EFFECTS OF VARIOUS PLANT AND ENVIRONMENTAL FACTORS ON POST OAK RESPONSE TO 2,4,5-T

By

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CHAPTER I

INTRODUCTION

Response of oak brush (*Quercus spp.*), to a single application of 2,4,5-T [(2,4,5-trichlorophenoxy)acetic acid] can show wide variation among years and locations in the same year. Because of this, it is the usual practice to apply 2,4,5-T in two consecutive years at a rate of 2 pounds per acre with a carrier volume of 5 gallons per acre oil-water emulsion. This increases the odds of hitting a good spray year and results are usually satisfactory.

Some of the variation in response of oak trees to 2,4,5-T has been attributed to the date of application and poor spray coverage. However, even with good coverage and spraying at the correct time of the season, there still exists a lot of variation. If this effect of location and season on herbicide response could be correlated with some growing conditions of the brush or some environmental conditions at or before treatment, then brush could be sprayed under these conditions. This could result in a significant reduction in spraying expense.

The objective of this study was to determine if there were some plant or environmental factors that could be used to predict the response of post oak (*Quercus stellata* Wang) to 2,4,5-T.

CHAPTER II

LITERATURE REVIEW

Plant Factors Affecting Herbicide Activity

Stage of growth at the time of treatment has been observed to be of considerable importance in response of woody plants to the phenoxy herbicides. According to Crafts (1961), the hormone-like herbicides function by disrupting meristamatic growth associated with the growth and development of plants. Tschirley and Hull (1959) found that the stage of growth seemed to be a reliable criterion of velvet mesquite [*Prosopis juliflora* (Swartz) D. C.] susceptibility to 2,4,5-T. Hamner and Tukey (1944) found that 2,4-D [(2,4-dichlorophenoxy)acetic acid] was most effective when the plants are actively growing. Hyder et al. (1962) working with big sagebrush (*Artemisia tridentata* Nutt.) found its susceptibility to 2,4-D was near maximum as early as new growth activity became apparent. According to Robertson and Kirkwood (1970) application of 2,4-D to leaves which were healthy, but not actively growing resulted in retention of 2,4-D in the treated leaves.

Meadors et al. (1954) felt that the plant condition largely determined the extent of translocation and effectiveness of 2,4,5-T. Eaton et al. (1970) found that maximum defoliation of oaks by 2,4,5-T was obtained 6 to 8 weeds after the last killing frost when the leaves were fully expanded and before a thick waxy cuticle had been formed.

Robertson and Kirkwood (1970) stated that the differential activity of phenoxy-acid compounds may be attributed in part, at least, to differential movement. When a phloem-mobile herbicide is applied to the upper foliage, most of it is translocated into the shoot tips, whereas when applied to the lower, more mature, leaves the herbicides will be translocated into the roots (Ashton and Crafts, 1973). Schmutz (1971) found in general, translocation of 2,4,5-T was greater when applied to older leaves, fruits, flowers and young bark than when applied to young leaves of creosote bush [Larrea tridentata (D. C.) Coville]. In blackjack oak (Quercus marilandica Muenchh.) translocation appears to occur with equal facility in upward and downward directions in the stem during the months of May and June and mostly in the downward direction in July and August (Badiei et al., 1966).

Translocation of phloem-mobile herbicide molecules have been shown to take place along with the assimilate stream (Wills and Basler, 1971). While working with green rabbitbrush [Chrysothamnus greenii (A. Gray) Greene], Hyder et al. (1962) observed that the highest mortalities were obtained with spray applications coinciding with high carbohydrate contents in the herbage. However, Badiei et al. (1966) observed that when free sugar levels were at a maximum in the root tissue of blackjack oak seedlings, translocation was low. Application of 10% sucrose solution to excised leaf tips of treated plants kept in the dark appeared to enhance translocation of 2,4,5-T-C^{14} indicating the importance of sugars in the translocation of herbicides (Badiei et al. 1966). These data indicate that a high sugar level in root tissue apparently is not necessary for high translocation rate. However, a high translocation rate of sugars towards the root tissue may be essential. Coble et al. (1970) indicated that translocation of 2,4-D into the roots of honeyvine milkweed [Ampelamus albidus (Nutt.) Britt] can be related to new root growth which acts as active metabolic sinks. However, Schmutz (1971) indicated that translocation of 2,4,5-T in creosote bush was not significantly affected by diurnal photosynthesis and translocation of metabolites. There is evidence that the phenoxy-acid compounds reduce their own movement by inhibiting energy requiring processes associated with translocation (Robertson and Kirkwood, 1970) and probably inactivate the mechanisms involved in translocation due to high concentrations of herbicide or carrier in the treated area (Badiei et al. 1966).

Plant growth and translocation has been observed to be affected by a plant's internal water status. Kozlowski (1958) observed that when internal water deficits prevail in trees, growth is decreased. The decrease in growth could have an affect on the effectiveness of 2,4,5-T as indicated by Fisher et al. (1956). Kozlowski (1958) explained the decrease of growth when internal water deficits are present as a decreased availability of carbohydrates, decreased cell enlargement and earlier cell differentiation. Basler et al. (1961) found that translocation of 2,4-D was reduced when the soil moisture level was lowered to the extent that a water stress existed in the treated plants. It has been shown that translocation of 2,4,5-T is reduced by water stress by differing degrees in mesquite and winged elm (Ulmus alata Michx) (Davis et al. 1968 and Robertson and Kirkwood 1970).

