THE EFFECT OF CERTAIN CHEMICALS ON THINNING PECAN NUTS OF THE VARIETY WESTERN

By

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1968

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
May, 1971

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ACKNOWLEDGEMENTS

The author wishes to express his sincere appreciation to Professor Herman A. Hinrichs, thesis adviser, for his unselfish guidance and cooperation throughout the period of study.

Appreciation is expressed to Professor W. R. Kays, Head, Department of Horticulture for his encouragement, cooperation and assistance in preparing the manuscript.

Appreciation is extended to Dr. Robert D. Morrison of the Department of Mathematics and Statistics for his cooperation and assistance with the experimental design and statistical analysis.

The author wishes to thank Harold Davis and Jim Cummings for their assistance at the Pecan Research Station.

Special appreciation is expressed to my parents, Mr. and Mrs. Jake Hopfer, for their encouragement and understanding during the course of study.

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CHAPTER I

INTRODUCTION

The pecan ranks twelfth in commercial production of the fruit and nut crops in the United States, based on 1961-65 average yields. It is a commercial crop, primarily in the United States and Mexico (8).

Oklahoma ranks fifth among the states in average total production, which was 23,120,000 pounds for the 1960-69 mean. The highest yield was 53 million pounds in 1967, while the lowest production was 1.5 million pounds in 1968. A 6 million pound harvest preceded the heavy crop year (33). Irregular bearing appears to be the most important factor limiting pecan production and is largely responsible for the unstable market (17).

Trees of most pecan varieties with proper management require 7 to 12 years of age to produce commercial crops (8, 21). Crane (9) reports that the heaviest annual crops are produced while the trees are in their early "teens" and before they attain considerable size. He also states that the productivity of pecans declines with age, even though the potential bearing surface is increased.

Maximum fruitfulness usually depletes the food reserves and results in irregular bearing of crops (15). Fruit thinning appears to be one of the most promising methods of alleviating the irregular bearing habit of tree fruits and nuts. Heavy crop loads should be thinned so that a sufficient amount of food reserves can be maintained for flower

bud initiation and nut set the following year.

The use of chemical sprays for fruit thinning of apple and other deciduous tree fruits is a commercial practice in orchards in the United States (8).

The objectives of this study were:

(a) to determine the effect of certain chemicals on thinning pecan nutlets;

(b) to determine suitable levels of application;

(c) to determine the time of application in relation to nut size.

CHAPTER II

REVIEW OF LITERATURE

The pecan (Carya illinoensis, K. Koch.) is a monoecious plant. Staminate and pistillate flowers are borne separately on the same tree. Prior to the late 1920's there was very little known about its flowering or fruiting habits.

Woodroof (35, 36), Isbell (20) and Storey (31) report that the staminate flowers (catkins) are formed in lateral buds on previous seasons' growth. Each shoot may produce 24 to 48 catkins (20, 35, 36). Madden et al. (21) state that a single catkin may produce approximately 2,640,000 pollen grains, which is sufficient for pollination of enough pistillate flowers to produce 50,000 pounds of pecans. For this reason, staminate flower production is considered to be adequate for pollinating a full crop.

Pistillate flower differentiation occurs at the time growth is initiated in February and early March. The flowers are inconspicuous and are borne in an inflorescence at the distal end of new shoots (15, 20, 21, 23, 31, 36, 37). Pollen of the pecan is transferred from the anther to the stigma by wind (21). The pollen grain germinates on the stigma and within 12 hours the pollen tube enters the ovarian cavity. Although the exact time of fertilization is not known, it occurs between 4 days and 7 weeks after pollination (34).

Sitton (26) and Woodroof et al. (39) suggest that production of irregular nut crops may result from failure of the tree to produce pistillate flowers, failure of the flowers to set, or failure of the nuts to mature. Inadequate tree vigor and premature defoliation are probably the two most important factors contributing to irregular bearing (26).

Physiological condition of the tree, as indicated by shoot growth, is one of the more important factors influencing the yield and quality of the nuts (8). The optimum shoot length for maximum fruitfulness differs with each variety (1, 20, 32). Moderately vigorous shoots, 4 to 15 inches in length, are the most productive (1, 9, 14, 15, 20, 26, 32). Taylor (32) found that diameter of the shoot measured between the fourth and fifth nodes from the terminal is an indication of potential fruitfulness. The optimum shoot diameter for maximum production was different for each of the varieties studied. Shoots having a diameter of 0.34 to 0.83 centimeters were the most fruitful.

Pistillate flowers are initiated only if the nutritional conditions in the bud are favorable when growth begins in early spring. Growth of new shoots and leaves is made from food materials stored the previous season. Most of the food reserves are carbohydrates which have been manufactured by the leaves (26).

Leaf area and crop size are the two primary factors which determine whether the food manufactured will be adequate (26). Dodge (11) and Crane et al. (10) report that 8 to 10 leaves per nut is the optimum leaf number assuring the accumulation of sufficient reserves in the tree to provide an adequate return bloom the following season and relatively uniform annual crops.

Premature defoliation may be caused by uncontrolled insects and diseases in addition to environmental conditions. The loss of leaves will result in poor nut filling and a crop failure the following year. Defoliation studies conducted by Hinrichs (17) show that the removal of leaves prior to early September prevents pistillate flower differentiation the following spring and greatly reduces the number of catkin buds produced. Two years after defoliation pistillate flower development was normal; whereas, catkin production was reduced 20 to 50 percent. It is therefore essential that leaves be retained in healthy condition until late in the season to assure sufficient carbohydrate storage for production the following year (17, 26, 28, 29).

Thinning nuts from the tree is one method which may be used to increase quality of the kernels and to reduce alternate bearing. Fruit thinning of apple, peach and other deciduous tree fruits by hand or with chemical sprays is a commercial practice in orchards of the United States. Thinning costs are reduced 25 to 90 percent with chemical sprays (8).

Crane et al. (10) reported that hand thinning of heavy crops of pecan in August resulted in better kernel filling, increased nut size and a greater return of bloom the following year. They suggested that thinning might be expected to increase the annual yield per tree by maintaining an optimum nutritional condition in the tree at all times.

The possibility of thinning pecan nuts with growth regulating chemicals was first noted by Smith (27) and Blackmon (7). Both were attempting to prevent nut drop with growth regulators such as naphthaleneacetic acid (NAA) and found that the treatments increased nut abscission.

Dodge (11) reported that solutions containing 0.20 and 0.50 percent Elgetol (DNOC) sprayed on the tree significantly reduced flower set of the variety Success. He also observed that 25 percent of the pistillate flowers on trees of the variety Moore failed to set following two applications of 4-1-100 bordeaux mixture.

Sharpe (24) found that spraying trees of the Moneymaker variety with a 20 ppm solution of the Na salt of 2,4-D on April 27 resulted in 65 percent reduction in nut set. The treatment was ineffective when applied in the same manner to nuts of the Moore variety. He also reported that a 20 ppm spray solution of 2,4,5-T reduced nut set (47 percent average) on Moneymaker, Success, Curtis and Randall varieties when applied June 11. The treatment was not effective in thinning nuts of the Kennedy and Stuart varieties. When the same two varieties were sprayed with a 100 ppm 2,4,5-T solution, nut set was reduced an average of 60 percent. An average of 95 percent of the nuts abscised when the 100 ppm treatment was applied to the varieties Moneymaker, Success, Curtis and Randall. Application of 330 and 660 ppm maleic hydrazide sprays on Stuart and Moore trees June 16 were ineffective in reducing nut set.

Harris and Smith (16) reported that nut drop was increased 20 percent when Moore, Success and Schley trees were sprayed with a 20 ppm 2,4,5-T solution May 24. Application of a 25 ppm spray increased the number of nuts thinned from trees of the Moore and Success varieties. The 2,4,5-T sprays had no apparent effect on size or filling of the nuts. In preliminary tests, 200 and 400 ppm sprays of Isopropyl N-3-chlorophenyl carbamate (CIPC) were found to be effective in thinning nuts of the Moore variety, but ineffective on trees of the Caddo

variety. The 400 ppm treatment was the more effective treatment and resulted in 75 percent thinning. Application of 500 and 1000 ppm maleic hydrazide sprays to trees of the Moore variety May 29 reduced nut set 64 to 84 percent. Phytotoxicity was noted in both treatments. The maleic hydrazide applications were not effective when applied to the Stuart and Success varieties.

Amling and Dozier (3, 4) applied sprays of four concentrations (50, 100, 150, 200 ppm) of 3-chlorophenoxy-a-propionamide (CPA) to trees of the Stuart variety June 1. The 100 ppm treatment reduced nut set 31 percent and was the most effective. Phytotoxicity was caused by the 150 and 200 ppm CPA sprays.

