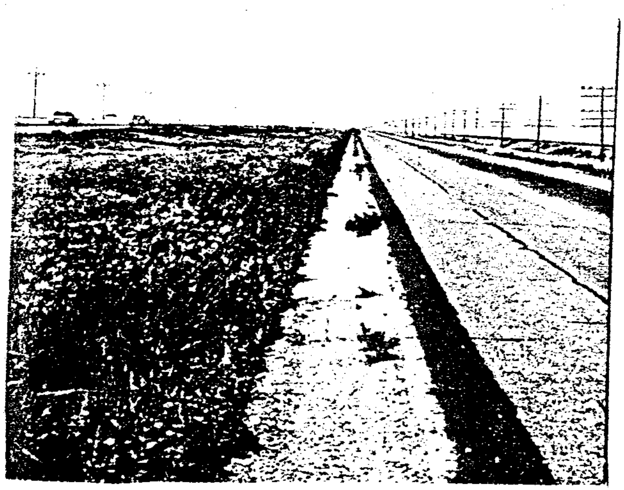

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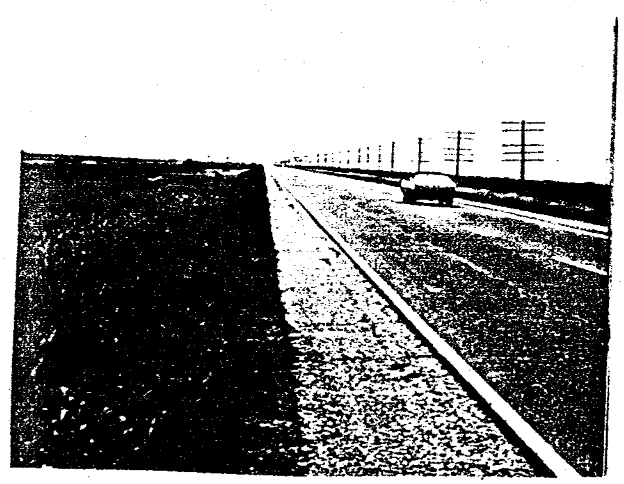

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Table 34: Relative effectiveness of TCA, TCA plus Velpar, and Velpar for general control of unwanted vegetation 30 days following treatment in State Department of Highways and Public Transportation District No. 19, Atlanta, Texas.

	Rate (lbs/ft. mile)		Relative Control[1/]
Chemical	TCA	Velpar	Rating
TCA	24.0	0.0	4.3 a
TCA + Velpar	18.0	0.375	3.7 a
TCA + Velpar	12.0	0.375	3.6 a
TCA + Velpar	12.0	0.25	3.3 a
Velpar	0.0	0.5	3.9 a
Velpar	0.0	0.75	4.1 a

1/ Means within each column followed by the same letter are not significantly different at the 5% level of confidence

Table 35: Relative effectiveness of various concentrations of Velpar for general control of unwanted vegetation 72 days following treatment in State Department of Highways and Public Transportation District No. 4, Amarillo, Texas.

Chemical	Rate (lbs/ft. mile)	Relative Control[1/] Rating
Velpar	0.5	3.5 b
Velpar	0.75	4.5 a
Velpar	1.0	4.8 a
Velpar	1.5	5.0 a
Velpar	2.0	4.8 a

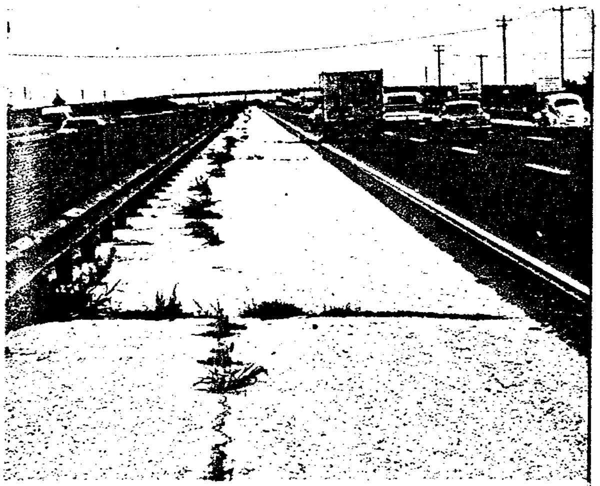
1/ Means within each column followed by the same letter are not significantly different at the 5% confidence level

severely affected at the higher rates, but evidently will not kill the plants (Fig. 8f).

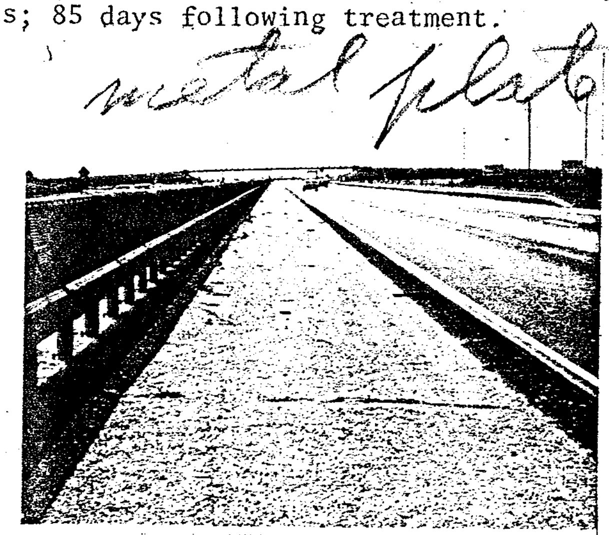
In District 12, two rates (0.50 and 0.75 lbs/ft. mile) of velpar were applied. The variable evaluated was the amount of diluent necessary for control (Figs. 9a-9f). In preparing a solution of the herbicide for application of 0.75 lb. of velpar/3 gal. of water/ft. mile, it was observed that all the herbicide did not go into the solution. The herbicide could not be applied at this rate/volume due to limitation of solubility. The solubility of velpar is less than 30,000 parts per million.

These trials were established on the mediam of Interstate 45, on asphaltic surface. Each side of the median was treated. The width of each side of the median is 12 feet. A ten foot section on each side was treated at the rates shown in Table 17. Treatment of the area was completed on July 15th and 1.1 inch of rainfall occurred on July 16th. The herbicide, velpar, moved off the asphaltic surface across the highway and affected vegetation near the paved surface. This chemical at the rates applied can be moved with the runoff water from asphaltic surfaces. The rates utilized (0.5 and 0.75 lbs/ft. mile) when applied on a 10 or 20 ft. wide asphaltic median is equivalent to applying 5 or 7.5 lbs. of chemical per mile on a 10 ft. width or 10 or 15 lbs. on a 20 ft. width. With no opportunity of the herbicide molecule to attach to the soil micelle or to percolate into the soil, would afford the possibility of movement of enough chemical to affect nearby vegetation.

Figure 9. Effect of carrier (water) qauntity/ft mile applied on the activity of the herbicide, velpar. (9a-velpar (p.5 lb/6 gal water/ft mile, 9c-velpar (0.75 lb/6 gal water/ft mile, 9e-velpar (0.75 lb/12 gal water/ft mile plots at treatment time and 9b-(0.5 lb/6 gal water), 9d-(0.75 lb/6 gal water), 9f-(0.75 lb/12 gal water) plots; 85 days following treatment.



9a



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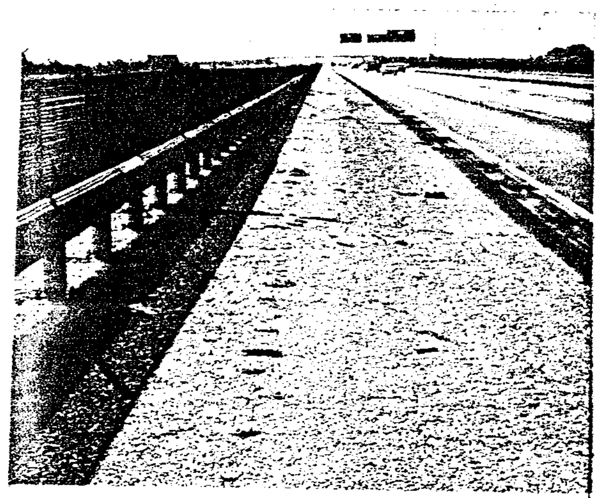
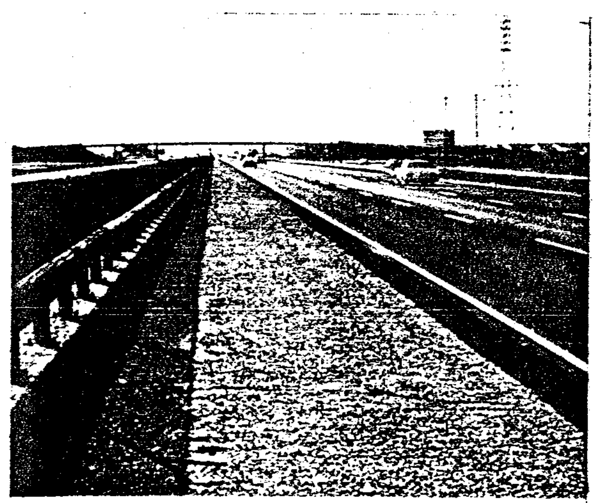


9d

9e



9f

Velpar is an effective chemical with a degree of safety as indicated by the experimental trials reported. However, precautions were taken to prevent damage to desirable vegetation. Should this material be applied around or near desirable vegetation damage should be expected. Careless and indiscriminate applications should be avoided.

In regard to its character of movement as defined in this report, excessive quantities should not be applied on asphaltic surfaces, especially just prior to rainfall. Discriminate use in cracks and on vegetation in asphaltic surfaces are very effective, except on johnsongrass, alfalfa, and bindweed at a 0.5 lb/ft. mile rate.

With only one year's data as a basis the effect of multiple applications cannot be determined. There is a possibility that there can be a buildup in the soil with more applications resulting in movement from the target area. Should this occur the degree of safety indicated would be much less and the material be deemed too hazardous for general use on highway sites.

Velpar has been demonstrated to control the growth of many species of plants for as long as 200 days (approximately 6½ months). This material under the direction of a competent applicator can result in the saving of millions of dollars per year. Indiscriminate use of this material can be just as costly to the Department. An understanding and appreciation for this type of herbicide must be possessed by the applicator. The applicator should be able to calibrate a sprayer and have the ability to prepare the correct concentration of material before application.

Prepavement treatments: During 1976 two locations were selected for experimentation. These applications were made in June of 1976. No results can be reported until 1977, and then will only be preliminary as duration of control will be of greatest importance.

Johnsongrass: Preliminary evaluations from the small plots indicate glyphosate to be the most effective herbicide applied, but only with an October application. Each of the three replication treated in October reduced johnsongrass approximately 80 percent, 8 months following treatment. Asulam reduced johnsongrass approximately 50 percent in two of the three replications treated in October. No other treatment at all dates reduced johnsongrass 8 months following treatment.

Brush control: Brush control plots were established in District 21 in April 1976. Evaluation of these applications must wait until 1977 or longer to determine the percentage root kill of each species. Woody plants have the ability to initiate new growth from latent buds years after apparent death. Chemicals, treatment rates, and species are shown in Table 20.

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APPENDIX I

Figure 10. Location of revegetation study (mulching) plots in State Department of Highways and Public Transportation, District No. 10, Tyler, Texas.

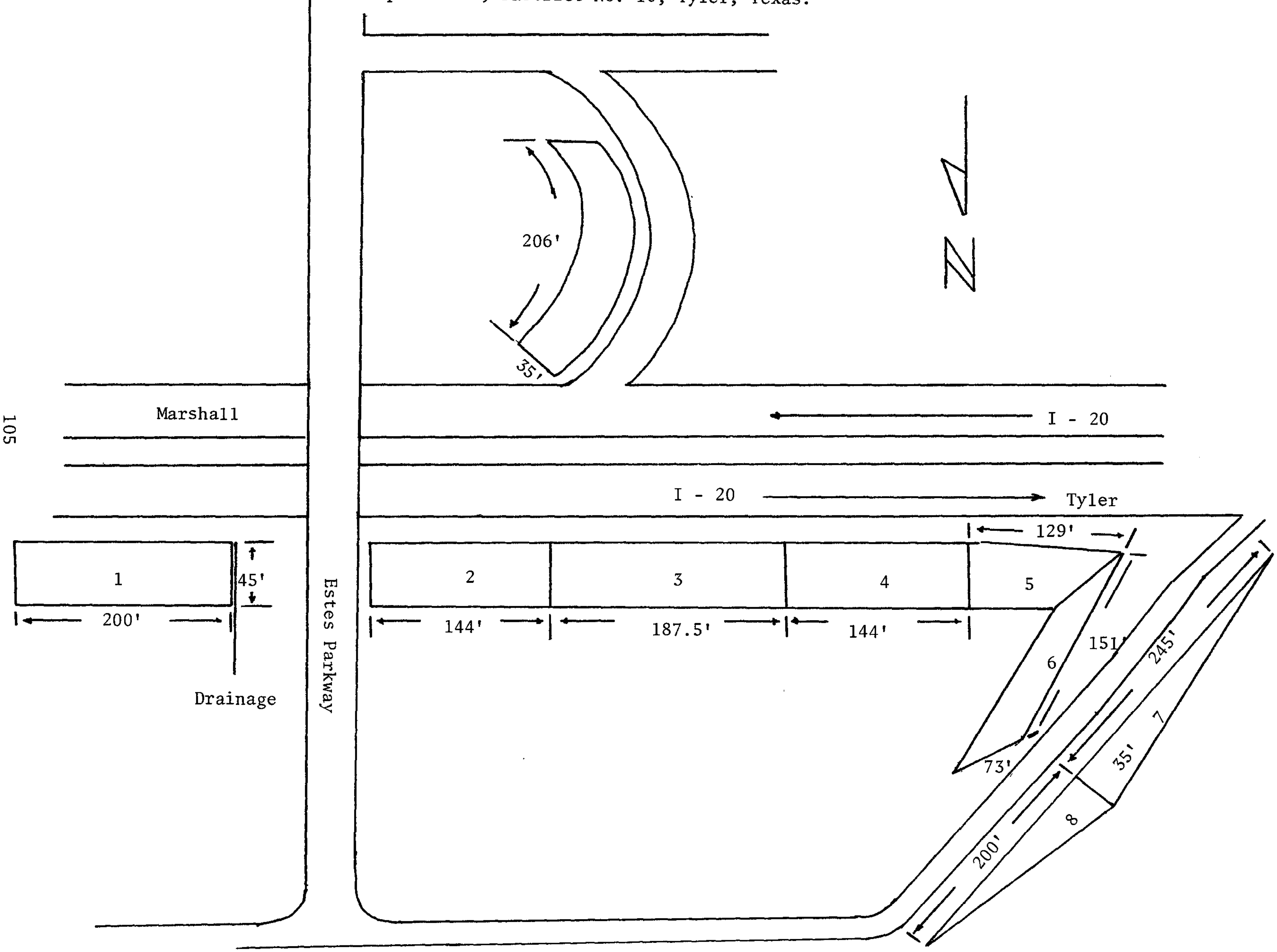


Figure 11. Location of revegetation study (mulch binder) plots in State Department of Highways and Public Transportation, District No. 10, Tyler, Texas.