Environmental Factors Affecting Herbicide Activity

Schmutz (1971) observed that more creosote bush plants were killed with 2,4,5-T between 12 and 60 days after the first summer rain of at least ½ inch. Meyers et al. (1972) found that high rainfall 7 days before spraying was correlated directly with high plant control of honey mesquite [Prosopis juliflora (Swartz) D. C. var. glandulosa (Torr.) Cockerell]. Schmutz (1971) also noted that the peak and duration of high susceptibility of creosote bush to 2,4,5-T varied with the amount and distribution of rainfall. Rainfall a few days before spraying may increase leaf wettability and enhance herbicidal susceptibility by mechanically damaging the wax structure of the leaf (Hammerton, 1967). Meyers et al. (1972) observed that rainfall after spraying was inversely correlated with high percent control of honey mesquite by 2,4,5-T. However, Coble et al. (1969) found that simulated rainfall after treatment with 2,4,5-T amine or 2,4,5-T ester had little effect on the control of turkey oak (Quercus laevis Watt).

Rainfall occurring before the time of treatment may not have as much affect on plant response to herbicides as the available soil moisture at the time of treatment. Hyder et al. (1962) observed that the growth activity of and the effectiveness of 2,4-D on big sagebrush decreased as the soil moisture content decreased. It has been shown in blackjack oak (Badiei et al. 1966) and winged elm (Wills and Basler 1971) that translocation of 2,4,5-T appeared to correlate with variation in soil moisture. This supports the possibility suggested by Basler et al. (1961) and Dalrymple and Basler (1963) that reported poor kill in blackjack oak during the summer months may in part be due to a moisture stress within the plant.

Other environmental factors such as humidity and temperature have been shown to affect the response of a plant to a herbicide. Basler et al. (1970) found that the basipetal translocation of 2,4,5-T in bean plants was enhanced by high humidity and acropetal translocation was enhanced by low humidity. However, Morton (1966) found no change in relative rates of translocation patterns of 2,4,5-T in mesquite at different humidity levels. Hammerton (1967) stated that in general a high relative humidity at and after spraying is likely to increase herbicidal penetration and absorption. The higher herbicidal penetration would allow for more herbicide to be available for translocation. Eaton et al. (1970) found that relative humidity at the time of treatment application was positively correlated with oak defoliation caused by 2,4,5-T. However, in honey mesquite Meyers et al. (1972) found that the maximum relative humidity before spraying was inversely correlated with high percent control by herbicide treatments.

Air temperature has been shown to affect the response of plants to herbicides. Pallas (1960) observed that as the temperature is increased the translocation of 2,4-D is also increased. Morton (1966) detected no differences in 2,4,5-T absorption at 70 and 85^{o} but an increase occurred at 100^{o} F. in mesquite seedlings. He also found that temperature affected translocation. Translocation was basipetal from the point of application at 70^{o} F. and both basipetal and acropetal at 75^{o} F. Marth and Davis (1945) found that plants responded more rapidly to 2,4-D treatment at high temperatures than those at lower temperatures. Muzik and Mauldin (1964) found that plants grown at temperatures cool enough to reduce their growth rate failed to respond to 2,4-D or responded to a lesser degree than plants grown at higher temperatures.

CHAPTER III

MATERIALS AND METHODS

Thirteen sites in the crosstimber and Ouachita highland areas of Oklahoma with a good stand of post oak were selected as experimental sites.

The treatments consisted of topically applied 2,4,5-T butoxyethanol ester and injected 2,4,5-T triethyl amine salt. Topical treatments of one and two pounds per acre were applied with a carrier volume of 10 gpa oil-water emulsion to post oak resprouts 4 to 5 feet in height. The treatments were applied with a small hand-held sprayer held one foot above the top of the tree. The two injection treatments (concentrated 4 lb/gal and a 1:1 water dilution) were applied to trees 4 to 6 inches in diameter at breast height. Incisions (one per inch of stem diameter) were made into the cambium 5 feet above the ground surface with a hatchet. One milliliter of herbicide solution was injected into each incision with a syringe. Each of the treatments were applied on ten trees at each of the thirteen locations between June 25 and July 3, 1973.

Plant characteristics measured at the time of treatment included the amount of growth in length of the major terminal branches in 1972 and 1973, the number of leaves on the new terminals, the plant's internal water potential, and the nutrient status of the leaves from four randomly selected trees at each location. The leaves were analyzed for nitrogen, phosphorus, potassium, calcium, magnesium, iron, zinc, and manganese. The percent nitrogen was determined by Technicon Auto-Analyzer II and the remaining nutrients were determined by Atomic Absorption Spectrophotometer. Five readings from each tree were taken on each tree to determine stem lengths and the number of leaves on new stems. Xylem ring growth for the year before and the year of treatment was recorded 15 months after treatment.