Preliminary investigations by Hinrichs (18) indicate that nuts may be thinned from San Saba Improved and Western trees with sprays of CPA. Nuts were completely thinned from both varieties when treatments (100, 150, 200 ppm) were applied May 23. The 100 ppm spray applied June 6 caused nut set to be reduced 49 and 57 percent respectively, over the check (normal drop). The best thinning response was obtained when the treatments were applied June 20 to the variety Western. The 100 ppm spray reduced nut set 24 percent and was the most effective. Phytotoxicity occurred on shoots of San Saba Improved trees for each date of application and the three concentrations of CPA. Phytotoxicity was observed on shoots of the variety Western at the highest rate of application.

The growth regulator, 2-chloroethanephosphonic acid[1] (Ethrel) has been shown to be effective in thinning apples, peaches and cherries (5,

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[1]Ethepon has been approved recently as the chemical name.

13). Application of sprays containing 100 to 2000 ppm during the pre-bloom to early post bloom stages of development thinned most of the fruit from several apple cultivars with no phytotoxicity. Fruit set of Redhaven peach was reduced 38 to 60 percent when 50 and 150 ppm Ethrel sprays were applied 4 weeks after full bloom (13). Sour cherries sprayed with 250, 500, 1000 and 2000 ppm solutions 5 days prior to harvest were removed from the tree by mechanical shakers with much greater ease than from untreated trees. The 500 ppm treatment was indicated as the most satisfactory level of application. The 1000 and 2000 ppm sprays caused excessive leaf abscission and hindered mechanical harvesting of the fruit.

Ethrel sprays (250, 500, 1000 ppm) applied September 30, 1969 to Stuart and Western pecan trees enhanced shuck loosening (19). Fourteen days following application the 1000 ppm treatment increased shuck loosening 67 and 62 percent respectively. The 500 ppm spray enhanced opening of the shucks of Stuart and Western nuts 40 and 49 percent. The 250 ppm application caused 31 percent of the Western shucks to loosen but was ineffective on the Stuart variety. The treated shoots were examined for injury May 4. Shoots of the Western variety were severely damaged as a result of the 1000 ppm treatment. Less damage to the shoots resulted from the 250 and 500 ppm applications. No phytotoxicity occurred when the Ethrel treatments were applied to Stuart.

Preliminary studies indicate that Ethrel is effective in promoting fruit abscission. It appears that the growth regulator may have potential for use in thinning pecan nutlets, if applied at the proper rate and stage of development.

CHAPTER III

METHODS AND MATERIALS

Petiole Abscission Test

A preliminary leaf petiole abscission test was conducted in the greenhouse. The objective of the study was to determine the effect of CPA, CIPC, Ethrel and NAA on abscission. The purpose of the study was to determine rates of application that might be employed for thinning pecan nuts.

Four stratified Western pecan nuts were planted in each of 100, one gallon, soil filled pots January 12, 1970. A uniform soil mix consisting of equal parts soil, sand and peat moss was used as the growing media. The plants were grown in a greenhouse in which the temperature ranged from 70° F. to 75° F. during the day and the night temperature was maintained near 60° F.

A completely randomized design was used to eliminate the effect of treatment location. Sixty-eight pots with uniform seedlings were selected for use in the test. Sixteen plants, four single pot replications, were used in each of the 17 treatments. The pots were assigned random numbers (1-68) for identification. Four columns (running from east to west) and 17 rows (running from north to south) were used to assign pot location in the bench. Pot location was then determined by drawing numbers (1-68) at random and filling the rows in consecutive order. Treatment and replication numbers were then assigned in the

same order. The plants were tagged for identification to simplify collection of data.

All pots were moved into the headhouse for treatment March 14. The four replications of each treatment were grouped together and the leaf blades were severed from the plants. The treatments were as follows: CPA (25, 50, 100, 200 ppm), CIPC (50, 100, 200, 400 ppm), Ethrel (100, 200, 400, 800 ppm), NAA (5, 10, 20, 40 ppm) and the check treatment (distilled water). Three drops of Tween 20 surfactant were added to each liter of spray solution. Larger volumes of the spray solutions were prepared than were needed to reduce error in measuring the small amount of chemical used. The petioles were sprayed by means of a small hand atomizer. The check treatment was applied first to prevent possible contamination from another treatment. Treatments were applied in order of increasing concentration. The sprayer was washed and rinsed thoroughly after each treatment. The pots were then moved back into the greenhouse to their assigned location. Pots in the columns were spaced on 10 inch centers and pots in the rows were spaced on 18 inch centers, to provide access to all pots when taking readings.

The first reading was taken 9 days following application of the treatments. Data were collected on alternate days for a period of 3 weeks. The seedlings were tapped lightly on the stem prior to recording data to dislodge abscised petioles.

Chemical Nut Thinning

Eight year old trees of the variety Western with a heavy set of pistillate flowers were used in the study. The trees were located on the Pecan Research Station near Sparks, Oklahoma. Trees were spaced

17.5 ft. apart within the row and 17.5 ft. apart between the rows. It was necessary to use young trees for the tests since the older trees were in the "off year" of production. During the summer months, the trees were sprayed periodically with Du-ter, Sevin and Malathion to control pecan scab, pecan nut casebearer, black aphids, fall webworm, pecan weevil and other insects.

The treatments were to have been applied 2, 4 and 6 weeks after pollination; however, applications were delayed 1 week due to heavy rains which occurred during the second week following pollination. The stigmas of the pistillate flowers were receptive from May 4-12 and pollen was shedding May 10. Three chemicals (CPA, CIPC, Ethrel) that were used in the petiole abscission study were applied June 3, June 17, and July 1, 1970.

White tags, 1 x 1¼ inches, were tied on the shoots to identify the clusters for treatment and for recording data. The tags were labeled on both sides with India ink.

Twenty-four trees were used in the CPA treatments. Each tree was divided into southwest, southeast, northeast, northwest quadrants and the treatments were randomized. A latin square was prepared for each treatment replication on the three dates of application. Each treatment (0, 40, 80, 160 ppm) appeared once in each row (tree) and column (section) of the latin square. Fifty nuts were tagged in each section of the trees prior to application. Eight trees were used on each date of application. Two hundred nuts were sprayed in each replication of the treatments.

In the CIPC test, a total of 20 trees were used. For the first date of application, 100 nuts were tagged on each of 4 trees. Two

replications and 2 concentrations (200, 400 ppm) were applied to single tree plots. Eight trees were used on each of the last two dates of application. Fifty nuts were tagged for treatment on each of the trees. One hundred nuts were sprayed in each of the two replications. The check treatments from the CPA plots were used for comparison, since the number of trees available for use were limited.

Two trees were used on each date of application of Ethrel treatments (50, 100 ppm). The trees were divided into quadrants (SW, SE, NE, NW) and 50 nuts were tagged in each section. The treatments were applied at random to half-tree plots. Since the number of trees which could be used were limited, comparison was made with check treatments in the CPA plots.

Nuts were harvested October 20, 1970 from all treatments for analysis.

Determination of Nut Size on the Date of Application

Nut clusters were collected at random from three trees, to which treatments were applied, for determination of nut size at the time of application. Ten nutlets were severed at random from the clusters in each of the samples and length and diameter were measured in centimeters with a caliper. The volume displacement (ml.) of the 10 nuts was then determined by submerging the nuts in a known volume of water.

CHAPTER IV

RESULTS AND DISCUSSION

Petiole Abscission Test

The cumulative number of petioles abscised from each of the treatments is shown in Table I. Abscission was influenced most by the treatments 9 to 17 days following application.

The CPA treatments inhibited abscission of petioles (Figure 1). The 50, 100 and 200 ppm sprays reduced abscission the most and caused approximately the same degree of response. When compared to the check treatment, there was a 34 percent reduction in the number of petioles abscised 11 days after treatment and a 24 percent reduction 13 days following application. The 25 ppm treatment had the least inhibitory effect. Eleven days following treatment, abscission was reduced 12 percent. The percent of the petioles abscised 13 days after treatment was equal to that of the check. Abscission was increased 9 percent 15 days following the 25 ppm spray.

Abscission was enhanced when the petioles were sprayed with CIPC (Figure 2). The 200 ppm treatment was the most effective in promoting abscission and resulted in a 28 percent increase in the number of petioles abscised 9 days after treatment, when compared to the check. Abscission was increased 24 percent 11 days following application and 19 percent 13 days after treatment. The number of petioles abscised was increased 18 percent 9 days following treatment with 400 ppm CIPC.