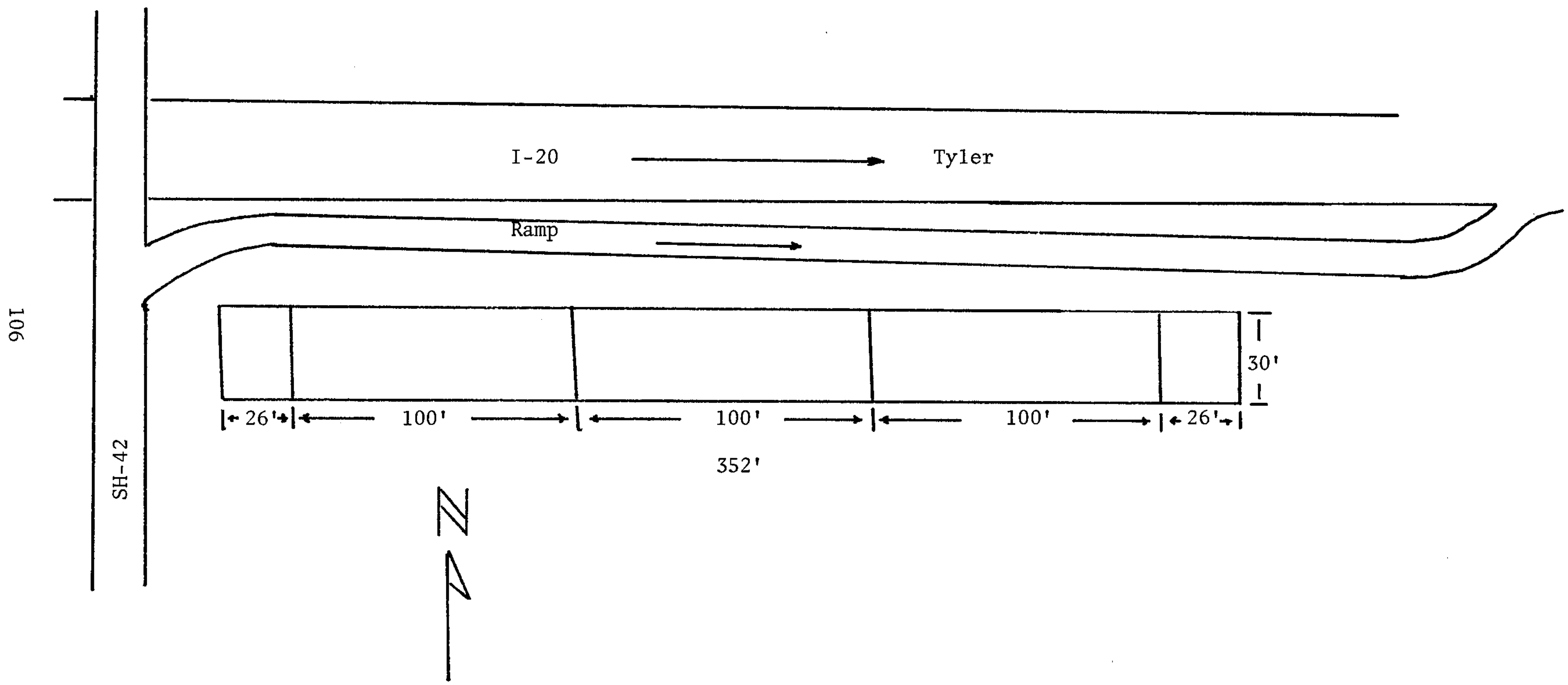


Figure 12. Location of revegetation study (mulch binders) plots in State Department of Highways and Public Transportation, District No. 10, Tyler, Texas.

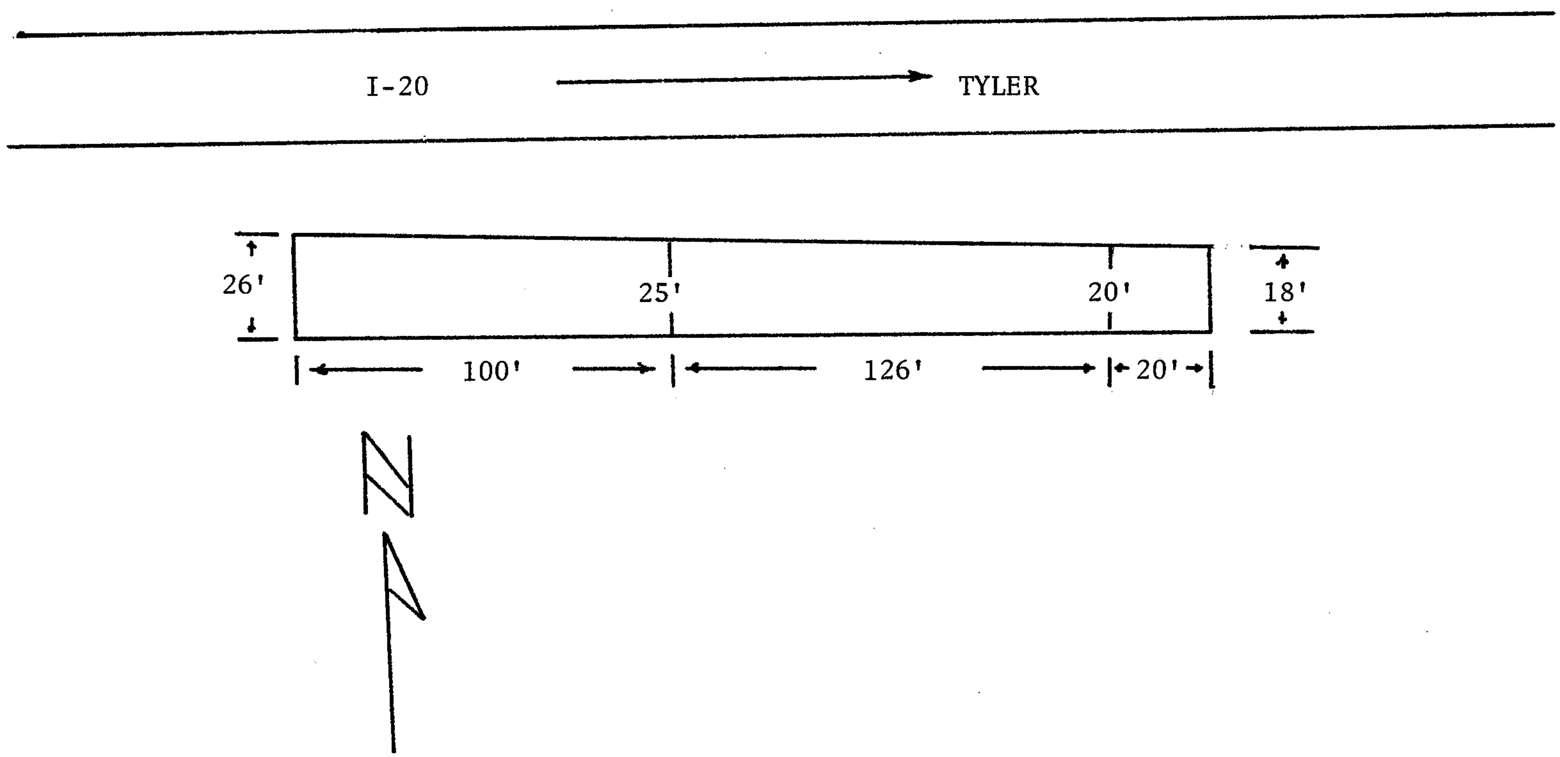


Figure 13. Location of revegetation study (mulch binders) plots in State Department of Highways and Public Transportation, District No. 10, Tyler, Texas.

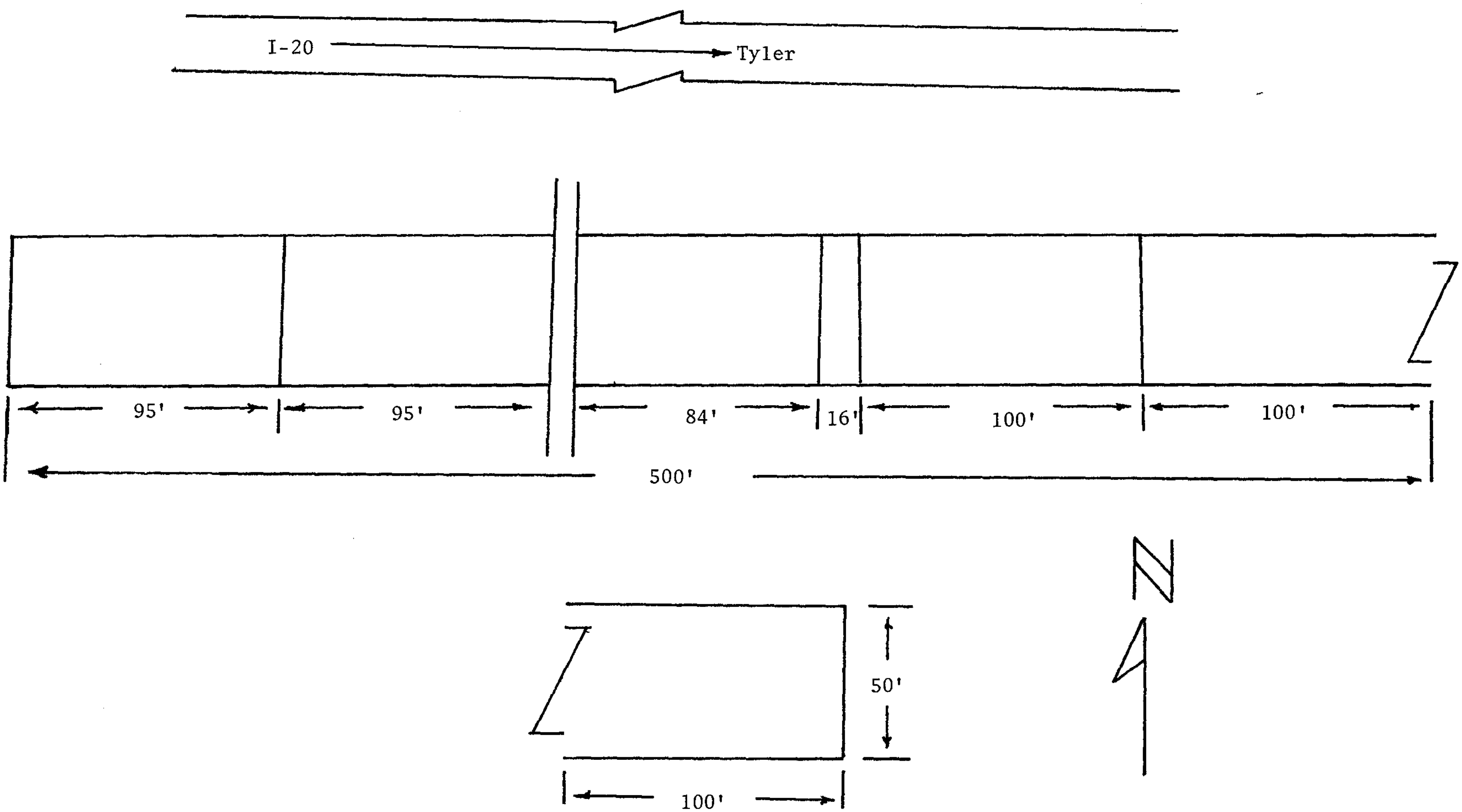


Figure 14A. Location of revegetation (ramps on FM - 2015 x I - 20) plots State Department of Highways and Public Transportation District No. 10, Tyler, Texas.