Three methods for determination of a plant's internal water potential were compared to determine which method gave the most reliable and easily obtainable data. The methods compared were the Spanner ceramic bulb psychrometers (Wiebe et al. 1971 and R. W. Brown 1970), Shardokov dye method (Barrs 1968 and Kozlowski 1968), and a pressure chamber method (Waring and Cleary 1967).

The pressure chamber method proved superior to the psychrometers and the dye method. The data was easily obtained and was consistent with that of the psychrometer measurements. The dye method proved to be unsuited for our study due to the inconsistency of data and the large number of containers required which was restrictive when used in the field.

Environmental variables measured at the time of treatment included wind velocity, relative humidity, air temperature, soil temperature and soil moisture. Soil moisture was also taken one month after treatment. Wind velocity was measured with a pocket anemometer and air temperature and relative humidity were determined with a sling psychrometer. Soil temperature was determined at a 4 inch depth and soil moisture samples were collected at four sites within each location. Soil moisture samples were taken at soil depths of 0 to 5 inches and 10 to 15 inches.

The samples were placed in plastic bags and transported to the lab and oven dried at 130° F. The percent soil moisture was determined by weight. Each location was located within three miles of an official weather station. Rainfall before and after spraying was obtained from these stations.

Visual ratings of response of the post oak to the herbicide treatments was taken as brownout one month after treatment and percent dead canopy and percent dead trees 15 months after treatment.

The data was analyzed as a completely randomized experiment with 10 replications. Data on stem length in 1972 and 1973, the number of leaves on the stem length of 1973, and xylem ring growth for 1972 and 1973 were subjected to multivariant regression analysis. The effects of location, rate of application, location by rate interaction, were first removed before determining the effects of the independent variables. The independent variables included; stem length for 1972 and 1973, the number of leaves on new stem length of 1973, xylem ring growth for 1972 and 1973. After the multivariate regression analysis the independent variables were analyzed as to their capability as predictors of the dependent variable canopy reduction. The maximum R^2 improvement technique of the stepwise regression procedures was used to find which independent variables should most likely be included in a regression model.

CHAPTER IV

RESULTS AND DISCUSSION

Plant Factors

Multivariate regression analysis was used on the plant factors (stem length 1972 and 1973, number of leaves on the stem length for 1973, and xylem ring growth for 1972 and 1973) to determine which factor would be a good indicator of tree response to 2,4,5-T. Correlation coefficients of the plant factors and control readings for topically and injected treated trees are listed in Table I and II respectively.

Stem length for 1972 was the only factor that was significantly correlated with percent dead canopy of the topical treatments (Table I). The negative correlation coefficient indicated that as the stem length the year before treatment decreased the percent dead canopy increased. Percent dead canopy and percent brownout for the injection treatments were also shown to increase as the stem length and leaf number the year of the treatment decreased (Table II). Brownout with the injection treatments also increased with decreased xylem ring growth the year before treatment. The brownout and dead canopy were not correlated when 2,4,5-T was topically applied but did correlate when 2,4,5-T was injected. The plant factors were positively correlated with each other

TABLE I

CORRELATION COEFFICIENTS FOR PLANT FACTORS, BROWNOUT AND CANOPY REDUCTION FOR THE TOPICAL TREATMENTS OF 1 AND 2 LB/A OF 2,4,5-T ESTER

	Stem Length 1972	Stem Length 1973	Leaf No. 1973	Xylem Ring Growth 1973	Xylem Ring Growth 1972	% Brownout
Stem Length 1973	0.40**					
Leaf Number 1973	0.27**	0.50**				
Xylem Ring Growth 1973	0.04	0.15*	0.08			
Xylem Ring Growth 1972	0.16**	0.13*	0.07	0.51**		
% Brownout	-0.05	-0.11	-0.01	0.02	0.05	
% Dead Canopy	-0.18**	-0.08	-0.10	0.07	0.09	0.08

*Significant at the 5% level.
**Significant at the 1% level.

TABLE II

CORRELATION COEFFICIENTS FOR PLANT FACTORS, BROWNOUT, AND CANOPY REDUCTION FOR THE INJECTION TREATMENT OF 2 AND 4 LB/GAL OF 2,4,5-T AMINE

	Stem Length 1972	Stem Length 1973	Leaf No. 1973	Xylem Ring Growth 1973	Xylem Ring Growth 1972	% Brownout
Stem Length 1973	0.60**					
Leaf Number 1973	0.36**	0.53**				
Xylem Ring Growth 1973	0.17*	0.21**	0.17*			
Xylem Ring Growth 1972	0.13*	0.13*	0.14*	0.74**		
% Brownout	-0.04	-0.17*	-0.14*	-0.12	-0.17**	
% Dead Canopy	-0.11	-0.14*	-0.27**	-0.10	-0.07	0.32**

*Significant at the 5% level.
**Significant at the 1% level.

in both small and large trees (Table I and II). The best correlation of plant factors was between xylem ring growth for 1972 and 1973 (0.51 for small trees and 0.74 for large trees). The correlations of plant factors with both application methods followed the same general pattern except the correlations were slightly better for the large injected trees.