TABLE I

EFFECT OF CPA, CIPC, ETHREL, AND NAA ON LEAF PETIOLE ABSCISSION

Treatment (ppm)	Number of Petioles Sprayed	Cumulative Number of Petioles Abscised — Days After Treatment										
		9	11	13	15	17	19	21	23	25	27	29
CPA (25)	78	13	45	62	70	71	72	73	73	73	73	73
CPA (50)	71	4	25	37	47	50	53	54	55	63	66	67
CPA (100)	80	12	27	44	56	60	62	64	69	72	72	72
CPA (200)	79	12	26	43	54	58	61	66	71	72	73	73
CIPC (50)	80	37	61	67	69	70	70	71	73	76	76	77
CIPC (100)	72	26	56	60	62	63	65	66	67	68	69	69
CIPC (200)	77	47	72	72	76	76	76	76	76	76	76	76
CIPC (400)	74	38	64	67	70	71	72	73	73	74	74	74
Ethrel (100)	77	55	75	76	77	77	77	77	77	77	77	77
Ethrel (200)	70	59	70	70	70	70	70	70	70	70	70	70
Ethrel (400)	70	57	70	70	70	70	70	70	70	70	70	70
Ethrel (800)	72	51	72	72	72	72	72	72	72	72	72	72
NAA (5)	71	11	25	40	50	58	62	65	66	69	69	69
NAA (10)	78	14	28	41	42	45	51	54	63	72	72	73
NAA (20)	78	15	30	44	53	57	60	62	68	73	73	74
NAA (40)	88	9	12	22	32	40	47	56	67	71	72	74
Check (00)	72	24	50	57	58	60	60	62	63	67	68	68