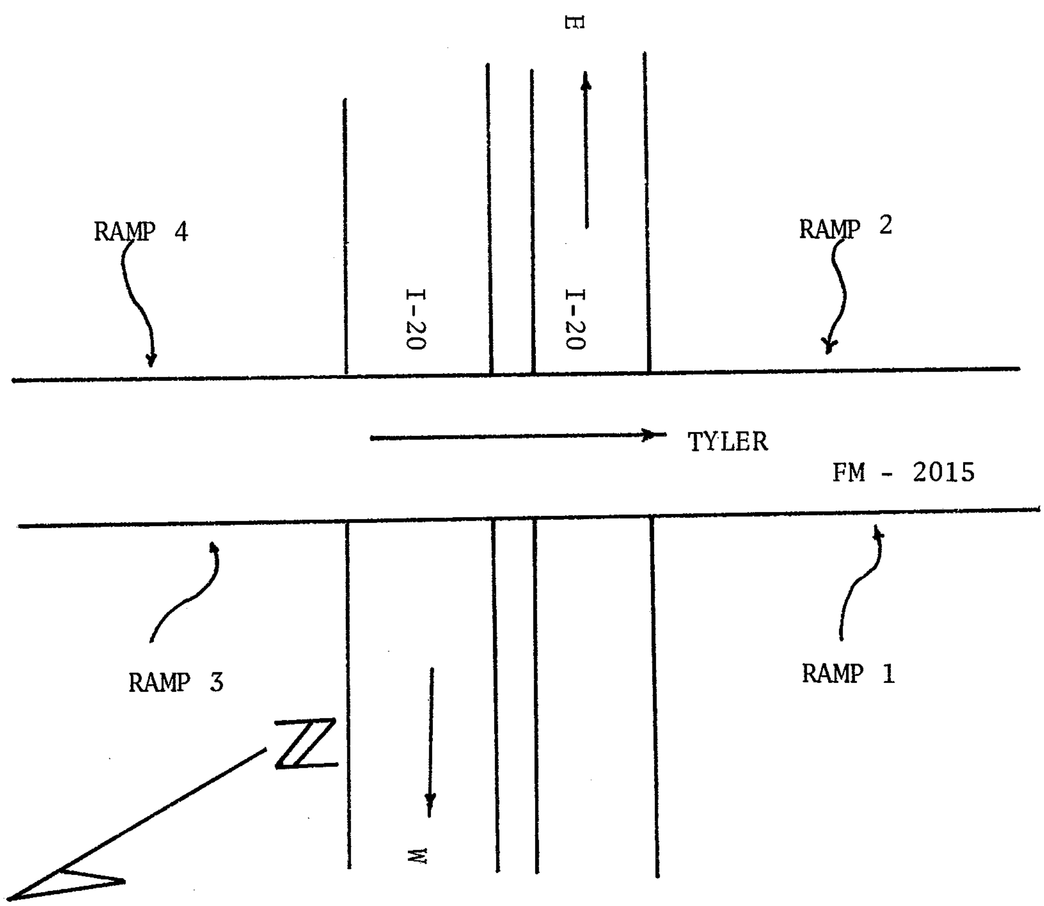
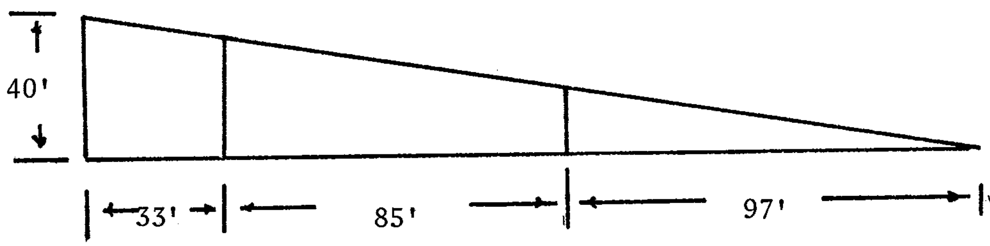


Figure 14B. Location of revegetation (ramps on FM - 2015 x I - 20) plots in State Department of Highways and Public Transportation, District No. 10, Tyler, Texas.



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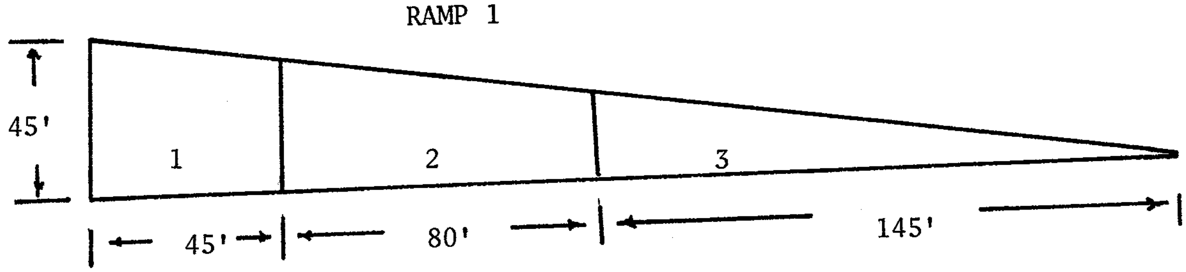

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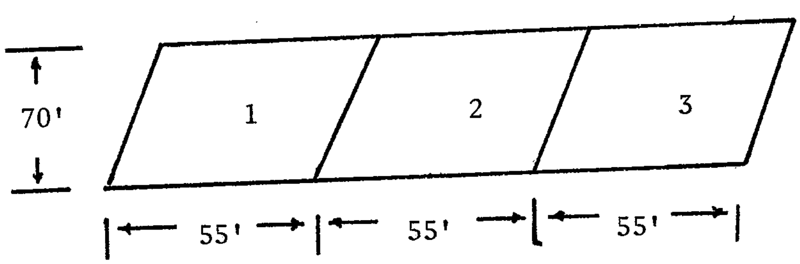

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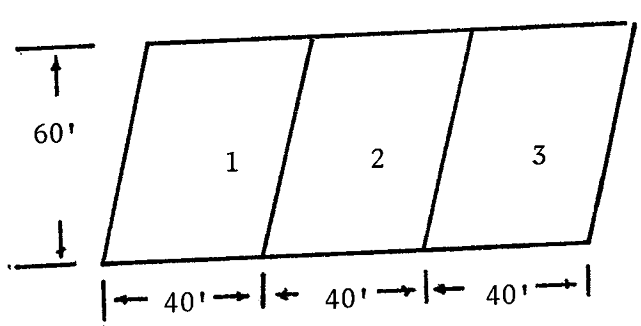


RAMP 4

Figure 15. Location of revegetation study (acid slope) in State Department of Highways and Public Transportation, District No. 10, Tyler, Texas.

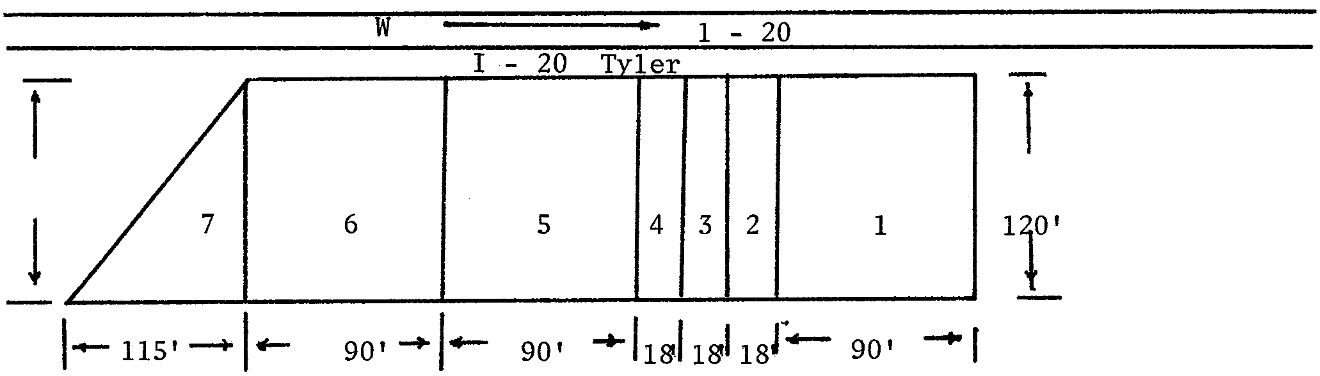


Figure 16. Location of revegetation study (acid slope) in State Department of Highways and Public Transportation, District No. 10, Tyler, Texas.

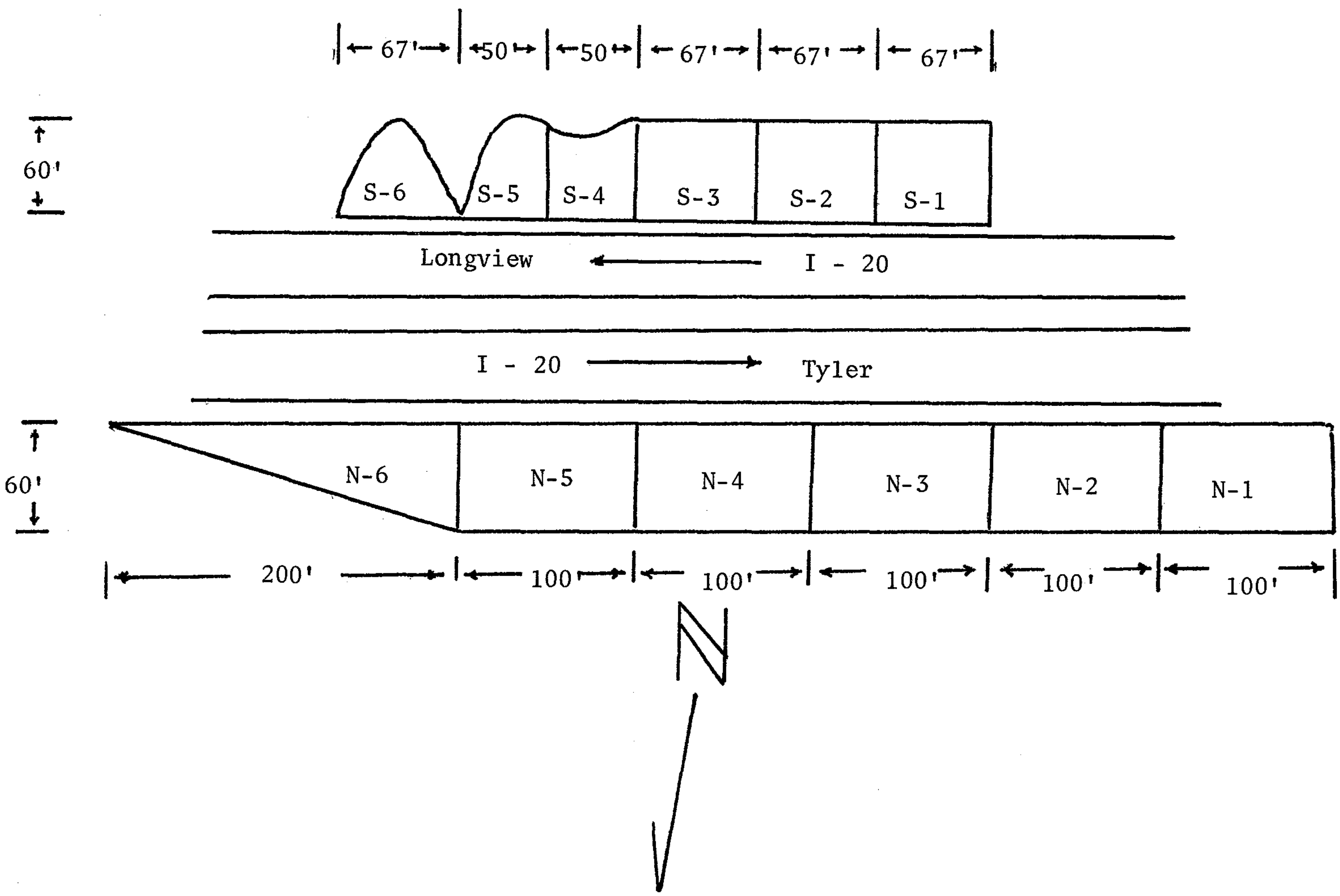


Figure 17A. Location of revegetation study (acidic soils) in State Department of Highways and Public Transportation, District No. 10, Tyler, Texas.

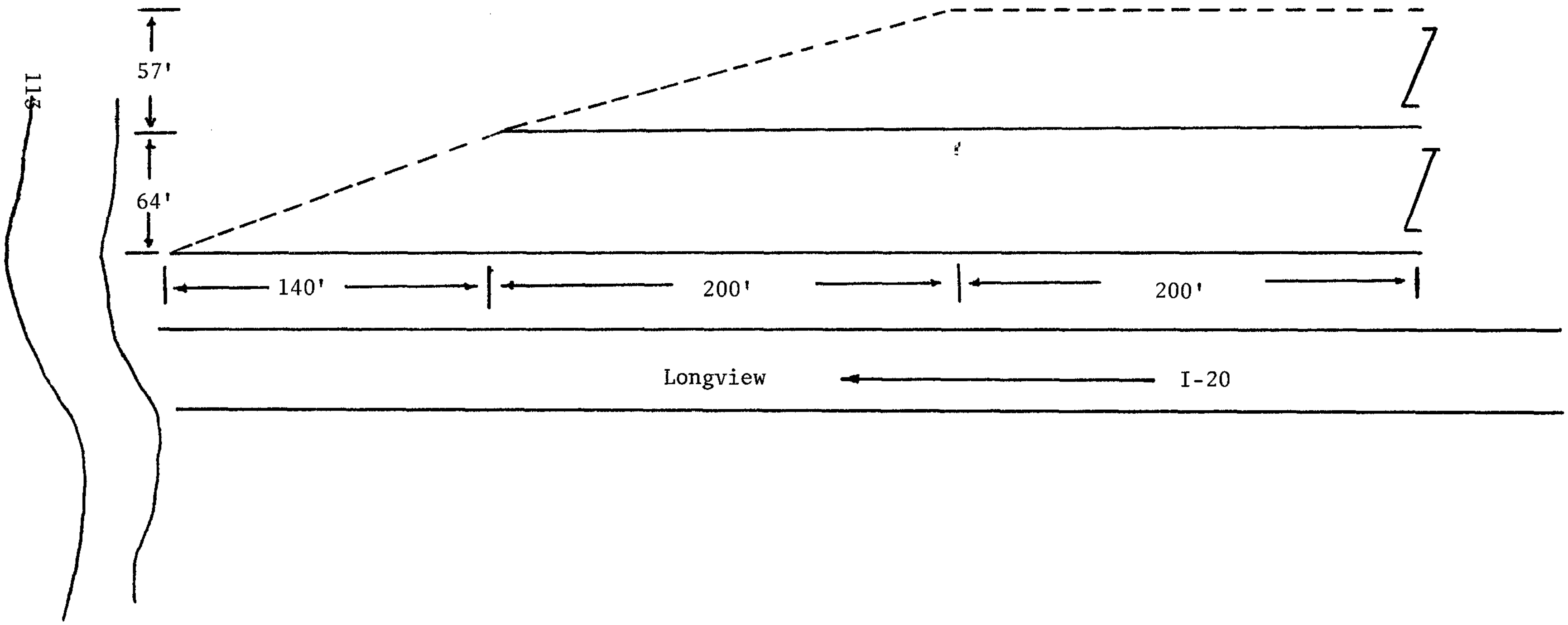


Figure 17B. Location of revegetation study (acidic soils) in State Department of Highways and Public Transportation, District No. 10, Tyler, Texas.