From the multivariate regression analysis, the relationships between the independent variables (location, rate, and location by rate interaction) and the dependent variables (stem length 1972 and 1973, the number of leaves on the stem length for 1973, xylem ring growth for 1972 and 1973, brownout and canopy reduction) were determined.

The effect of location was found to be significant for all variables with both topical and injection treatments (Tables III, IV, V, VI). Generally, as the rate for both the topical and injection treatments was increased, the percent brownout increased. The resulting dead canopy was not influenced by the rate of the topical treatments but rate did have an influence with the injection treatments. The best canopy reduction was obtained with the high rate. Also, the percent of dead trees within a location was greater with the high rates of applications indicating that as the percent dead canopy increased the percent dead trees increased (Tables IV and VI).

Analysis of variance for the tree nutrient status of the leaves indicated a significant difference among locations for the percent nitrogen, phosphorus, magnesium, zinc, and manganese (Table VII). However, the differences did not appear to have any relationship with the resulting activity of the herbicide. There were no significant differences among locations for potassium, calcium, or iron.

TABLE III

PLANT FACTORS ASSOCIATED WITH PERCENT DEAD CANOPY AND PERCENT DEAD TREES FROM THE LOW RATE OF TOPICAL TREATMENT

Location	Dead Canopy* (%)	Stem Length 1972 (mm)	Stem Length 1973 (mm)	Leaf No. 1973	Xylem Ring Growth 1972	Xylem Ring Growth 1973	Brownout (%)	Dead Trees (%)
Oakwood	71	52	109	9	.6	.8	66	10
Webbers Falls	72	79	72	8	1.1	1.0	62	10
Spiro	86	85	109	8	2.3	2.0	48	12
Pawhuska	96	89	123	9	2.2	1.8	83	40
Copan	98	86	108	10	1.3	1.6	65	20
Sallisaw	98	59	67	7	.5	.6	82	10
Shawnee	98	44	54	8	.5	.3	71	10
Skiatook	99	91	94	8	1.1	1.1	55	10
Wilburton	99	69	64	7	.7	.5	66	10
Pawnee	99	89	123	9	2.2	1.8	83	22
Calvin	100	99	77	7	1.2	.9	75	0
Poteau	100	28	52	6	.2	.2	80	10
Stillwater	100	111	147	12	1.6	2.0	81	0
LSD 5%**	20	34	45	2	2.1	2.2	25	

*Ranked lowest to highest.
**LSD performed with smallest number of observations in any location.

TABLE IV

PLANT FACTORS ASSOCIATED WITH PERCENT DEAD CANOPY AND PERCENT DEAD TREES FROM THE HIGH RATE OF TOPICAL TREATMENT

Location	Dead Canopy* (%)	Stem Length 1972 (mm)	Stem Length 1973 (mm)	Leaf No. 1973	Xylem Ring Growth 1972	Xylem Ring Growth 1973	Brownout (%)	Dead Trees (%)
Webbers Falls	83	88	83	8	.9	1.0	75	30
Oakwood	84	50	90	10	1.0	1.0	75	20
Spiro	89	81	104	10	2.0	2.0	57	20
Poteau	92	43	48	7	.4	.4	93	0
Sallisaw	92	61	74	7	.5	.6	75	33
Stillwater	92	95	134	11	1.4	1.6	81	33
Shawnee	94	44	54	8	.5	.3	85	0
Wilburton	97	73	56	7	.6	.6	81	10
Skiatook	97	86	81	8	.9	1.0	78	10
Pawnee	98	65	67	7	.6	.5	100	20
Copan	99	60	86	10	1.4	1.0	82	22
Calvin	99	99	77	7	1.2	.9	75	40
Pawhuska	100	72	85	11	1.6	1.2	97	30
LSD 5%**	16	27	36	2	1.7	1.8	19	

*Ranked Lowest to highest.
**LSD performed with smallest number of observations in any location.

TABLE V

PLANT FACTORS ASSOCIATED WITH PERCENT DEAD CANOPY AND PERCENT DEAD TREES FROM LOW RATE OF INJECTION TREATMENTS OF 2,4,5-T

Location	Dead Canopy* (%)	Stem Length 1972 (mm)	Stem Length 1973 (mm)	Leaf No. 1973	Xylem Ring Growth 1972	Xylem Ring Growth 1973	Brownout (%)	Dead Trees (%)
Oakwood	61	43	37	6	.6	.7	54	0
Pawnee	62	97	68	7	.5	.6	45	10
Stillwater	62	90	62	8	1.1	1.1	40	0
Sallisaw	85	53	57	6	1.2	.9	37	0
Pawhuska	87	79	87	7	3.0	3.1	63	10
Copan	90	67	72	7	1.2	1.4	48	30
Calvin	93	51	40	5	.7	.8	55	65
Spiro	93	30	59	5	1.2	1.0	53	40
Shawnee	95	51	53	6	.9	1.0	53	0
Poteau	95	32	43	5	.5	.5	47	20
Wilburton	96	62	48	5	.9	.8	58	60
Webbers Falls	98	60	77	5	1.6	1.5	61	70
Skiatook	100	57	34	6	1.2	1.1	57	30
LSD 5%**	17	27	29	2	0.5	1.6	22	

*Ranked lowest to highest.
**LSD performed with smallest number of observations in any location.