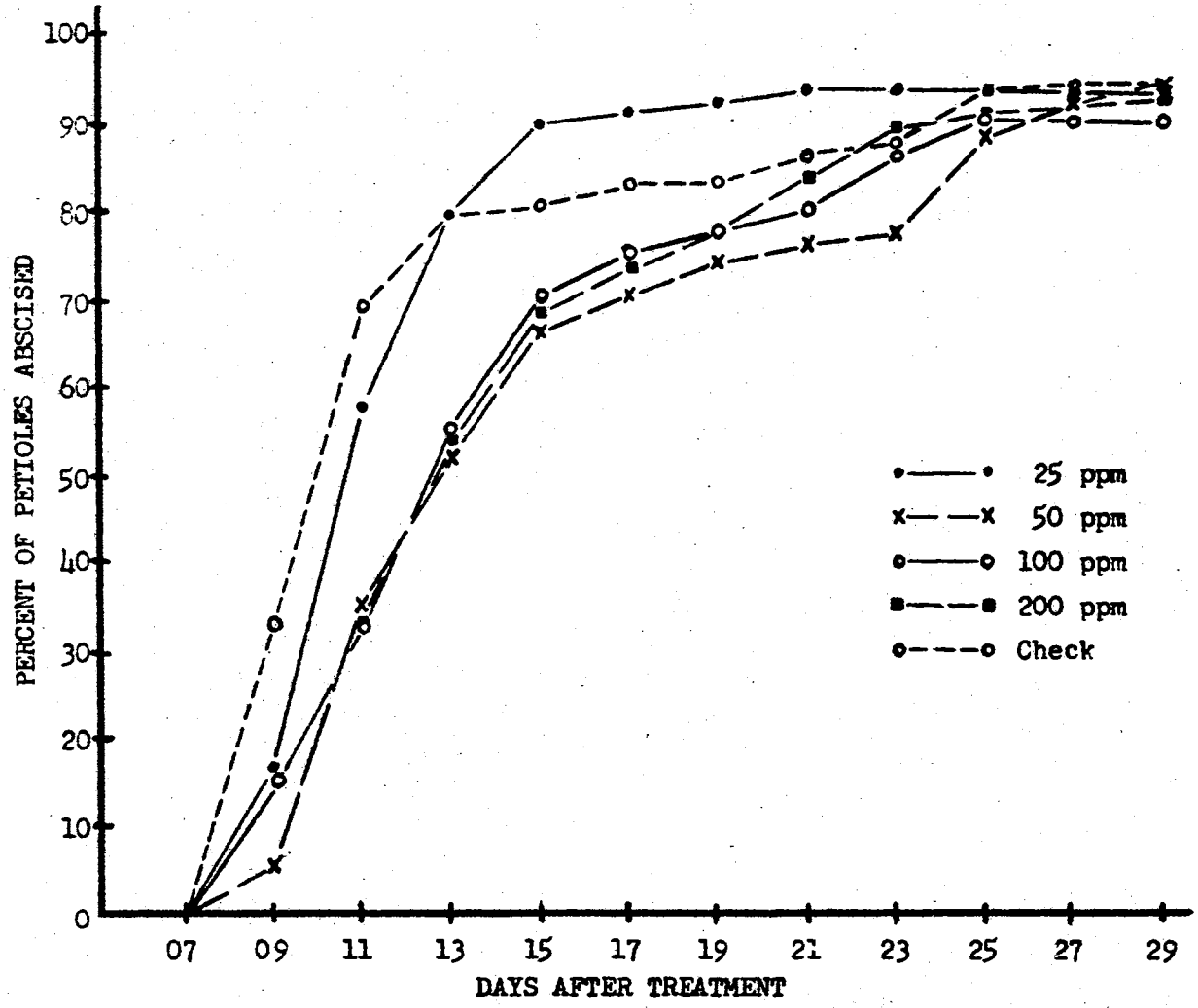

Figure 1. Effect of CPA on Leaf Petiole Abscission of Western Pecan Seedlings

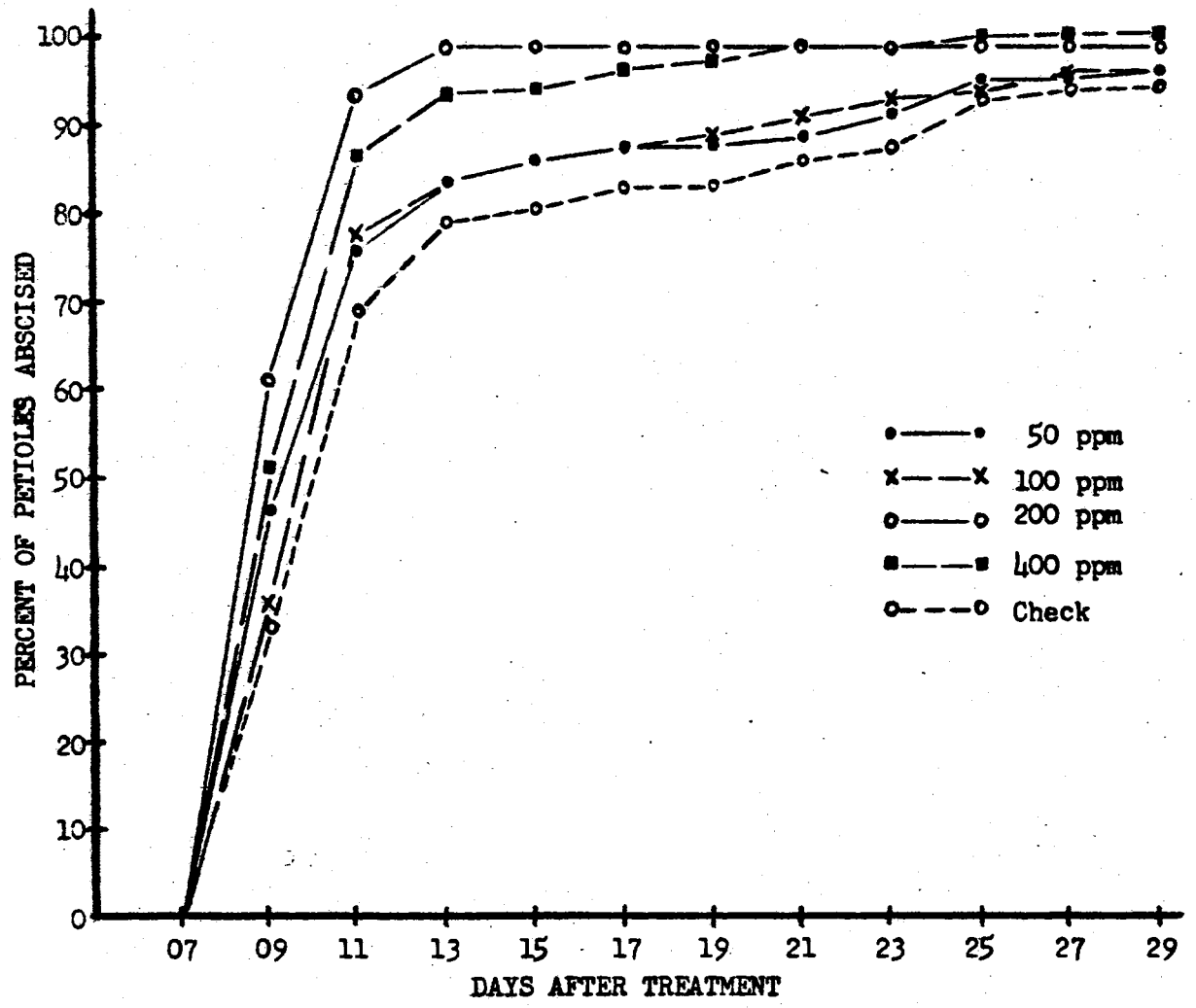

Figure 2. Effect of CIPC on Leaf Petiole Abscission of Western Pecan Seedlings

Abscission was enhanced 17 and 14 percent 11 and 13 days following treatment respectively. The 50 and 100 ppm treatments were equally effective and caused 8 percent of the petioles to abscise 11 days after treatment. The treatments caused only a 4 percent increase in abscission 13 days following application.

Ethrel was very effective in promoting abscission, when compared to the check (Figure 3). The 200 and 400 ppm treatments increased abscission 50 and 31 percent 9 and 11 days following application respectively. Abscission was enhanced 38 percent by the 100 and 800 ppm treatments 9 days after application. One hundred percent of the petioles had abscised 11 days following treatment with the 3 highest rates. The 100 ppm spray increased abscission 20 percent 15 days after application and all the petioles had abscised. The rates used were excessive, since all treatments resulted in complete abscission of the petioles.

Petiole abscission was inhibited considerably with NAA treatments, when compared with the check (Figure 4). The 40 ppm treatment was the most effective and increased petiole retention 23 percent, 9 days after application. Abscission was inhibited 56, 54, 44 and 38 percent respectively 11, 13, 15 and 17 days following treatment. Effectiveness of the 5, 10 and 20 ppm sprays were the same 9, 11 and 13 days after application and abscission was reduced 14, 31 and 23 percent respectively. Fifteen days after application abscission was not as great from the 10 ppm as compared with the 5 and 20 ppm treatments. The 5 ppm treatment was the least effective and reduced petiole abscission 10 percent, 15 days after application. Abscission was enhanced slightly by the 5 ppm treatment 19 days following application.