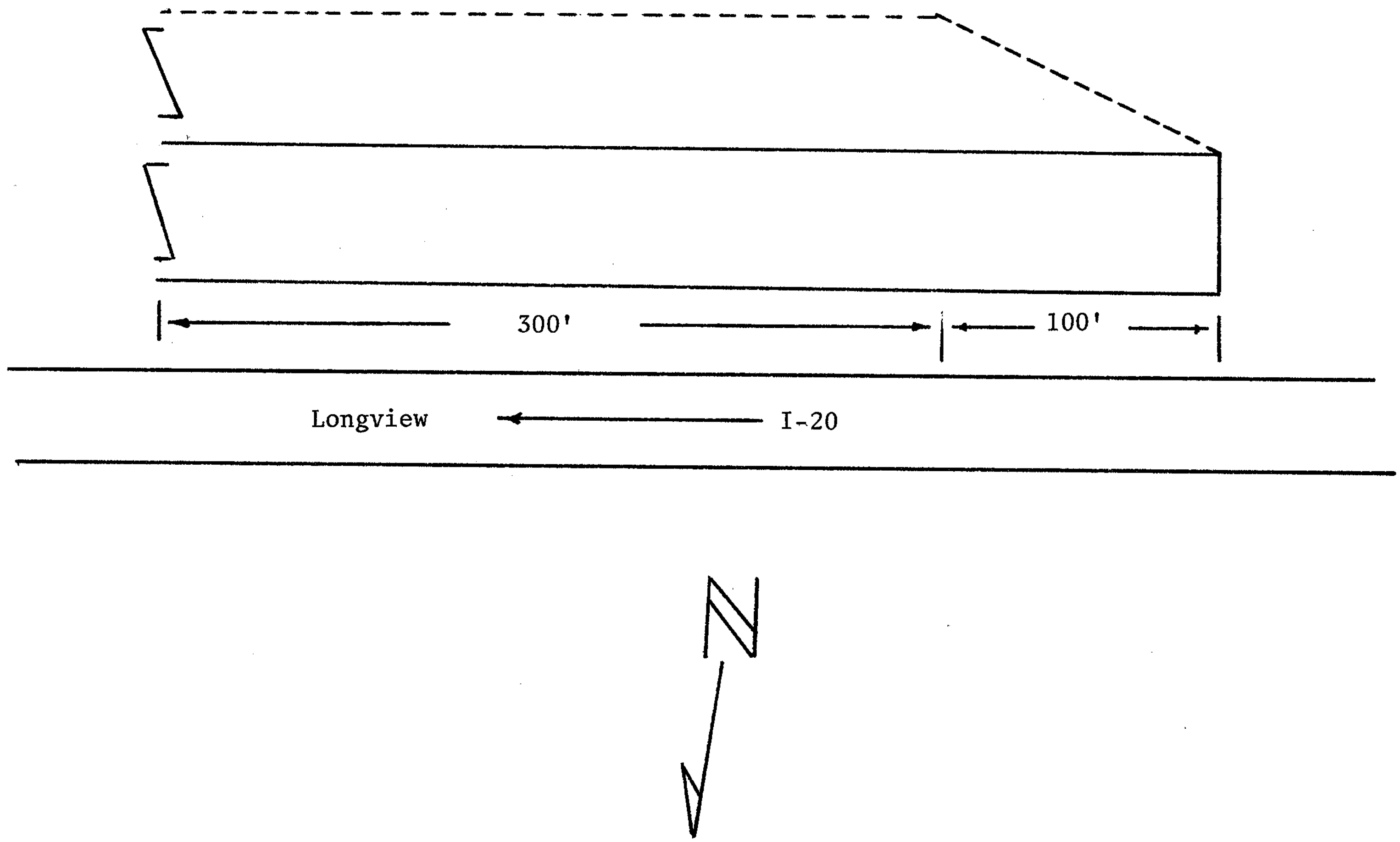


Figure 18. Location of TCA experimental spray plots in State Department of Highways and Public Transportation, District No. 2, Fort Worth, Texas.

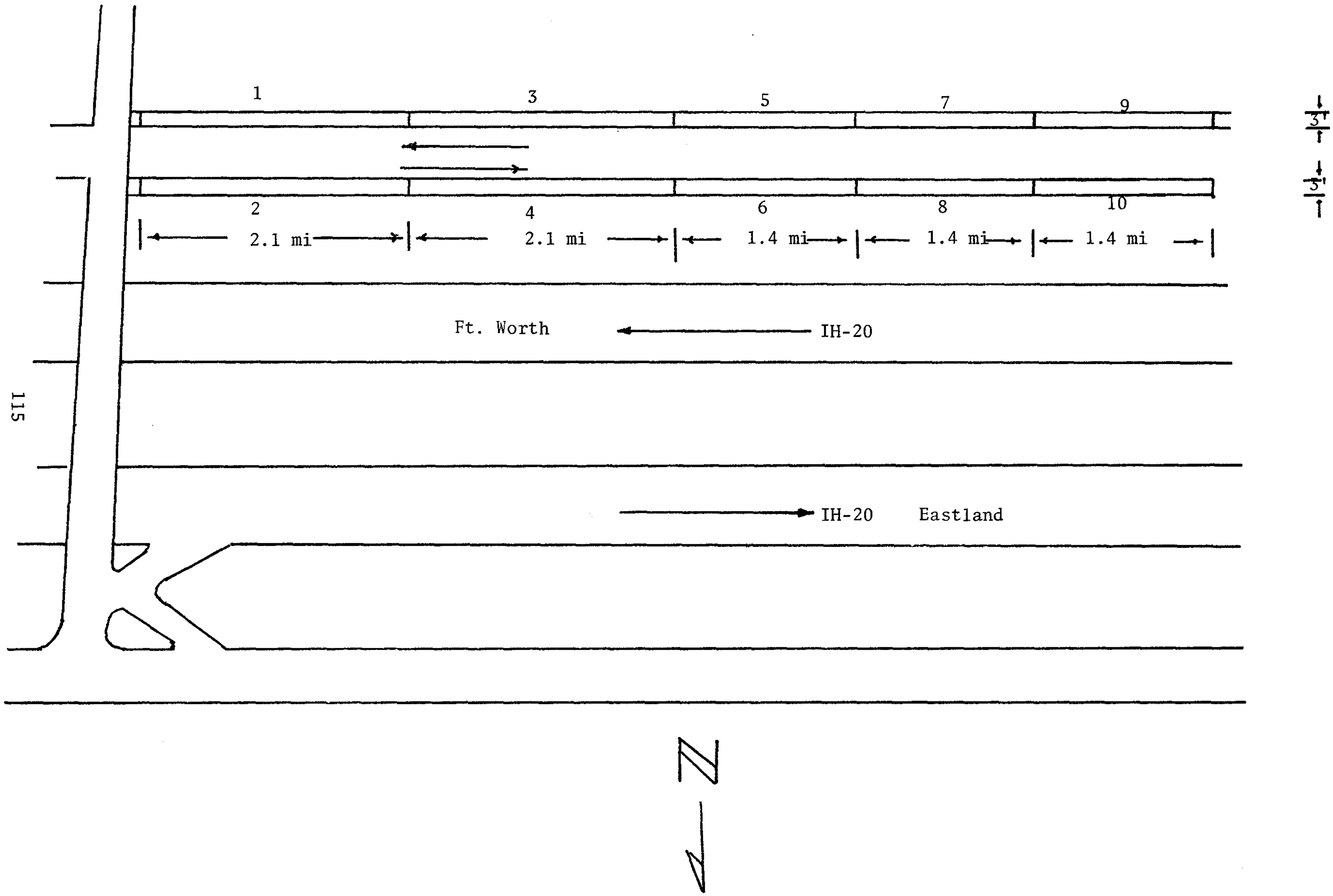


Figure 19. Location of TCA experimental spray plots in State Department of Highways and Public Transportation, District No. 17, Bryan, Texas.

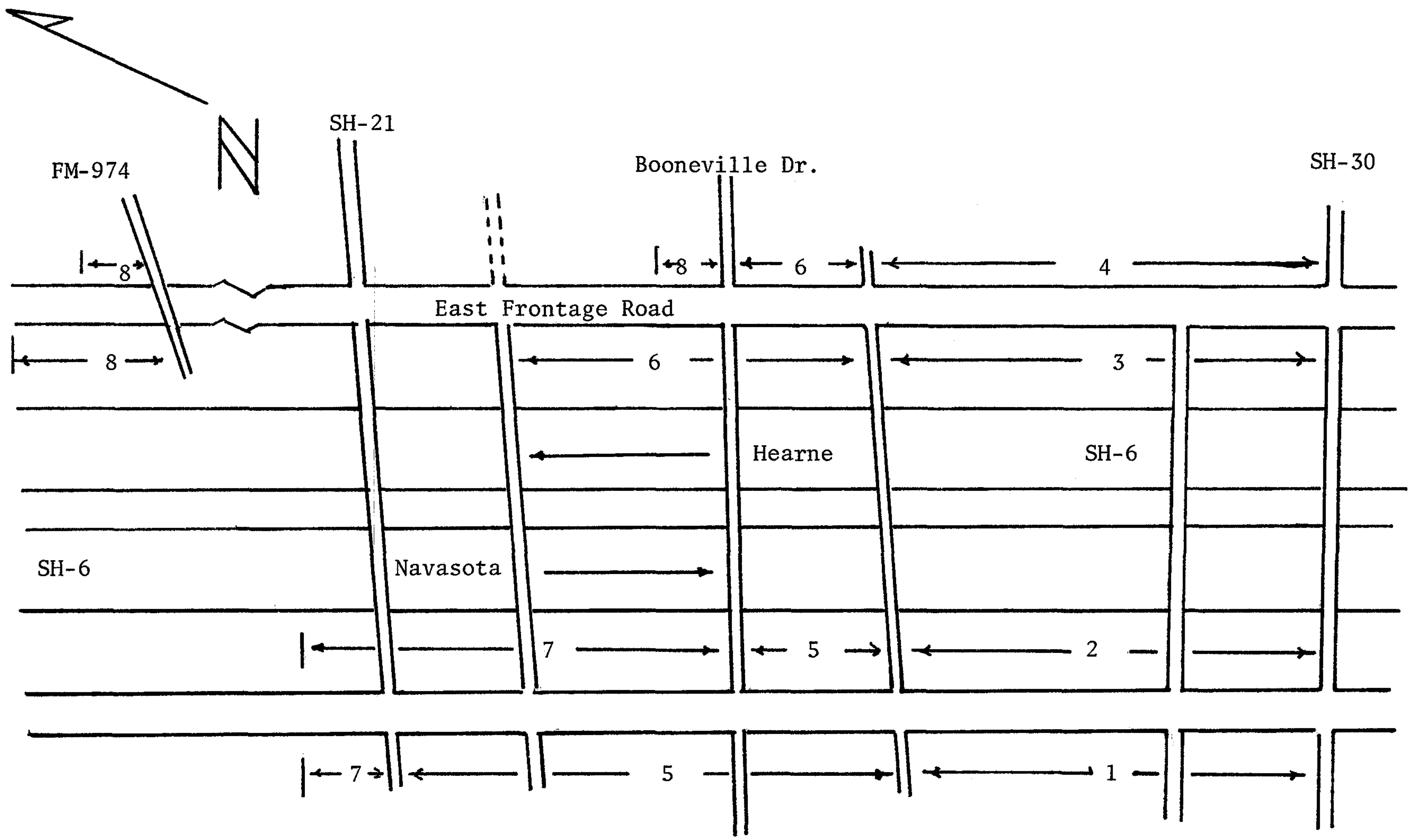


Figure 20. Location of TCA experimental spray plots in State Department of Highways and Public Transportation, District No. 5, Lubbock, Texas.