TABLE VI

PLANT FACTORS ASSOCIATED WITH PERCENT DEAD CANOPY AND PERCENT DEAD TREES FROM HIGH RATE OF INJECTION TREATMENTS OF 2,4,5-T

Location	Dead Canopy* (%)	Stem Length 1972 (mm)	Stem Length 1973 (mm)	Leaf No. 1973	Xylem Ring Growth 1972	Xylem Ring Growth 1973	Brownout (%)	Dead Trees (%)
Pawnee	65	103	59	6	.6	.7	62	10
Stillwater	91	76	68	8	1.7	1.3	59	0
Pawhuska	92	90	89	7	2.2	2.3	85	40
Oakwood	94	48	51	5	.6	.6	74	10
Copan	94	63	55	6	1.6	1.4	56	30
Spiro	94	44	63	7	.9	.9	54	30
Shawnee	95	60	63	6	1.0	1.1	45	10
Calvin	99	65	33	5	.7	.6	74	50
Sallisaw	99	38	61	7	1.0	.8	52	10
Poteau	100	29	36	5	.5	.5	48	40
Wilburton	100	54	45	5	1.0	1.1	67	80
Skiatook	100	45	36	5	1.1	1.1	70	80
Webbers Falls	100	52	52	5	.9	.8	60	70
LSD 5%**	16	25	27	1	1.6	1.5	21	

*Ranked lowest to highest.
**LSD performed with smallest number of observations in any location.

TABLE VII

NUTRIENT STATUS OF CHECK TREES AT THE TIME OF TREATMENT

Location	% N	PPM P	PPM K	PPM Ca	PPM mg	PPM Fe	PPM Zn	PPM Mn
Webbers Falls	2.1 ab[1]	1225 ab	8062 a	2989 bc	1988 cde	219 a	230 a	2060 a
Oakwood	2.1 ab	831 d	7594 a	3012 bc	1839 de	162 a	51 b	208 g
Spiro	1.8 c	1312 a	8250 a	3310 abc	1964 cde	194 a	48 b	1391 b
Sallisaw	1.7 cd	1094 a-d	6781 a	3099 abc	2567 ab	150 a	168 ab	1387 b
Poteau	1.5 e	919 cd	6562 a	3537 abc	2230 a-e	150 a	75 b	1150 b
Stillwater	2.0 b	962 cd	6500 a	3779 ab	2559 ab	194 a	63 b	837 cde
Shawnee	2.0 b	1050 a-d	6625 a	3459 abc	2480 abc	219 a	138 ab	988 bcd
Wilburton	1.6 de	1312 a	6656 a	3404 abc	2293 a-e	181 a	44 b	170 g
Skiatook	1.8 c	1137 abc	7125 a	3913 a	2011 b-e	162 a	164 ab	800 def
Pawhuska	2.0 b	1006 bcd	7219 a	2880 b	1745 e	169 a	48 b	991 bcd
Pawnee	2.2 a	1138 abc	7438 a	3482 abc	2731 a	162 a	46 b	1041 bc
Copan	1.7 cd	1138 abc	7812 a	3302 abc	2340 a-d	225 a	75 b	447 efg
Calvin	1.7 cd	919 cd	6469 a	3615 abc	2113 b-e	219 a	80 b	1847 a

[1]Numbers followed by the same letter within each column do not differ significantly at the 0.05 level by Duncan's Multiple range test.

Environmental Factors

Since location was found to have the greatest effect on post oak response to 2,4,5-T it appears that the environmental factors associated with each location had a greater effect than did herbicide rate. Since the environmental factors' effects technically could not be separated from location interpretations are difficult.

The percent humidity did not appear to have much affect on percent dead canopy or percent dead trees (Tables VIII and X). The amount of dead canopy was less in some instances with the topical treatment when humidity was less than 65%, but there were also some cases of good canopy reduction when humidity was less than 45%. The greatest number of dead trees from the injected treatments occurred at locations with humidity above 60 percent at treatment (Table X).

Air and soil temperature had very little effect on the percent dead canopy with either the topical or injected treatments but air temperature may have an effect on tree kill (Tables VIII and X). For example, the best tree kill resulted from the injection treatments at temperatures near 80^{o} F. (Table VIII).

The soil temperature appeared to have very little effect on percent dead canopy or the percent dead trees for the topical treatments. Canopy reduction was generally good except for in a few instances where percent dead canopy for the injection treatments fell below 70% (Table X).

Soil moisture content at time of spraying did not appear to have much affect on the percent dead canopy or percent dead trees (Tables IX and XI). Percent of dead canopy was high with both the topical and injection treatments, in some instances when the soil moisture content

TABLE VIII

ENVIRONMENTAL FACTORS ASSOCIATED WITH PERCENT DEAD CANOPY AND PERCENT DEAD TREES FROM THE TOPICAL TREATMENTS

% Dead Canopy		% Dead Trees		Humidity	Air	Soil
1 lb/A	2 lb/A	1 lb/A	2 lb/A	(%)	Temp. (°F.)	Temp. (°C.)
71*	84	10	20	88	82	24
72	83	10	30	33	94	27
86	89	12	20	64	91	28
96	100	40	38	74	89	26
98	99	20	22	84	82	26
98	92	10	33	61	86	25
98	94	10	0	77	83	24
99	97	10	10	78	86	24
99	97	10	10	67	79	21
99	98	22	20	64	80	21
100	99	0	40	52	89	23
100	92	10	0	44	86	24
100	92	0	33	72	81	24

*Ranked lowest to highest.