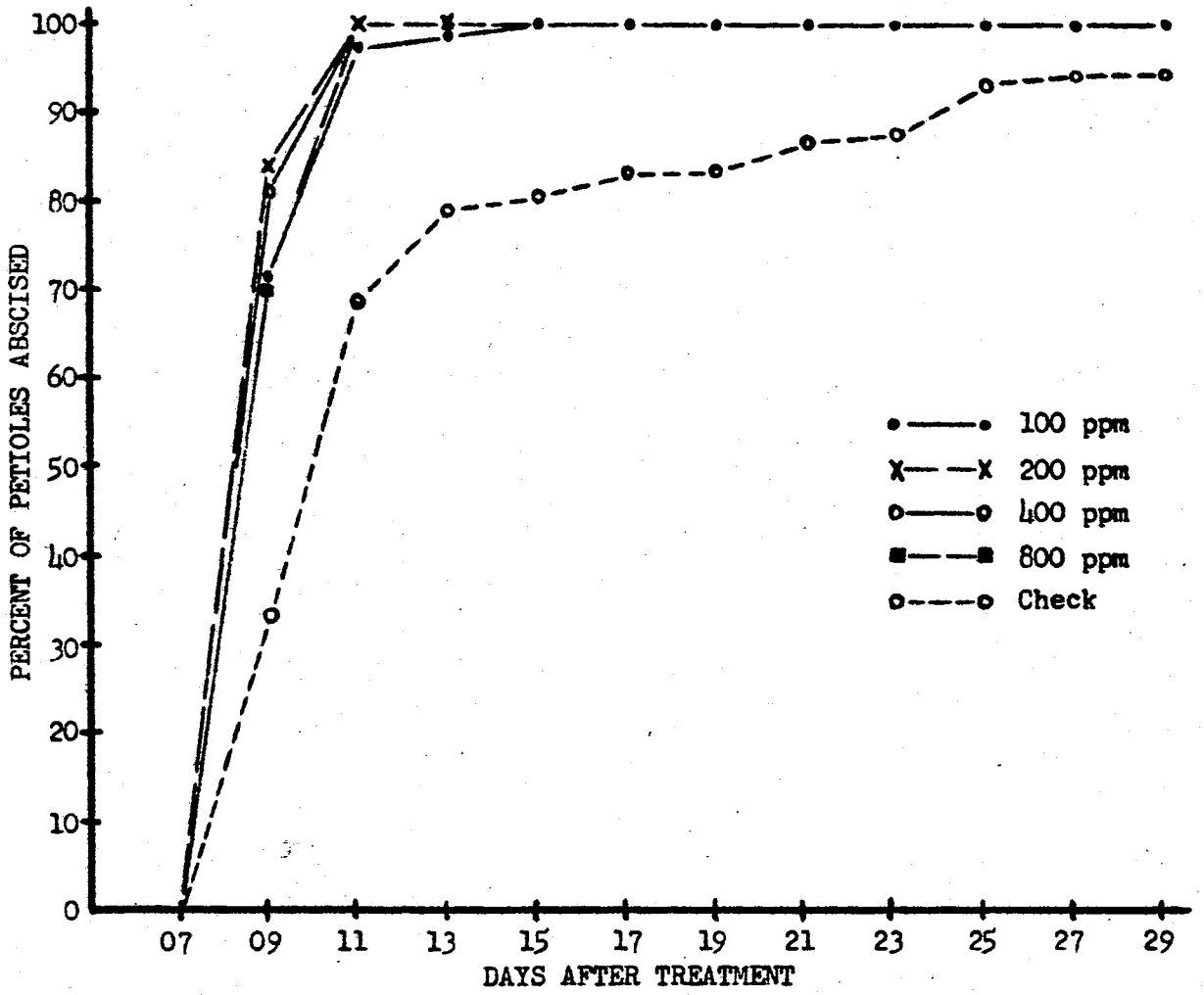

Figure 3. Effect of Ethrel on Leaf Petiole Abscission of Western Pecan Seedlings

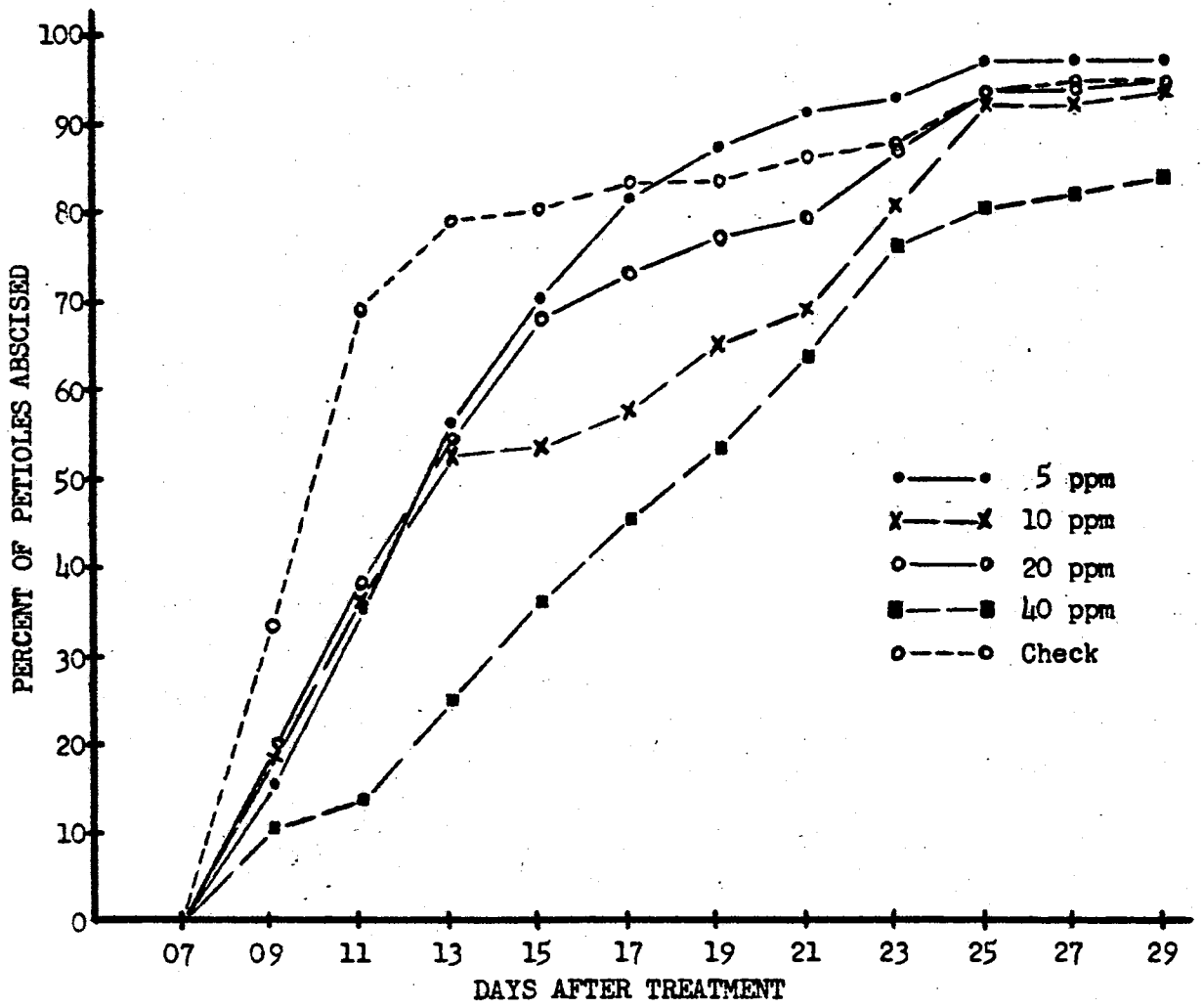

Figure 4. Effect of NAA on Leaf Petiole Abscission of Western Pecan Seedlings

Abscission was accelerated by the CIPC and Ethrel treatments. Application of CPA and NAA treatments delayed petiole abscission considerably. The results of the preliminary study indicate the CIPC and Ethrel have a different mode of action than CPA and NAA on abscission.

Chemical Nut Thinning

The cumulative number of nuts abscised from the CPA treatments on each date of application is shown in Table II. The effectiveness of the treatments occurred within the first 15 days after application. The 80 ppm treatment thinned 14 percent of the nuts, 8 days after application (Figure 5). Treatments consisting of 80 and 160 ppm sprays were equally effective 15 days following application. Nut set was reduced 27 percent when compared with the check. There was no difference in thinning from the treatments after 22 days. The 40 ppm treatment removed less nuts and resulted in adequate thinning. Fifteen days after treatment, nuts were thinned 15 percent. Treatments applied June 3 were shown to be significantly different from the check at the 1 percent level (Table III). Readings taken 8, 15, 22, 29 and 36 days following treatment were significantly different. The date by treatment interaction was also significant at the 1 percent level. Location of the treatments in different sections of the trees had no effect on nut thinning.

The number of nuts thinned by the CIPC treatments are shown in Table IV. The thinning response occurred within 15 days, following the June 3 application. Figure 6 illustrates the effectiveness of CIPC sprays applied on the first date. Fifteen days following application, 100 percent of the nuts treated with the 400 ppm spray had abscised.

TABLE II

EFFECT OF CPA ON THINNING WESTERN PECAN NUTS

Treatment (ppm)	Date Applied 1970	Number of Nuts Sprayed	Cumulative Number of Nuts Abscised — Days After Treatment				
			8	15	22	29	36
CPA (40)	6-3	400	94	174	184	184	184
CPA (80)	6-3	400	140	225	228	231	231
CPA (160)	6-3	400	92	230	231	231	231
Check (00)	6-3	400	82	117	123	128	128
CPA (40)	6-17	400	5	11	14	18	
CPA (80)	6-17	400	10	18	20	21	
CPA (160)	6-17	400	7	13	25	28	
Check (00)	6-17	400	12	12	12	16	
CPA (40)	7-1	400	4	8	10		
CPA (80)	7-1	400	6	10	14		
CPA (160)	7-1	400	2	8	20		
Check	7-1	400	2	6	18		

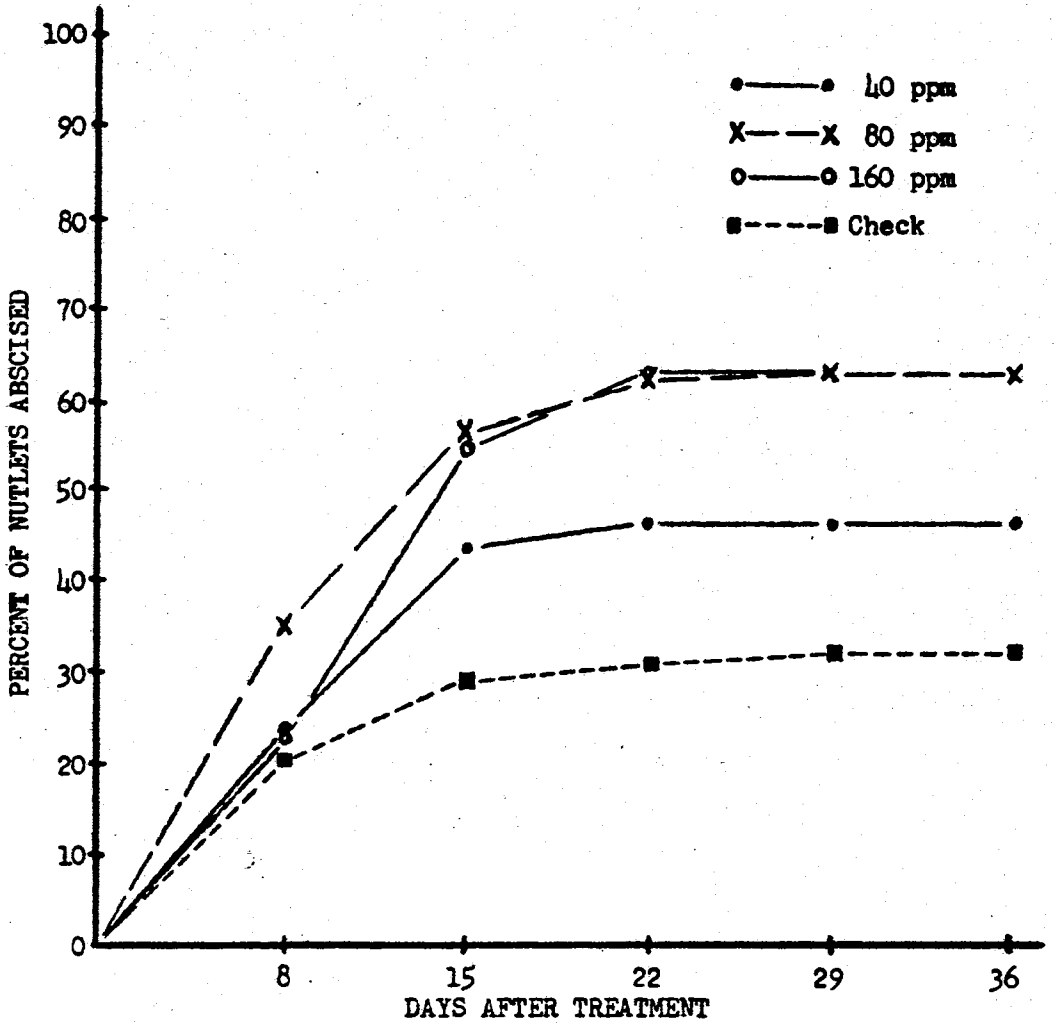

Figure 5. Effect of CPA Sprays Applied June 3, 1970 on Thinning Western Pecan Nutlets

TABLE III

ANALYSIS OF VARIANCE FOR CPA TREATMENTS APPLIED JUNE 3, 1970 TO WESTERN PECAN NUTLETS

Source of Variation	df	MS
Total	88	
Replications (R)	1	371.28
Treatments (T)	3	898.11*
Section (S)	3	44.53
Error A	12	141.59
Trees in Replications	6	350.11
T x R	3	7.03
S x R	3	164.03
Dates of Reading (D)	3	983.36*
D x T	9	50.67*
D x S	9	8.45
Error B	36	5.37

*Significant at the 1 percent level.