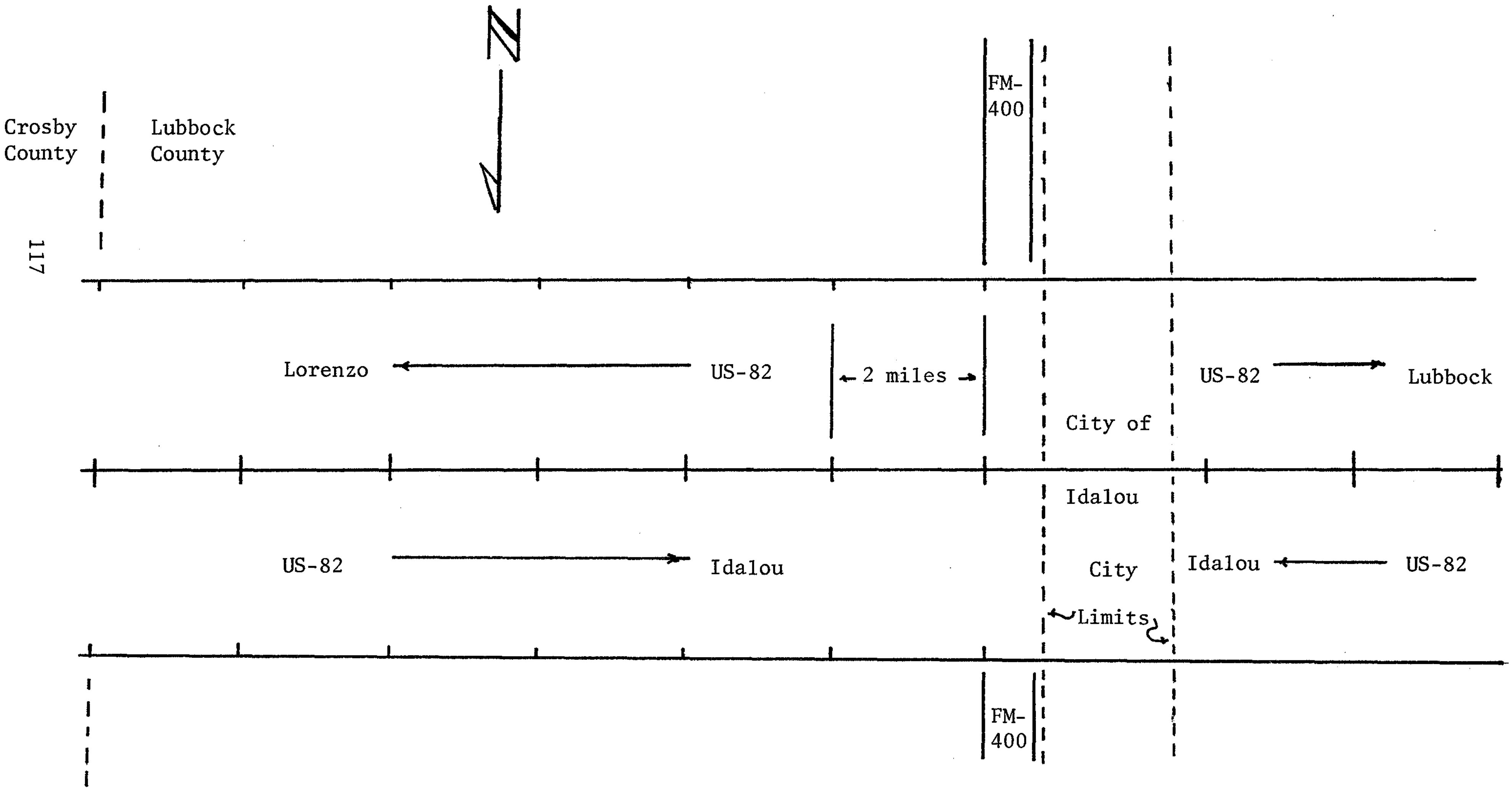


Figure 21. Location of TCA experimental spray plots in State Department of Highways and Public Transportation, District No. 8, Abilene, Texas.

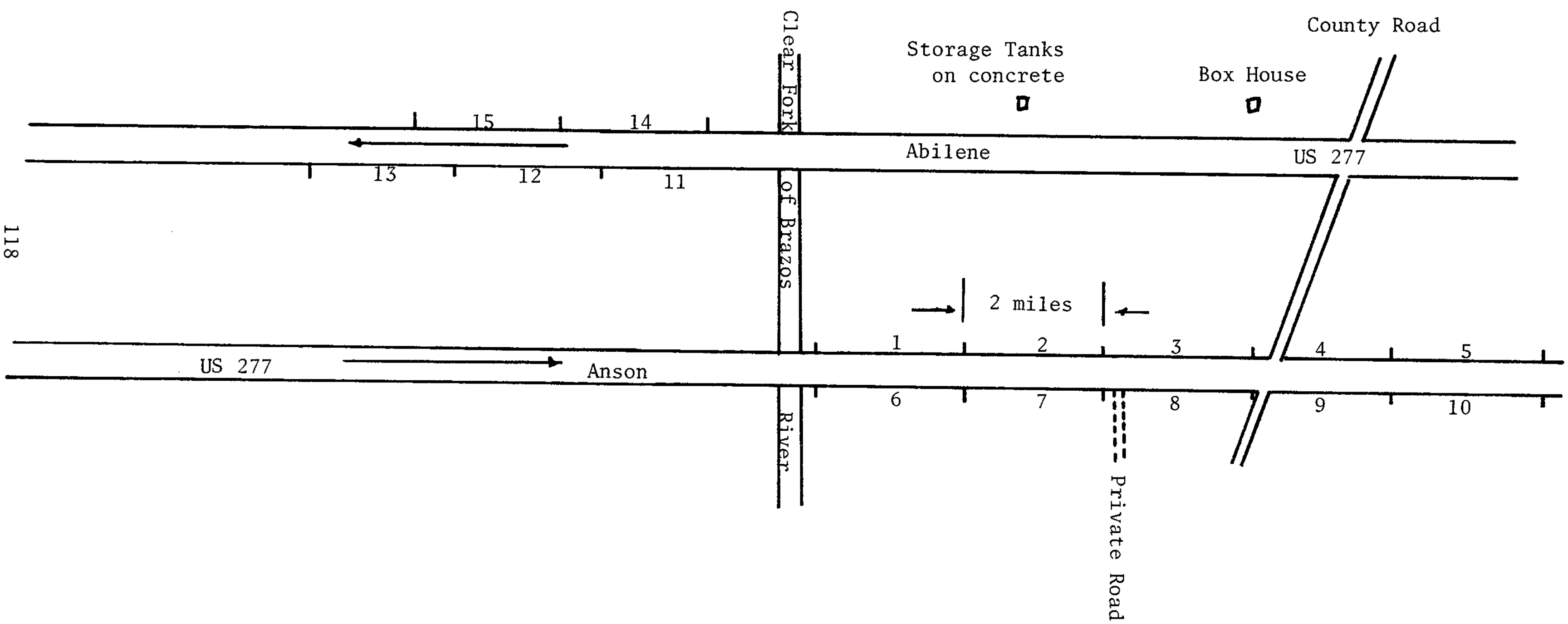


Figure 22. Location of TCA experimental spray plots in State Department of Highways and Public Transportation, District No. 20, Beaumont, Texas.

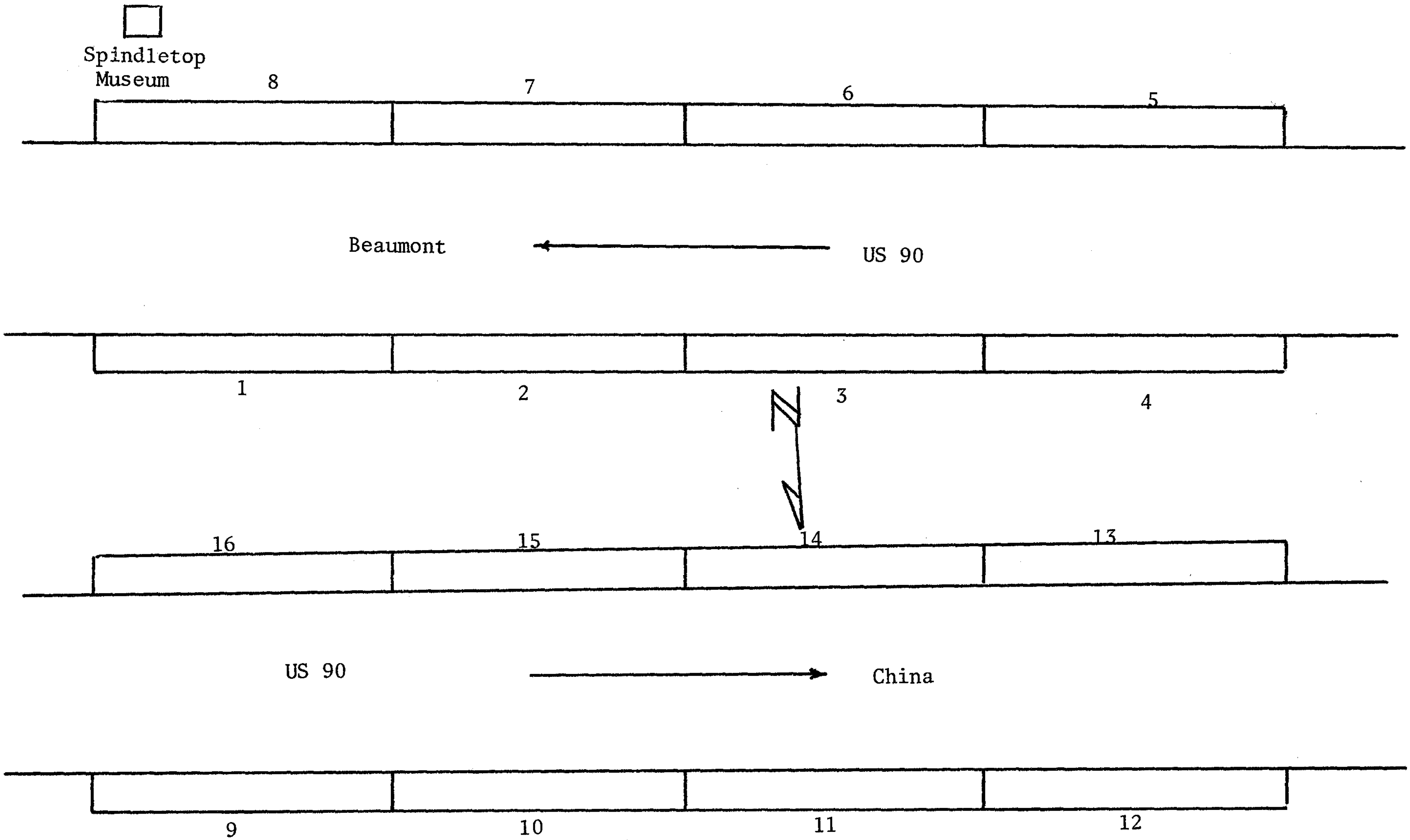


Figure 23. Location of TCA and velpar experimental spray plots in State Department of Highways and Public Transportation, District No. 4, Amarillo, Texas.

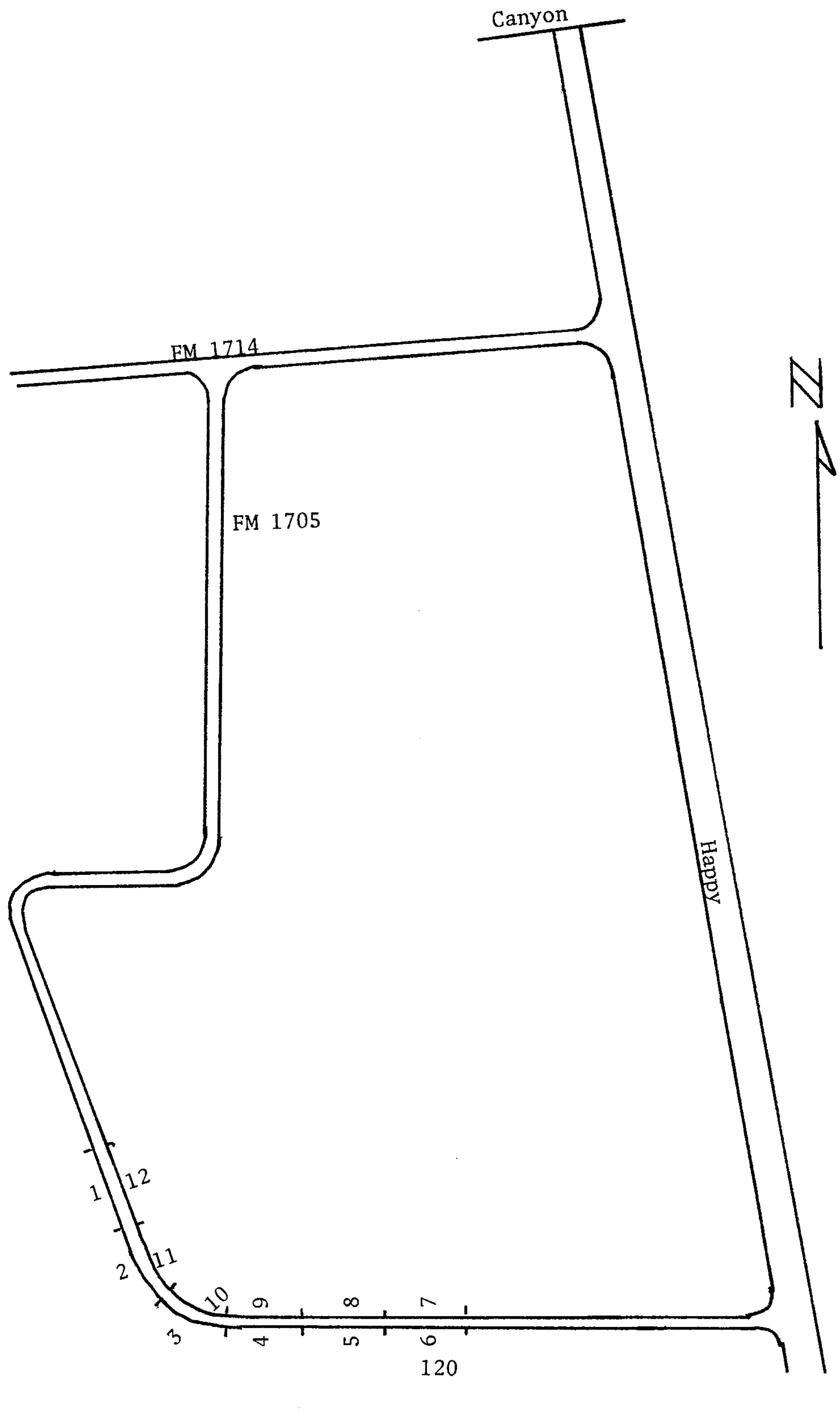


Figure 24. Location of TCA and velpar experimental spray plots in State Department of Highways and Public Transportation, District No. 21, Pharr, Texas.