TABLE IX

MOISTURE RELATIONS ASSOCIATED WITH PERCENT DEAD CANOPY AND PERCENT DEAD TREES FROM THE TOPICAL TREATMENTS

% Dead Canopy		% Dead Trees		Soil Moisture	Internal Water Potential	Rainfall
1 lb/A	2 lb/A	1 lb/A	2 lb/A	(%)	(bars)	(in.)
71*	84	10	20	19	-15	22
72	83	10	30	3	-29	9
86	89	12	20	12	-20	21
96	100	40	38	14	-25	24
98	99	20	22	13	- 8	26
98	92	10	33	5	-11	16
98	94	10	0	8	-30	14
99	97	10	10	7	-20	23
99	97	10	10	8	-23	19
99	98	22	20	10	-24	15
100	99	0	40	8	- 6	17
100	92	10	0	8	-15	20
100	92	0	33	9	-12	14

*Ranked lowest to highest.

TABLE X

ENVIRONMENTAL FACTORS ASSOCIATED WITH PERCENT DEAD CANOPY AND PERCENT DEAD TREES FROM THE INJECTION TREATMENTS

% Dead Canopy		% Dead Trees		Humidity	Air	Soil
2 lb/gal	4 lb/gal	2 lb/gal	4 lb/gal	(%)	Temp. (°F.)	Temp. (°C.)
61*	94	0	10	52	89	23
62	65	10	10	61	86	25
62	91	0	0	33	94	27
85	99	0	10	64	80	21
87	92	10	40	44	86	24
90	94	30	30	74	89	26
93	99	65	50	64	91	28
93	94	40	30	77	83	24
95	95	0	10	72	81	24
95	100	20	40	84	82	26
96	100	60	80	78	86	24
98	100	70	70	88	82	24
100	100	30	80	67	79	21

*Ranked lowest to highest.

TABLE XI

MOISTURE RELATIONS ASSOCIATED WITH PERCENT DEAD CANOPY AND PERCENT DEAD TREES FROM THE INJECTION TREATMENTS

% Dead Canopy		% Dead Trees		Soil Moisture	Internal Water Potential	Rainfall
2 lb/gal	4 lb/gal	2 lb/gal	4 lb/gal	(%)	(bars)	(in.)
61*	94	0	10	8	-24	15
62	65	10	10	5	-30	14
62	91	0	0	3	-29	9
85	99	0	10	8	- 6	17
87	92	10	40	7	-23	19
90	94	30	30	14	-25	24
93	99	65	50	12	-20	21
93	94	40	30	8	-11	16
95	95	0	10	9	-12	14
95	100	20	40	13	- 8	26
96	100	60	80	8	-20	23
98	100	70	70	19	-15	22
100	100	30	80	10	-15	20

*Ranked lowest to highest.

was greater than 5% but there were also some cases of low percent dead canopy when the soil moisture content was 10%.

The internal water potential of the post oak at the time of treatment also did not appear to influence the activity of 2,4,5-T (Tables IX and XI). Canopy reduction was good at most areas and the percent dead trees was good in some areas where the plant's internal water potential was below -20 bars and lower in areas where the internal water potential was above -15 bars.

The total rainfall for March, April, and May may have an effect on 2,4,5-T activity. The percent dead canopy with the topical treatment was best in those areas that received 13 to 20 inches of rainfall for the three months before treatment and percent dead canopy was low when rainfall was below 13 inches for the three months before treatment (Figure 1). With the injected treatments, the percent dead canopy for the injection treatments was highest when the rainfall three months before treatment was above 15 inches (Figure 2). This trend also is reflected in the tree kill. The tree kill was greatest at areas which received between 19 and 24 inches of rainfall three months before treatment (Table XI).

Stepwise regression procedure was used to find which variable should most likely be included in a regression model. The maximum R^2 improvement was the specific procedure used for finding the "best" one variable model, the "best" two variable model and so forth. The independent variables included stem length for 1972 and 1973, the number of leaves on the stem growth of 1973, and the xylem ring growth for 1972 and 1973 and percent brownout. The dependent variable was percent dead canopy.