TABLE IV

EFFECT OF CIPC ON THINNING WESTERN PECAN NUTS

Treatment (ppm)	Date Applied 1970	Number of Nuts Sprayed	Cumulative Number of Nuts Abscised — Days After Treatment				
			8	15	22	29	36
CIPC (200)	6-3	200	109	170	170	170	170
CIPC (400)	6-3	200	178	200	200	200	200
Check (00)	6-3	200	41	58	61	64	64
CIPC (200)	6-17	200	6	6	6	7	
CIPC (400)	6-17	200	6	7	7	7	
Check (00)	6-17	200	6	6	6	8	
CIPC (200)	7-1	200	2	4	6		
CIPC (400)	7-1	200	2	3	4		
Check (00)	7-1	200	1	3	9		

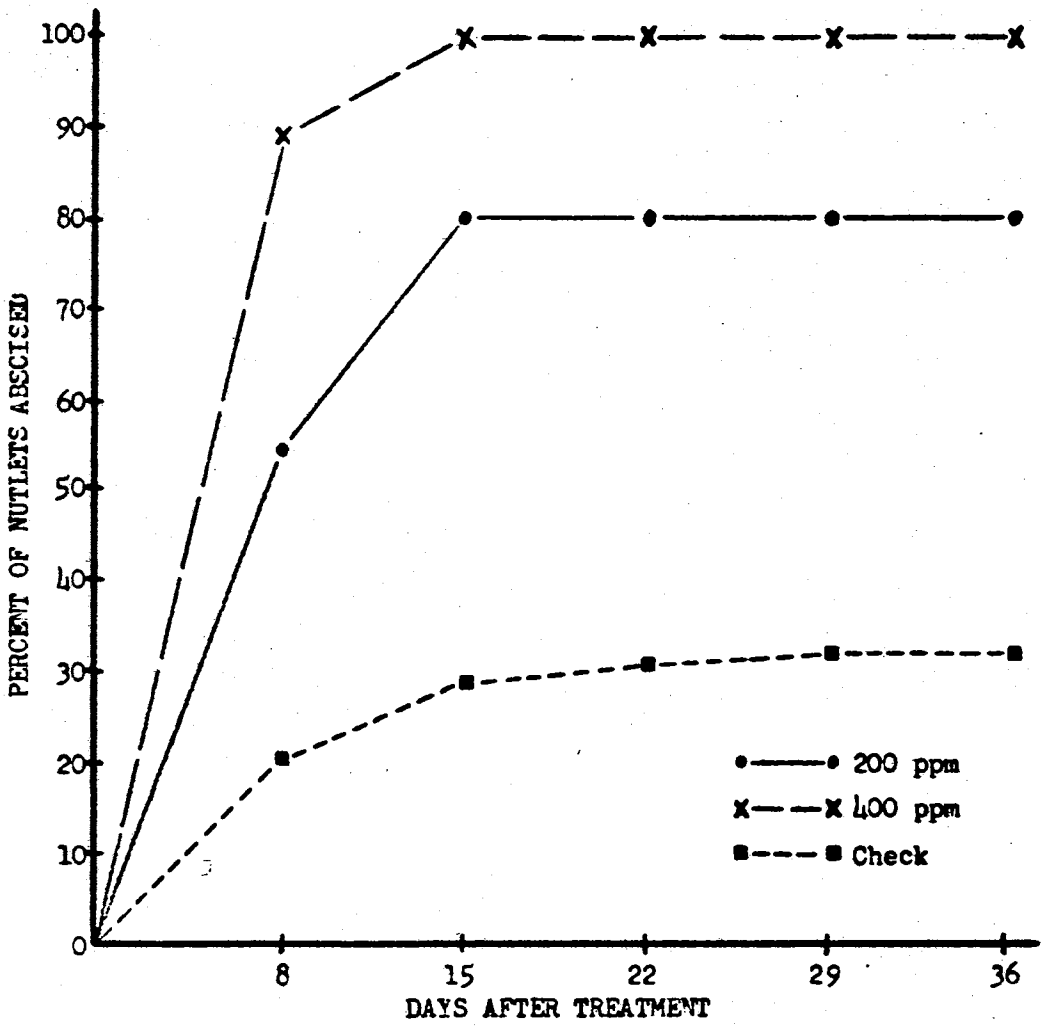

Figure 6. Effect of CIPC Sprays Applied June 3, 1970 on Thinning Western Pecan Nutlets

Nut thinning was increased 68 and 71 percent respectively 8 and 15 days after treatment, when compared to the check. The 200 ppm treatment enhanced thinning 34 and 56 percent during the same period of time. Both rates of application caused excessive thinning of the nuts, when applied June 3.

The cumulative number of nuts abscised following treatment with Ethrel is shown in Table V. The thinning response occurred within 15 days after treatment. The 100 ppm treatment was the most effective. Thinning was increased 63 and 65 percent respectively 8 and 15 days following treatment, when compared to the check (Figure 7). Nuts sprayed with 50 ppm Ethrel were thinned 31 and 44 percent during the same period. Excessive thinning resulted from both treatments, when applied June 3.

None of the treatments (CPA, CIPC, Ethrel) were effective in thinning nuts when applied June 17 and July 1 (Figures 8-13). Nut development apparently was to a stage of development that the chemicals used were not effective.

Samples were analyzed from the different treatments for nut size (number of nuts per pound). There were 58.1 nuts per pound in the check treatment as compared to 55.6 to 59.7 nuts per pound for the treatments. There was essentially no difference in nut size.

Nut Size on the Date of Application

Table VI shows the average length, average diameter and volume displacement for each of the three 10 nut samples collected on the first two dates of application. On June 3, the average length ranged from 0.78 to 0.85 centimeters, the average diameter ranged from 0.28 to

TABLE V

EFFECT OF ETHREL ON THINNING WESTERN PECAN NUTS

Treatment (ppm)	Date Applied 1970	Number of Nuts Sprayed	Cumulative Number of Nuts Abscised Days After Treatment				
			8	15	22	29	36
Ethrel (50)	6-3	200	104	146	150	151	151
Ethrel (100)	6-3	200	167	191	192	192	192
Check (00)	6-3	200	41	58	61	64	64
Ethrel (50)	6-17	200	4	7	8	8	
Ethrel (100)	6-17	200	5	5	6	7	
Check (00)	6-17	200	6	6	6	8	
Ethrel (50)	7-1	200	0	1	1		
Ethrel (100)	7-1	200	0	0	1		
Check (00)	7-1	200	1	3	9		