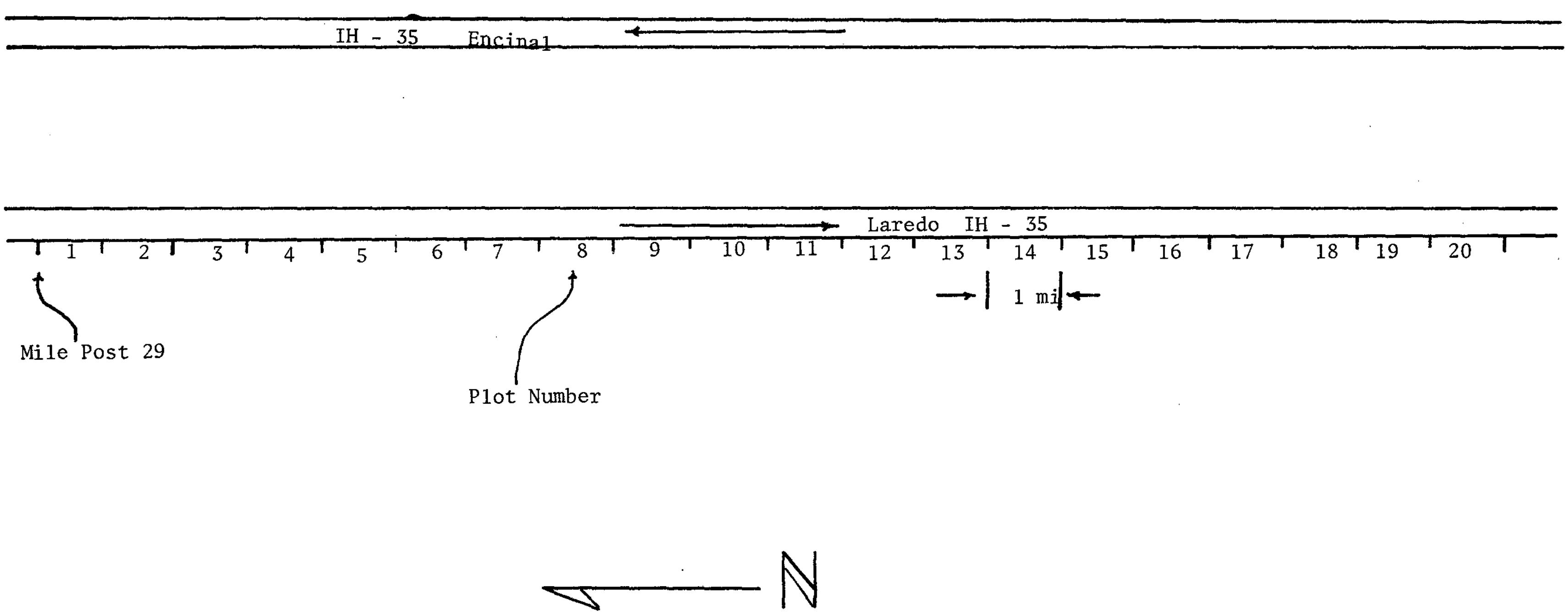


Figure 25. Location of TCA and velpar experimental spray plots in State Department of Highways and Public Transportation, District No. 8, Abilene, Texas.

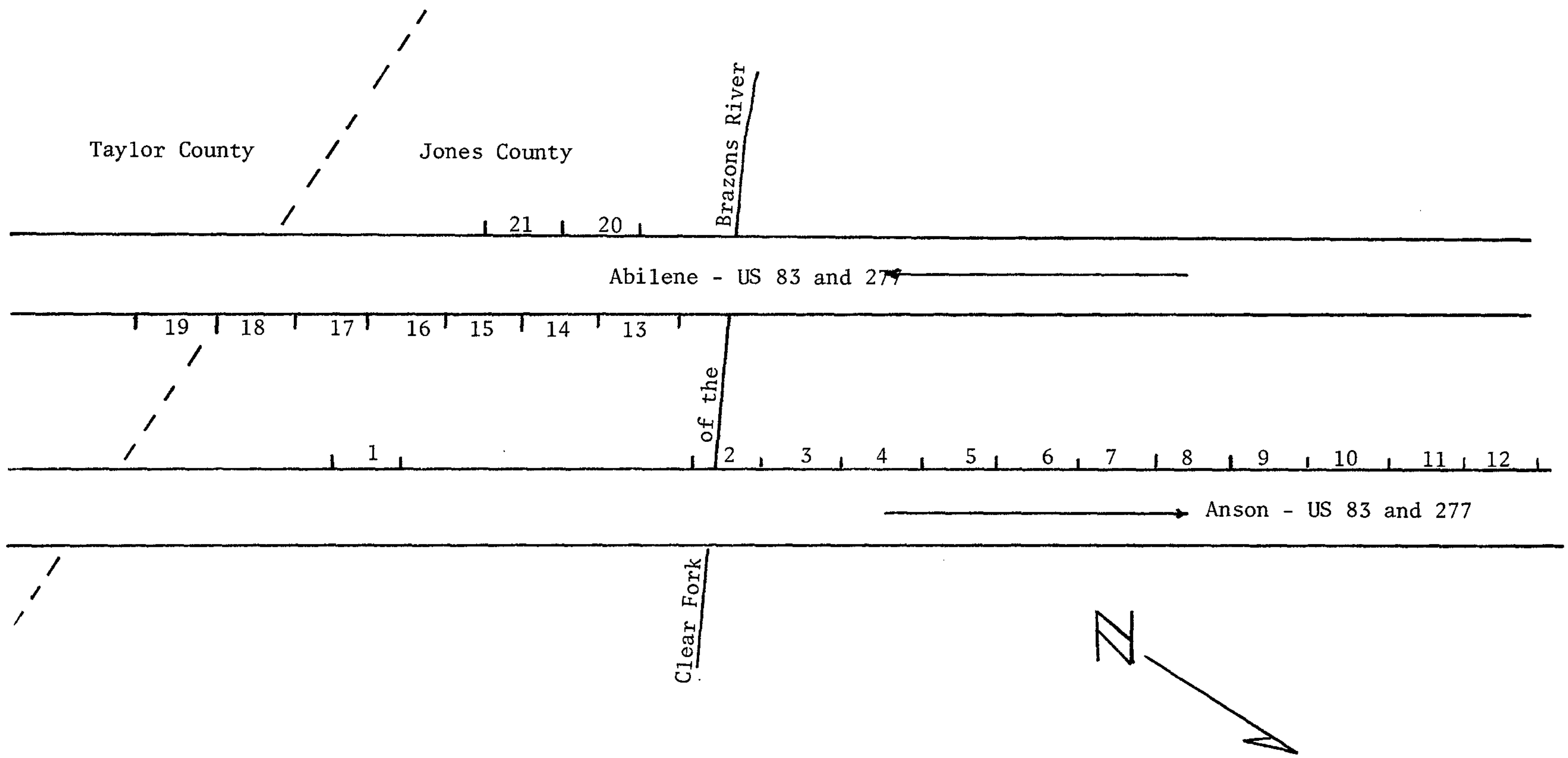


Figure 26. Location of TCA and velpar experimental spray plots in State Department of Highways and Public Transportation, District No. 5, Lubbock, Texas.

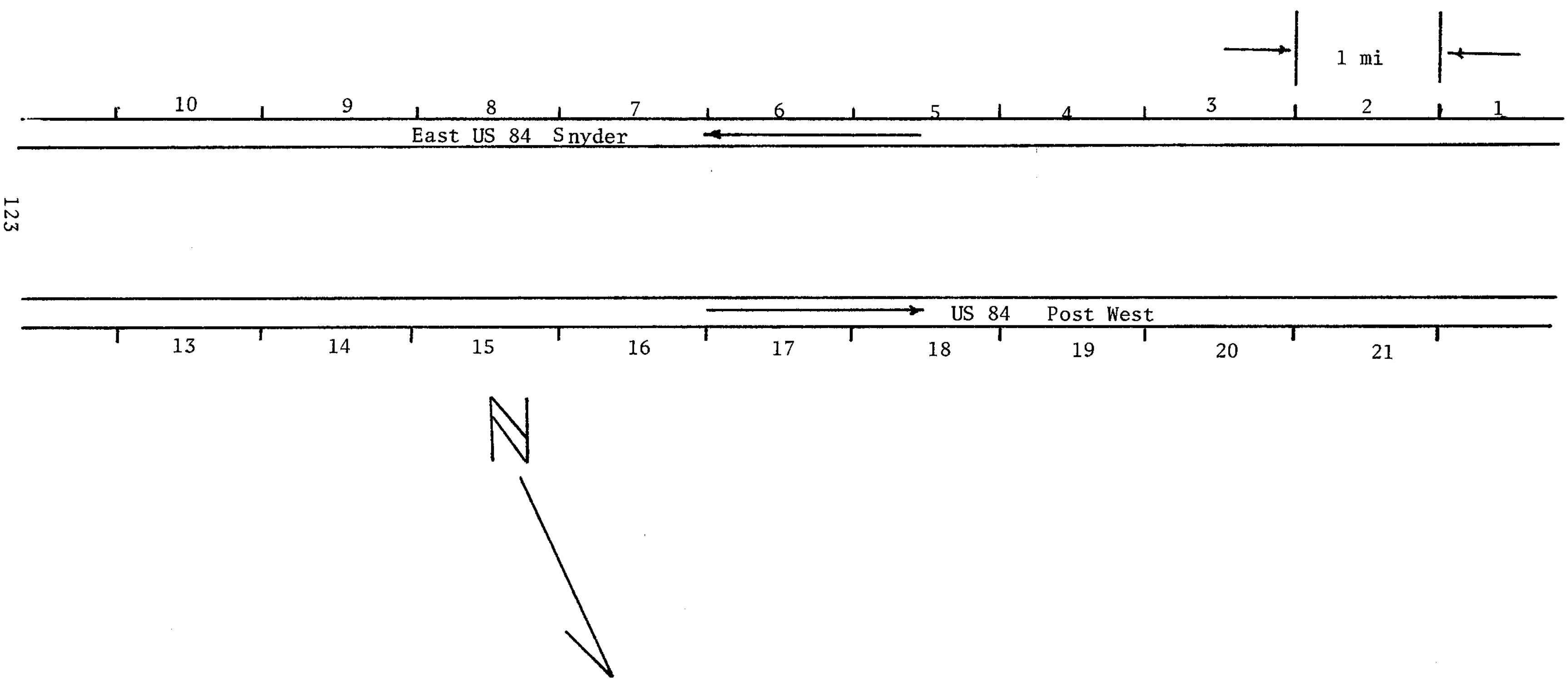


Figure 27. Location of TCA and velpar experimental spray plots in State Department of Highways and Public Transportation, District No. 19, Atlanta, Texas.

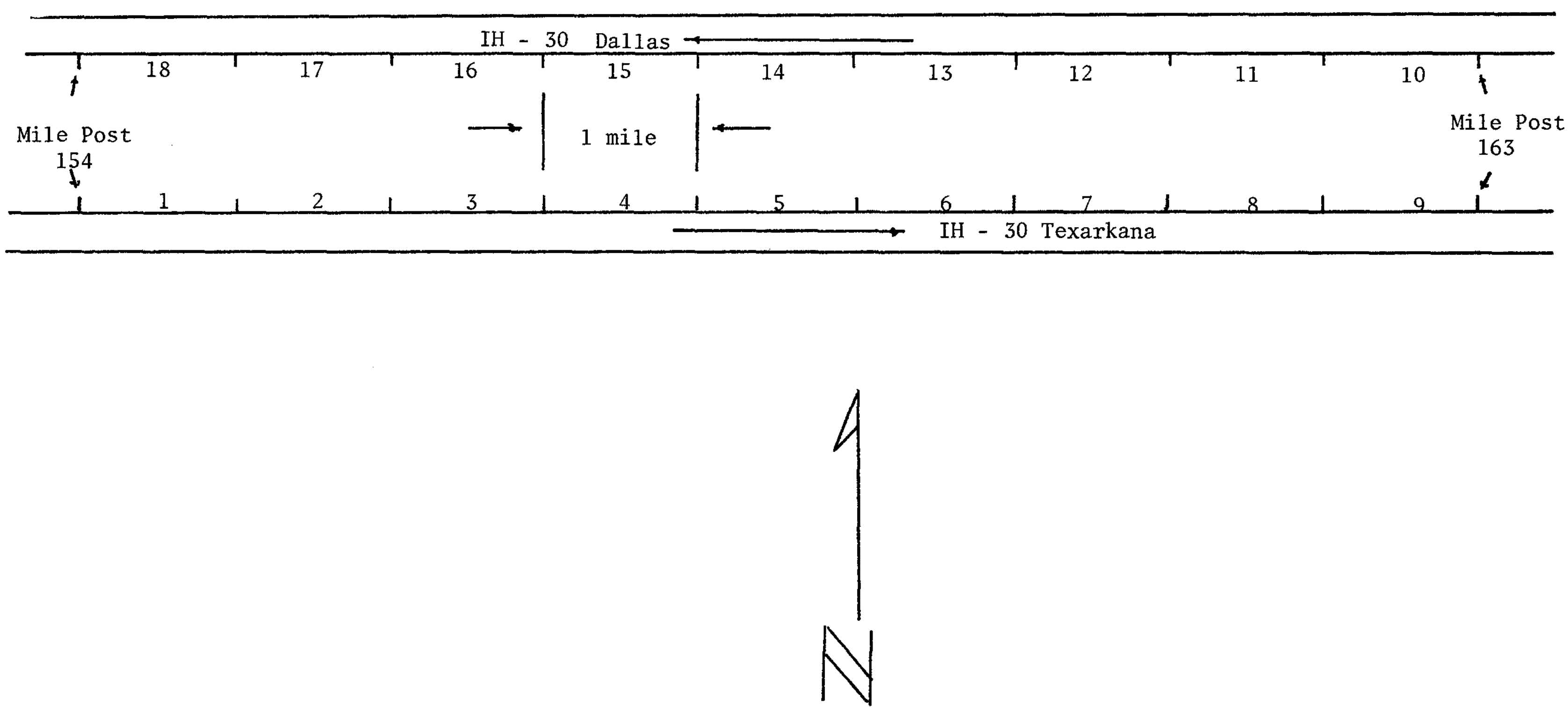


Figure 28. Location of velpar experimental spray plots in State Department of Highways and Public Transportation, District No. 4, Amarillo, Texas.