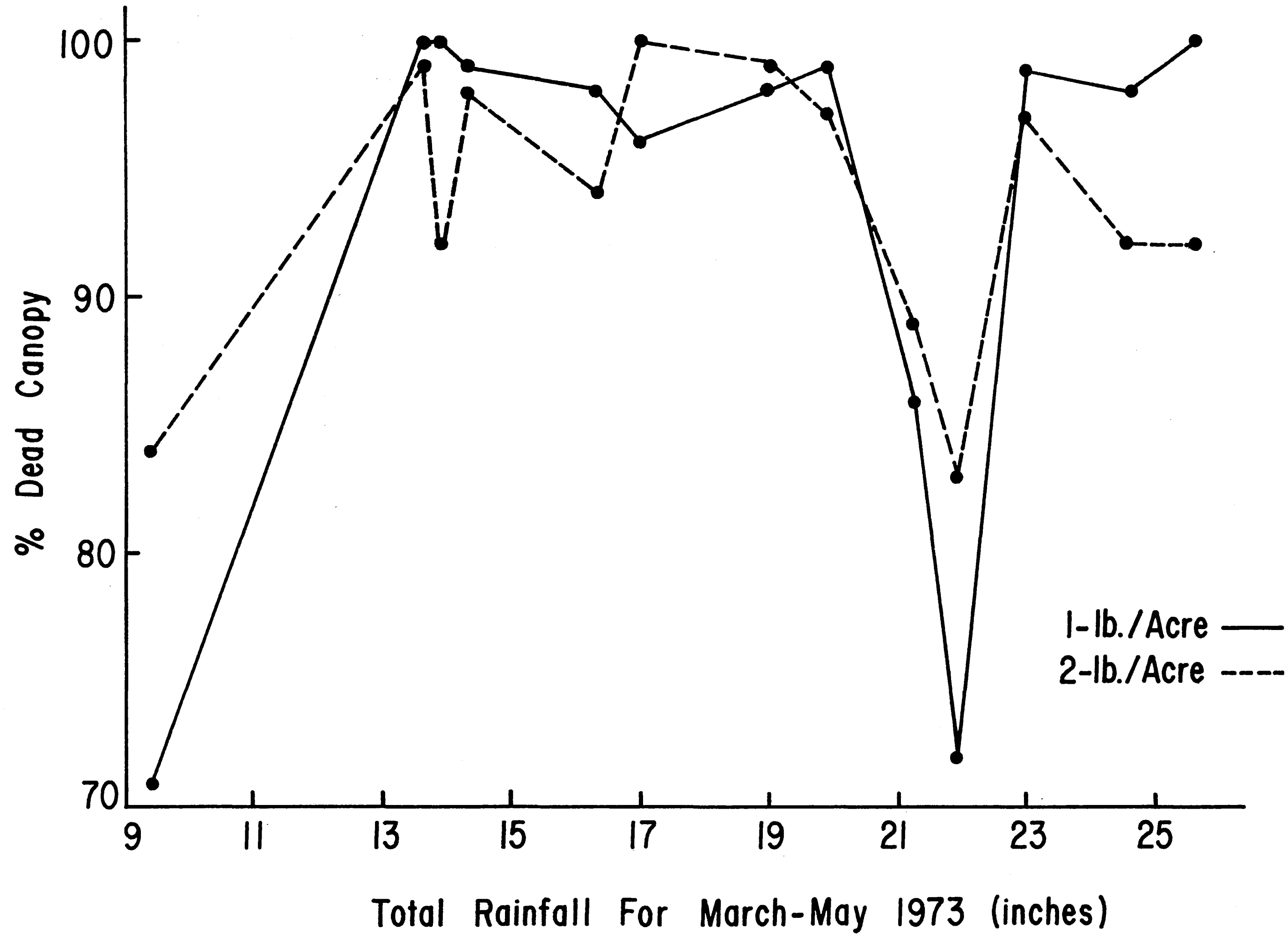

Figure 1. Effect of Total Rainfall for March, April, and May 1973 on Canopy Reduction Due to Topically Applied 2,4,5-T