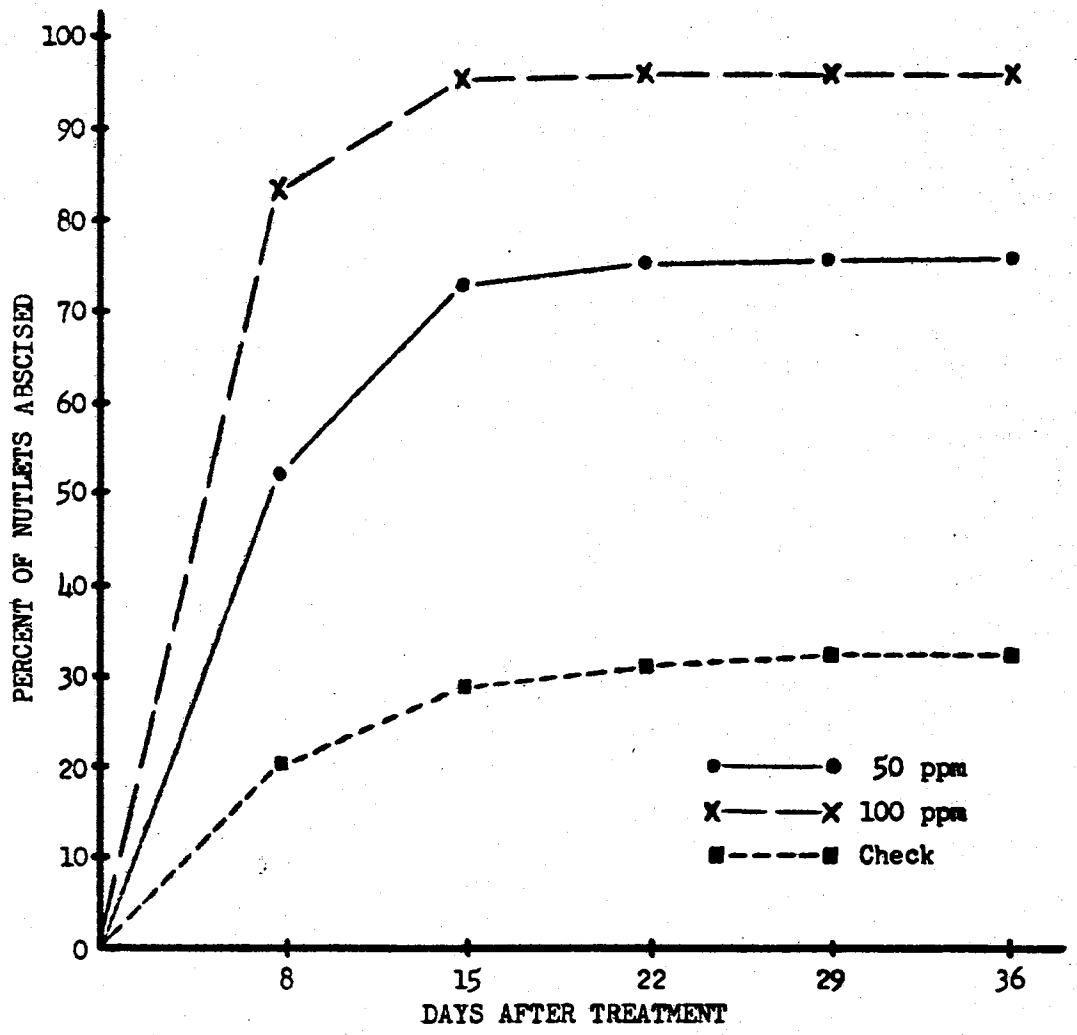

Figure 7. Effect of Ethrel Sprays Applied June 3, 1970 on Thinning Western Pecan Nutlets

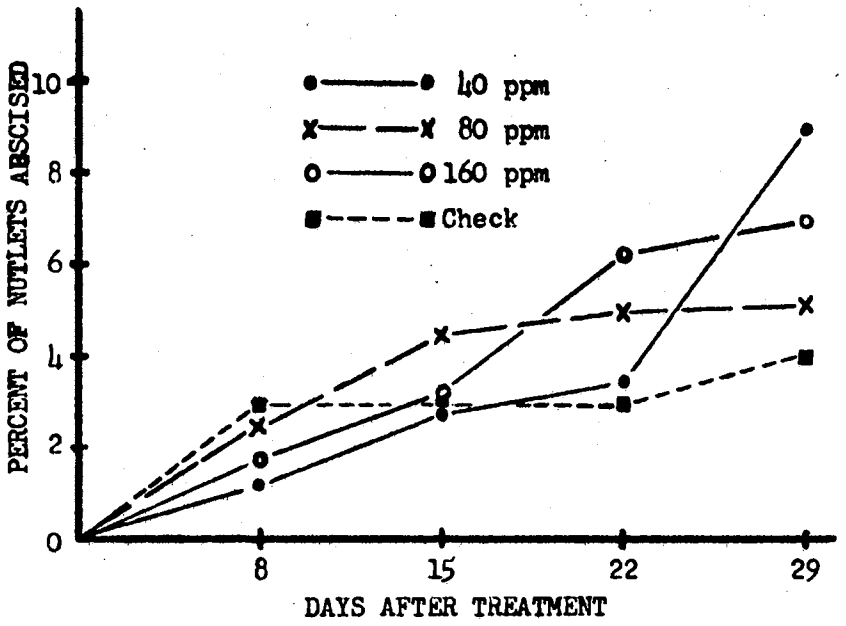

Figure 8. Effect of CPA Sprays Applied June 17, 1970 on Thinning Western Pecan Nutlets

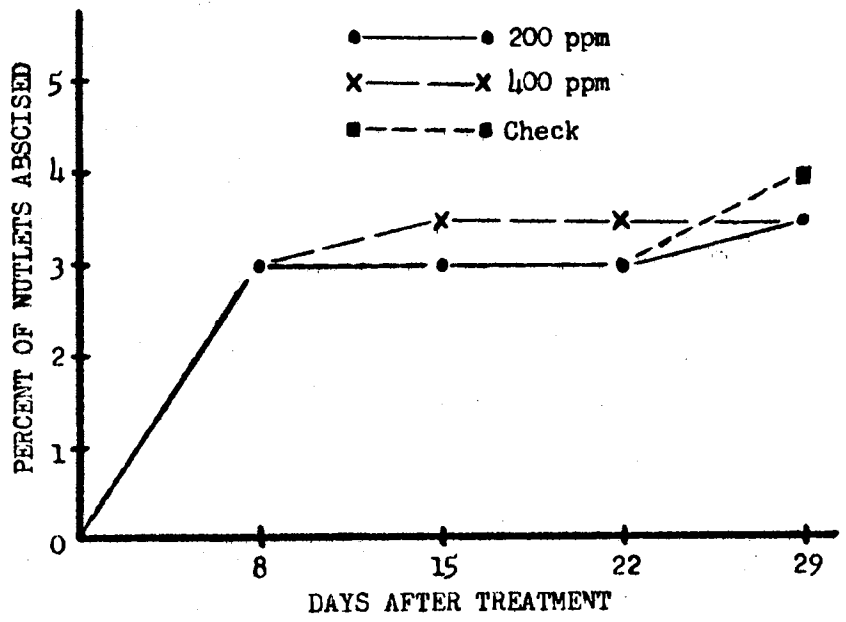

Figure 9. Effect of CIPC Sprays Applied June 17, 1970 on Thinning Western Pecan Nutlets

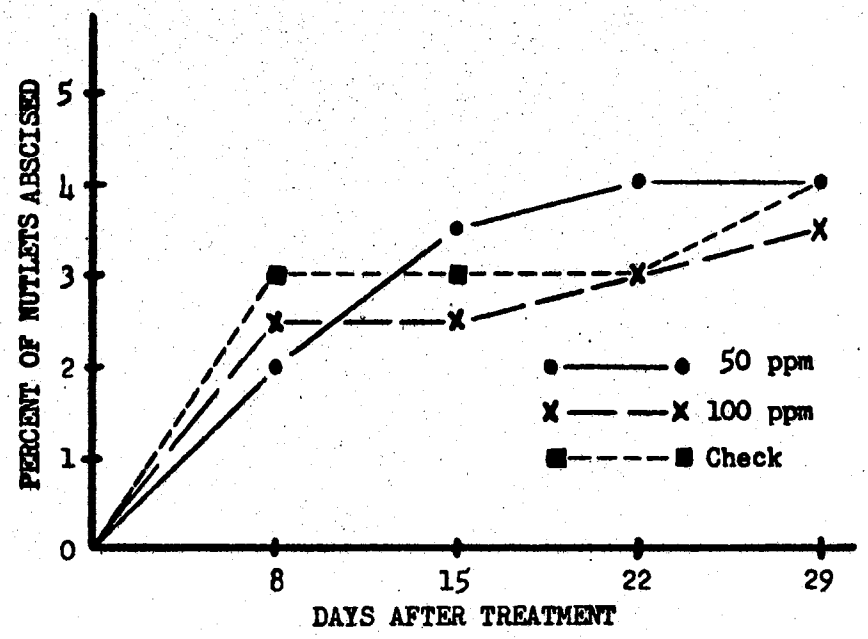

Figure 10. Effect of Ethrel Sprays Applied June 17, 1970 on Thinning Western Pecan Nutlets

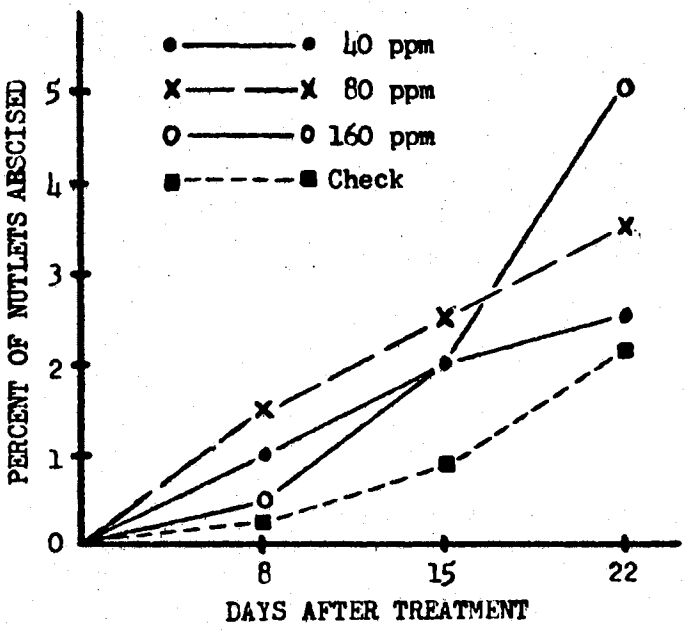

Figure 11. Effect of CPA Sprays Applied July 1, 1970 on Thinning Western Pecan Nutlets