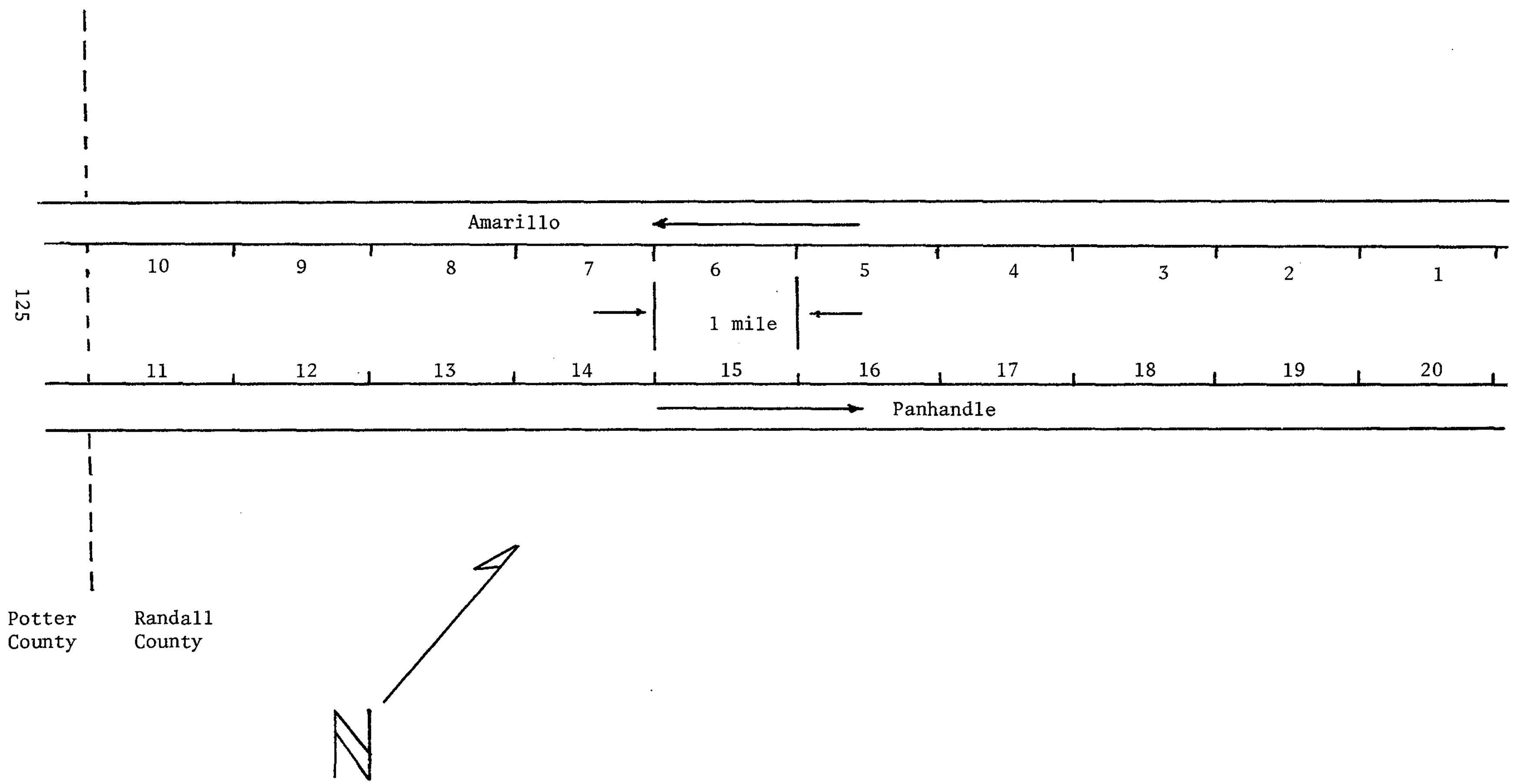


Figure 29A. Location of experimental spray plots in State Department of Highways and Public Transportation District No. 12, Houston, Texas.

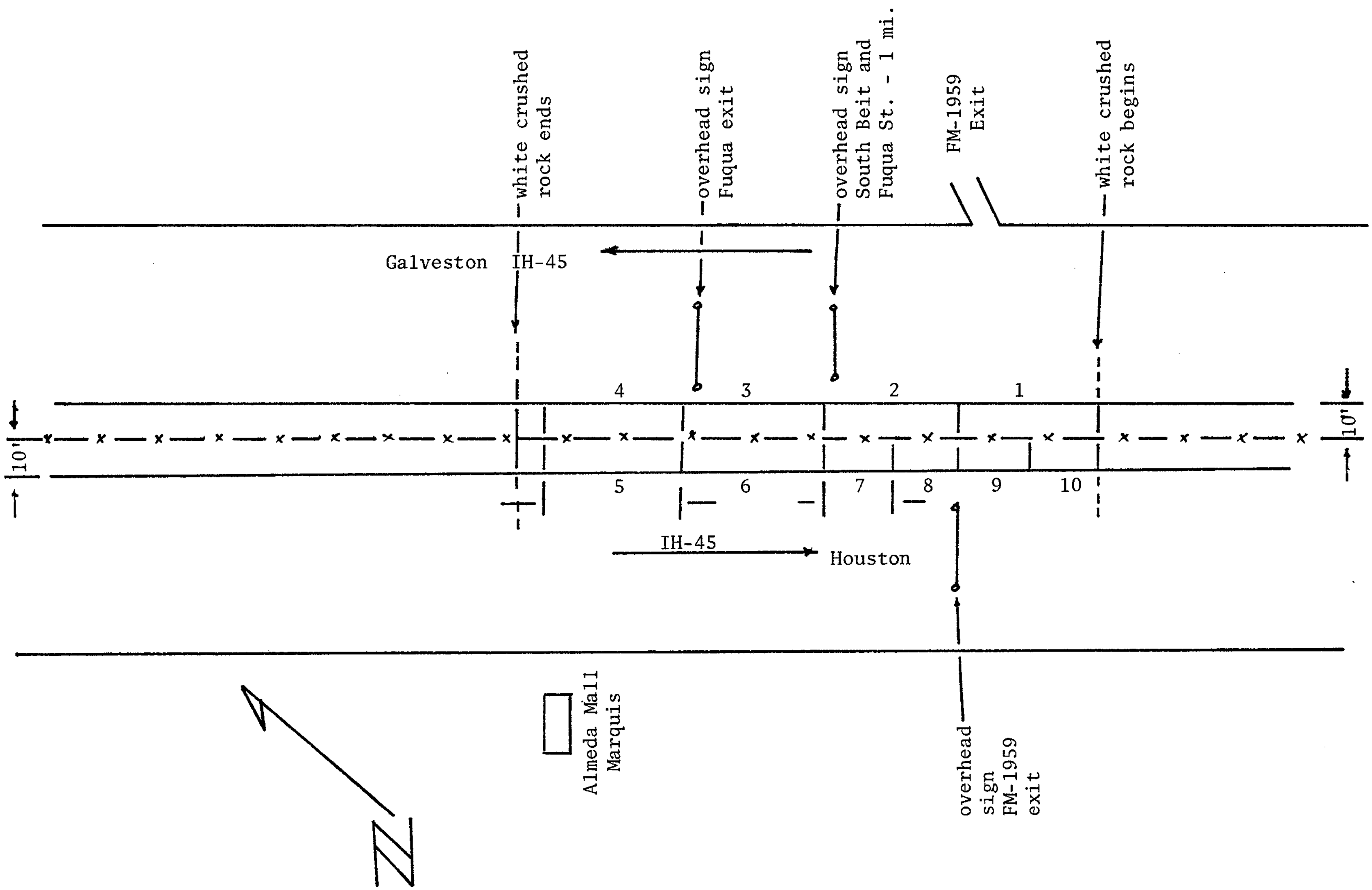


Figure 29B. Location of experimental spray plots in State Department of Highways and Public Transporation, District No. 12, Houston, Texas.

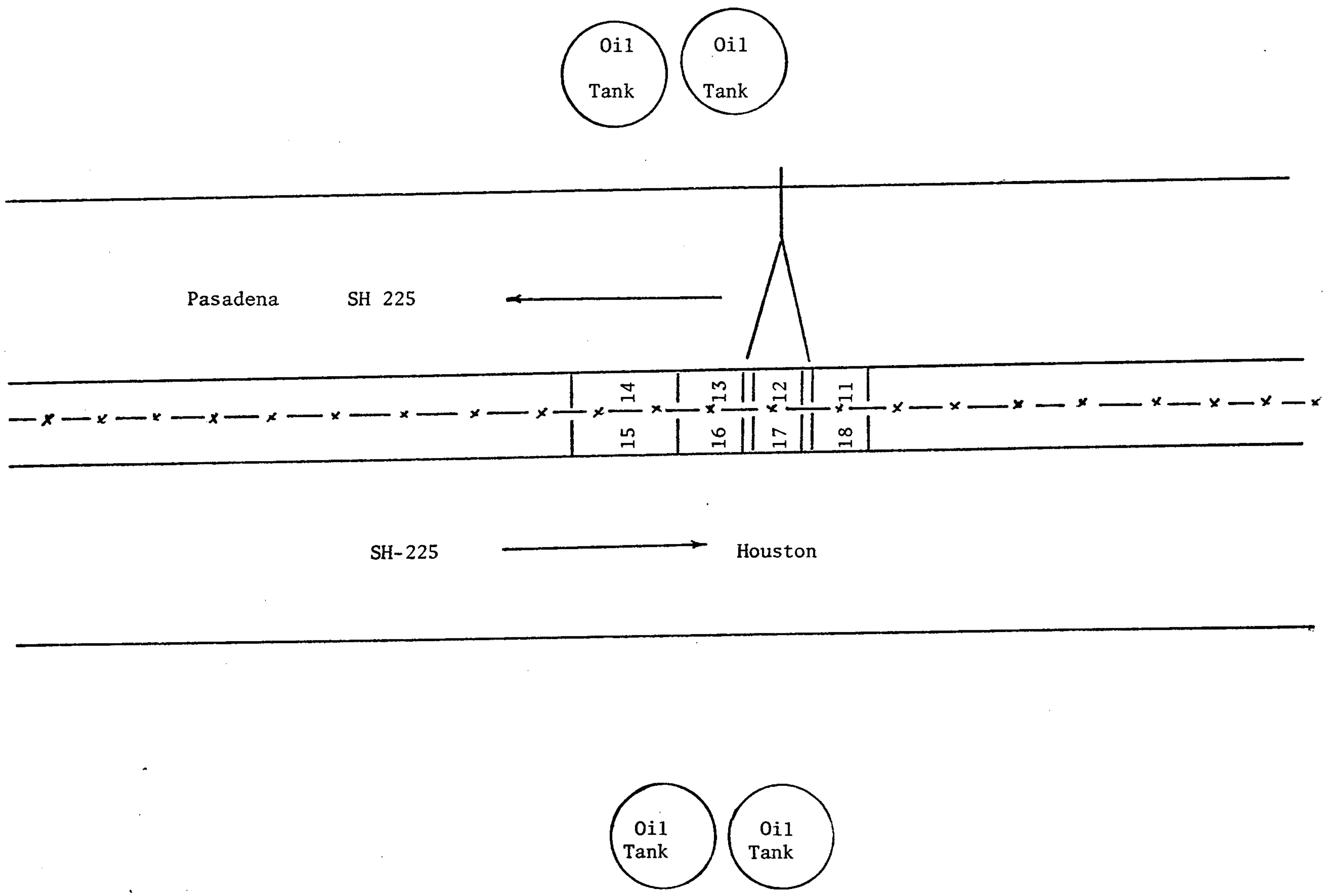


Figure 30. Location of prepavement-herbicide experimental plots in State Department of Highways and Public Transportation, District No. 11, Lufkin, Texas.