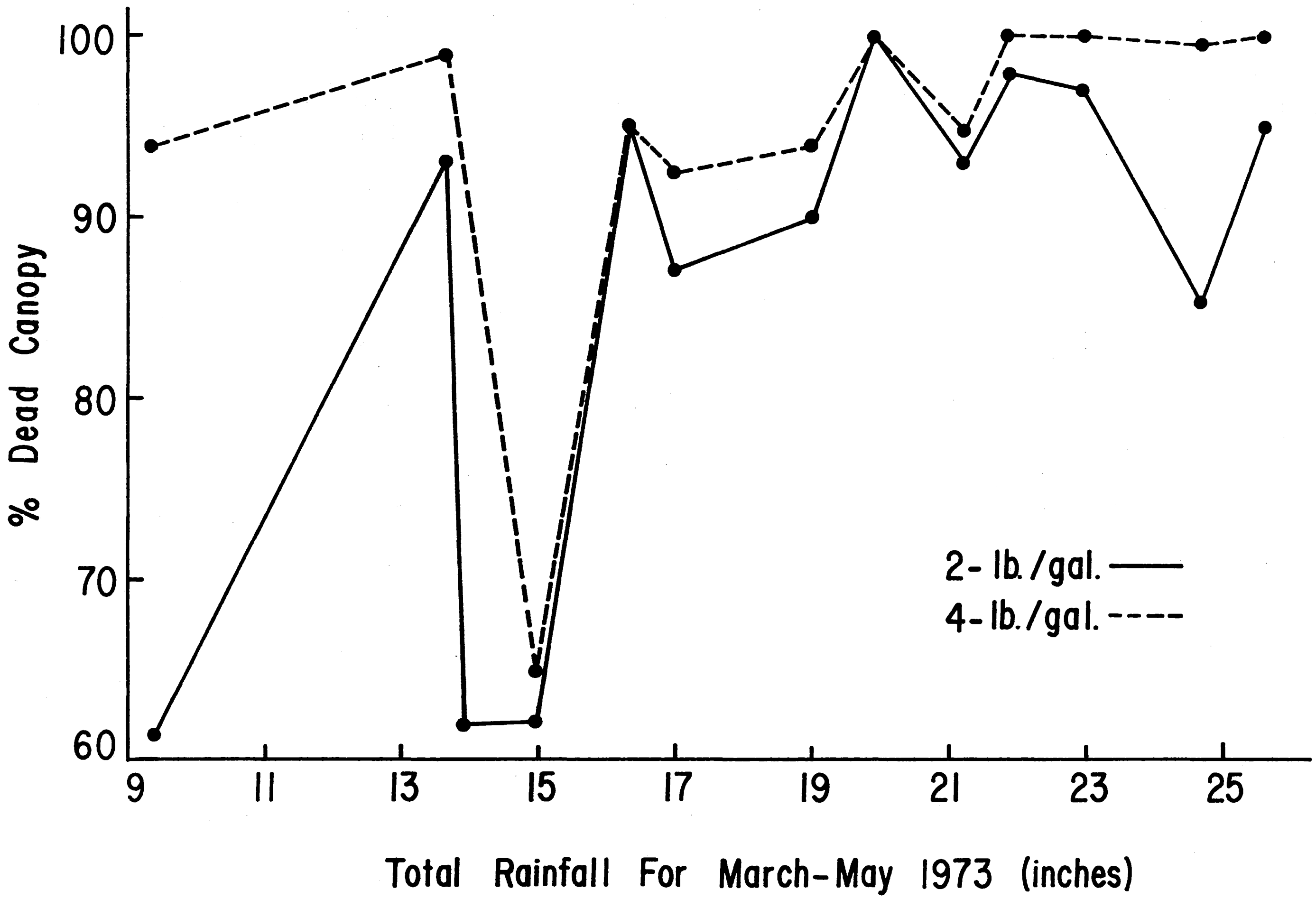

Figure 2. Effect of Rainfall for March, April, and May of 1973 on Canopy Reduction Due to Injected 2,4,5-T Amine

On the basis of a single variable, percent dead canopy at both rates of topically applied 2,4,5-T was best estimated using the stem length for 1972. Percent brownout was found to be the best estimator of dead canopy for the injection treatments. The stem length for 1972 was found to be the least best estimator of dead canopy for the injection treatments and new stem length for 1973 was the least best for estimating dead canopy of the topical treatments. The "best" two variable model for estimating dead canopy of the injection treatment was brownout and the number of leaves on new stem length for 1973. The stem length and xylem ring growth for 1972 were found to be the best two variable model for the prediction of dead canopy for the topical treatments.

CHAPTER V

SUMMARY

The objective of this study was to determine if there were some plant and environmental factors that could be used to predict the response of post oak to 2,4,5-T.

A comparison study of three methods, psychrometers, pressure chamber and a dye method, for internal water potential measurement was conducted to find which method gave the most consistent and easiest obtainable data. The pressure chamber was found to be best suited for our needs and the data was consistent with that of the psychrometers.

Multivariate regression analysis procedures used to describe the relationship of the plant factors, percent brownout and percent dead canopy showed that location had the greatest affect on tree response. The amount of brownout was generally increased with an increase in herbicide treatment rate for both the topical and injection treatments. The percent dead canopy was also increased with the high rate of injection treatment.

The variability of environmental factors encountered in this study such as those for humidity, air and soil temperature, soil moisture and plant internal water potential could not be correlated with the degree of dead canopy in either topical or injection treatments. The environmental factors may be confounded with each other, therefore, not allowing the effect of one or two of the variables to be visible on the total effect of canopy reduction. Instead, the environmental factors as a whole are controlling plant response. The percent dead canopy for either the topical or the injection treatments appeared to be little affected by the environmental factors investigated. Generally the percent of dead canopy was great for all areas. The percent dead trees was best for the high rate of injection treatment with humidity above 60% and an air temperature near 80^{o} F. The soil temperature and soil moisture appeared to have little effect on the percent of dead canopy or the number of dead trees with either the topical or injection treatments.

The percent dead canopy was best with the topical treatments in areas that received 13 to 20 inches of rainfall for the three months before treatment. The percent dead canopy for the injection treatments was best when the rainfall for the three months before treatment was greater than 15 inches. The percent of dead trees for the topical treatment did not seem to be affected by the rainfall the three months before treatment, but the percent dead trees for the injection treatments was greatest at areas which received between 19 to 24 inches of rainfall the three months before treatment.

Stepwise regression analysis procedures determined that the "best" single variable for estimating the percent dead canopy for the topical treatments was stem length for 1972. The xylem ring growth for 1972 improved the equation only slightly. Thus, growth the year before treatment was the most usable factor in estimation of the percent dead canopy from topically applied 2,4,5-T on small resprouts.

The percent brownout was found to be the "best" estimator of the percent dead canopy for the injection treatments. The number of leaves on the stem length for 1973 enhanced the percent dead canopy when added to the equation.

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