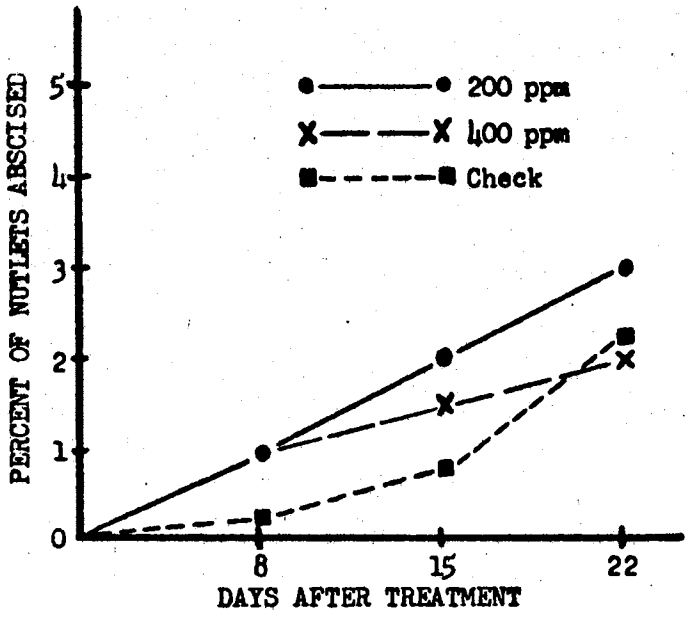

Figure 12. Effect of CIPC Sprays Applied July 1, 1970 on Thinning Western Pecan Nutlets

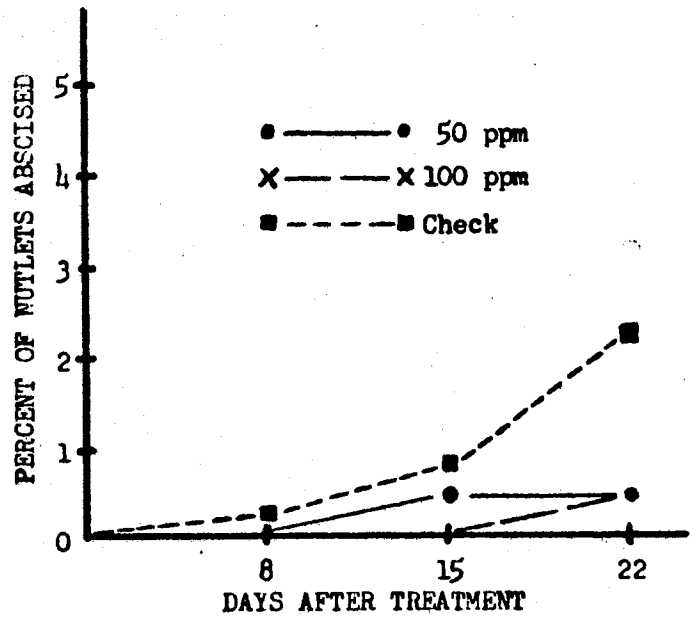

Figure 13. Effect of Ethrel Sprays Applied July 1, 1970 on Thinning Western Pecan Nutlets

TABLE VI

DETERMINATION OF NUT SIZE OF THE VARIETY WESTERN
ON THE DATE OF APPLICATION

Date of Collection 1970	Replication*	Average Nut Size		
		Length (cm)	Diameter (cm)	Volume of Water Displaced (ml)
6-3	1	0.78	0.28	0.68
6-3	2	0.85	0.31	0.79
6-3	3	0.82	0.30	0.78
6-17	1	1.30	0.42	1.74
6-17	2	1.28	0.42	1.69
6-17	3	1.25	0.42	1.59

*Ten nuts were analyzed in each replication to determine the average nut size.

0.31 centimeters, and the volume of water displaced by 10 nuts ranged from 0.68 to 0.79 milliliters. On June 17, the average length ranged from 1.25 to 1.30 centimeters and the volume displacement ranged from 1.59 to 1.74 milliliters. The diameter was 0.42 centimeters for all 3 samples. From the three measurements, the nut diameter was the least variable.

CHAPTER V

SUMMARY AND CONCLUSIONS

Irregular bearing appears to be the most limiting factor in the production of pecan crops. Maximum fruitfulness usually depletes the food reserves and results in variable production.

The objectives of this study were to determine: (1) the effect of certain growth regulating chemicals on thinning pecan nuts; (2) suitable levels of application; (3) time of application in relation to nut development.

A preliminary test of petiole abscission was conducted in the greenhouse to determine application rates of CPA, CIPC, Ethrel and NAA for thinning pecan nuts. Abscission was influenced most by treatments 9 to 17 days following application (Table I).

The Ethrel treatments (100, 200, 400, 800 ppm) were the most effective in promoting petiole abscission. All petioles abscised from the treated plants within 11 to 15 days following application (Figure 3).

The percent petiole abscission was moderately increased with CIPC treatments (50, 100, 200, 400 ppm). The 200 ppm treatment was the most effective and caused 28 percent of the petioles to abscise 9 days after application (Figure 2). The 50 and 100 ppm CIPC sprays were the least effective in accelerating abscission.

The CPA treatments (25, 50, 100, 200 ppm) inhibited petiole abscission. The three highest rates of application caused an approximately equal retention of the petioles. When compared with the check treatment, abscission was reduced 34 and 24 percent respectively 11 and 13 days following treatment (Figure 1). The 25 ppm treatment was the least inhibitory and reduced petiole abscission 12 percent, 11 days after application.

Petiole abscission was considerably delayed with NAA treatments, when compared to the check. The 40 ppm treatment was the most effective inhibitor of abscission. The number of petioles retained 9, 11, 13, 15 and 17 days after treatment was increased 23, 56, 54, 44 and 38 percent respectively (Figure 4). The 5 ppm treatment was the least effective and the number of petioles abscised was reduced 10 percent, 15 days following application.

The CPA treatments (40, 80, 160 ppm) thinned nuts effectively when applied June 3. When compared to the check, the 80 ppm treatment was the most effective and thinned 14 and 27 percent of the nuts 8 and 15 days following application (Figure 5). The 160 ppm spray was equally effective but no additional thinning occurred from the treatment. Fifteen days following treatment, the 40 ppm spray had caused 15 percent thinning of the nuts. The treatments were found to be significantly different from the check at the 1 percent level. Location of the treatments in different sections of the trees had no effect on nut thinning.

Nuts were excessively thinned when 200 and 400 ppm CIPC treatments were applied June 3. The 400 ppm application caused abscission of all nuts in the treatments within 15 days (Figure 6). Thinning was

increased 34 and 56 percent respectively 8 and 15 days following application of the 200 ppm spray.

Ethrel treatments applied June 3 increased the number of nuts thinned from Western trees considerably. The 100 ppm treatment thinned 65 percent of the nuts within 15 days and was excessive. The 50 ppm treatment thinned 31 and 44 percent of the nuts respectively 8 and 15 days following application.

On June 3, the average nut length ranged from 0.78 to 0.85 centimeters and the average nut diameter ranged from 0.28 to 0.31 centimeters (Table VI). The volume of water displaced by 10 nuts ranged from 0.68 to 0.79 milliliters. On June 17, the average nut length ranged from 1.25 to 1.30 centimeters and the nut diameter was 0.42 centimeters for each of the three samples. The volume displacement of 10 nuts ranged from 1.59 to 1.74 milliliters.

Results of this study indicate:

(1) The preliminary test on petiole abscission was useful in determining application rates of CPA, CIPC and Ethrel for thinning pecan nuts.

(2) Nut thinning resulting from the CPA treatments applied June 3 was significantly different from the check at the 1 percent level.

(3) An optimum amount of thinning was obtained when trees of the Western variety were sprayed with 40 and 80 ppm CPA.

(4) The nut diameter ranging from 0.28 to 0.31 centimeters appeared to be optimum size for thinning Western pecans with CPA.

(5) CIPC and Ethrel treatments were effective in thinning nuts of the Western variety.

(6) Location of the treatments in different sections of the tree had no effect on nut thinning.

(7) Treatments applied June 17 and July 1 were ineffective in thinning nuts of the Western variety.

(8) From the results of this study on young trees, chemical thinning of the nuts had no effect on nut size at harvest.

(9) No phytotoxicity was observed from any of the treatments, at the time shoots were examined February 11, 1971.

Additional investigation is needed to determine:

(1) The most suitable nutlet size for timing of chemical thinning sprays, under different environmental conditions.

(2) The optimum rate of application for thinning pecans of different varieties with CPA, CIPC, Ethrel and other growth regulators.

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VITA

2

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