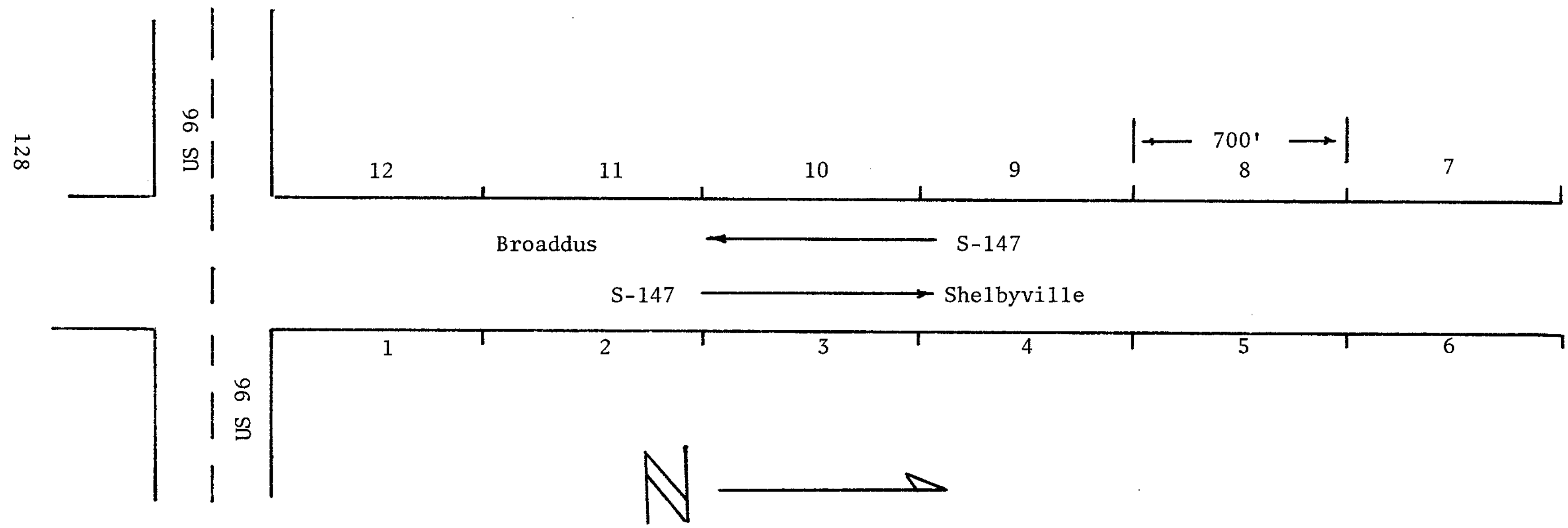


Figure 31. Location of prepavement- herbicide experimental plots in State Departments of Highways and Public Transportation, District No. 25, Childress, Texas.

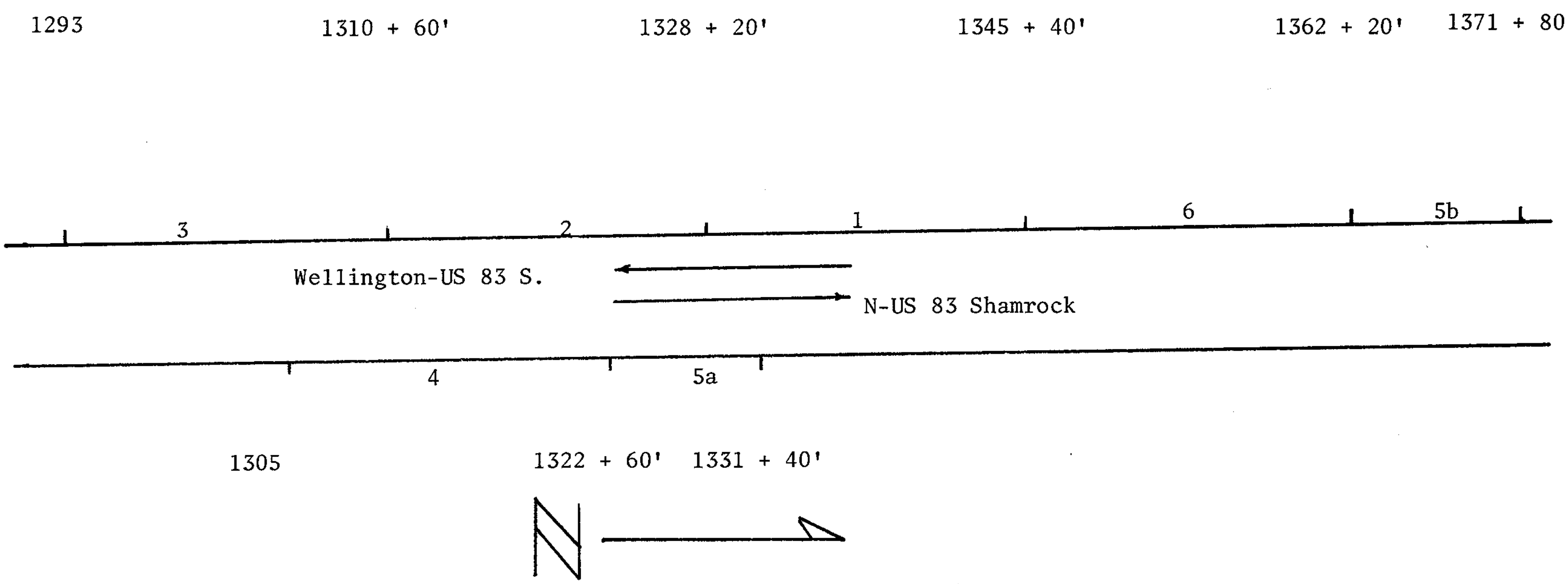
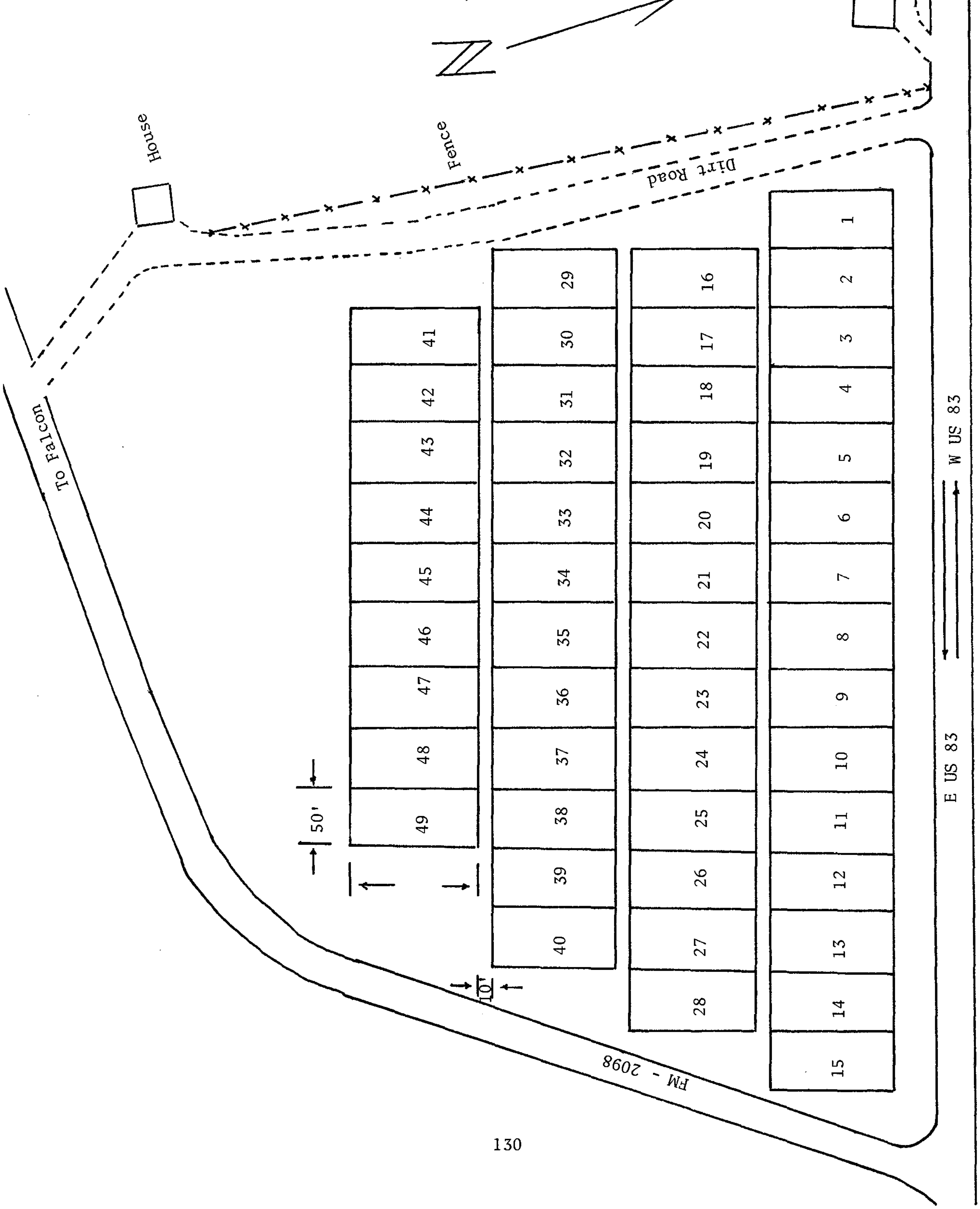


Figure 32. Location of brush control experimental spray plots in State Department of Highways and Public Tranportation, District No. 21, Pharr, Texas.



APPENDIX II

COMMON NAME	CHEMICAL NAME
Amitrole	3-amino-s-triazole
AMS	Ammonium sulfamate
Asulam	Methyl sulfanilylcarbamate
Bromacil	5-bromo-3-sec-butyl-6 methyluracil
Bromoxynil	3,5-dibromo-4-hydroxybenzonitrile
2,4-D	(2,4-dichlorophenoxy) acetic acid
2,4-DB	4-(2,4 dichlorophenoxy) butric acid
2,4-DEP	tris [2-(2,4-dichlorophenoxy) ethyl] phosphite
Dalapon	2,2-dichloroproponic acid
Dicamba (DMA)	Dimethylamine salt of 3,6-dichloro-o-anisic acid
Dicamba (granular)	3,6-dichloro-o-anisic acid
Diuron	3-(3,4-dichlorophenyl)-1, 1-dimenthylurea
DSMA	Disodium methanearsonate
Fenac	(2,3,6-trichlorophenyl) acetic acid
Glyphosate	N-(phosphonomethyl) glycine
Kartibutilate	tert-butylcarbamic acid ester with 3-(m-hydroxyphenyl)-1, 1-dimenthylurea
Methazole	2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadiozolidine-3,5-dione.
Monuron	3-(p-chlorophenyl)1,1-dimethylurea
MSMA	Monosodium methanearsonate
Picloram	4-amino-3,5-6-trichloropicolinic acid

COMMON NAME	CHEMICAL NAME
TCA	Trichloroacetic acid
RP 20630	Experimental herbicide
RP 20810	Experimental herbicide
RP 23465	N'[3-chloro-4-[5-(1,1-dimethylethyl)-2-oxo-1,3,4-oxadiazol-3-(2H)-yl]phenyl]-N,N-dimethylurea
Prometone	2,4-bis(isopropylamino)-6-Methoxy-s-triazine
Tebuthiuron	N-[5-(1,1-dimethylethyl)-1,3,4-thiadizol-2yl]-N, N' dimethylurea
2,4,5-TP	2-(2,4,5-trichlorophenoxy) propionic acid
Vel 5026	1-(5 butyl-,3,4-thiadiazol-2-yl)-3-methyl-5 hydroxy-2-imidozolidinone
Vel 5028	Experimental herbicide
Vel 5052	Experimental herbicide
Velpar	3-cyclohexyl-6-(dimethylamino)-1-methyl-s-triazine-2,4(1H, 3H)-dione

APPENDIX III

Plants treated along the roadsides of Texas

1976

Symbol	Binomial name	Common Name
Acbe	Acacia berlandieri Benth.	Guajillo
Acfa	Acacia farnesiana (L.) Willd.	Huisache
Acri	Acacia rigidula Benth.	Blackbrush acacia
Amps	Ambrosia psilostachya D.C.	Ragweed
Amsp	Amaranthus spp.	Carelessweed
Arlo	Aristida longiseta Steud.	Red threeawn
Bagl	Baccharis salicina T. & G.	Willow baccharis
Boas	Bothriochloa saccharoides (Swartz) Rydb.	Silver Bluestem
Bois	Bothriochloa ischaemum (L.) Keng.	King Ranch bluestem
Brja	Bromus japonicus Thumb.	Japanese brome
Ceci	Cenchrus ciliaris L.	Buffelgrass
Ciun	Cirsium undulatum (Nutt.) Spreng.	Wavyleaf thistle
Coin	Canvolvulus incanus Vahl.	Gray bindweed
Coho	Condalia obtusifolia (Hook.) Weberb.	Lotebush
Coti	Coreopsis tinctoria Nutt.	Plains coreopsis
Cyda	Cynodon dactylon (L.) Pers.	Bermuda grass
Cyes	Cyperus esculentus L.	Yellow nut-grass

Symbol	Binomial name	Common Name
Disa	*Digitaria sanguinalis* (L.) Scop.	Crabgrass
Erca	*Erigeron canadensis* L.	Mares tail
Eusp	*Euphorbia prostrata* Ait.	Prostrate spurge
Heam	*Helenium amarum* (Raf.) H. Rock	Bitterweed
Hean	*Helianthus annuus* L.	Sanflower
Heci	*Helianthus ciliaris* DC.	Blueweed
Jasp	*Jatropha dioica* Sesse ex Cerv.	Nettlespurge
Kagr	*Krameria ramosissima* (Gray) Wats.	Manystem ratany
Kosp	*Kochia* spp.	Summer cypress
Lefr	*Leucophyllum frutescens* (Berl.) Johnston	Ceniza
Lesp	*Lepidium densiflorum* Schrad.	Prairie pepperweed
Lite	*Linaria texana* Scheele.	Toadflax
Lope	*Lolium perenne* L.	Perennial Ryegrass
Mesa	*Medicargo sativa* L.	Alfalfa
Opsp	*Opuntia* species	Pricklypear
Plpu	*Plantago purshii* R. & S.	Plantain
Poan	*Polieria angustifolia* (Englm) Gray	Guayacan
Prgl	*Prosopis glandulosa* Torr.	Mesquite
Raco	*Ratibida columnaris* (Sims) D. Don	Upright prairie coneflower

Symbol	Binomial Name	Common Name
Saca	*Sabatia campestris* Nutt.	Prairie rosegentain
Soel	*Solanum elaeagnifolium* Car.	Silverleaf nightshade
Soha	*Sorghum halepense* (L.) Pers.	Johnsongrass
Spcr	*Sporobolus cryptandrus* (Torr.) Gray	Sand dropseed
Xagl	*Xanthocephaleum glutinosum* (Spreng) Shinners	Selloa