THE EFFECT OF CPA AND ETHEPHON ON THINNING OF NUTS OF THE WICHITA AND WESTERN PECANS

By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The pecan is the most important native horticultural crop in the United States (8). The average annual national production ranged from 225 and 250 million pounds, from 1970-1975. Oklahoma ranks fifth among states in total pecan production (13.6 million pound yearly average from 1970-1975) and ranked third in native production (34). However, in 1967 Oklahoma harvested 53 million pounds, indicating the tremendous potential for pecan production.

Alternate bearing is the greatest problem associated with pecan production (20). In the last three years Oklahoma crops have varied from 2.5 million pounds in 1974, to 20 million pounds in 1975, to an estimated 1 million pounds for the 1976 crop (34). Fluctuations such as these have lead to an unstable marketing situation (4).

During years when a heavy crop is on the tree, the nuts are poorly filled and of poor quality. This over abundance of pecans during the "on" year decreases the carbohydrate level within the tree and causes a decline in pistillate flower production the following year (4, 18).

Irregular bearing is also a problem in other fruit crops. Chemical fruit thinning has been used to help solve this problem. Thinning of fruit increases the leaf to fruit ratio and keeps the present drop from reducing the plant food reserve for the next year's crop (30). By chemically thinning the pecans on the good year, the carbohydrate supply will not be depleted, leaving sufficient food reserve for pistillate flower initiation the "off" year.

Two factors which have limited chemical thinning of pecans have been finding the right chemicals and determining the correct time of application of the chemicals. A chemical must be found which will thin the nuts but not cause excessive phytotoxicity to the tree. Over-thinning and under-thinning will result unless the chemicals are applied at the correct time (23).

The objectives of this study were:

(a) to determine the effect of three concentrations of two chemicals on pecan nut thinning,

(b) to study the use of nut size as a means of determining the time of chemical application, and

(c) to determine the effect of the chemicals on abscission of the nutlet in relation to its position on the peduncle.

CHAPTER II

REVIEW OF LITERATURE

The pecan (*Carya illinoensis*, (Wang) K. Koch.) is a monoecious plant, and little was known about the floral development before the 1920's.

The catkins (staminate flowers) are borne from lateral buds of one year old wood. Usually each bud produces a vegetative shoot and two three-stalked catkins on each side (8, 33). The staminate flowers are differentiated at the base of newly formed shoots in a fairly continuous process from April until growth ceases in the late spring or early summer (2, 8). This is nearly a full year before pollen is shed. A bearing tree produces thousands of catkins; each catkin produces approximately 2,640,000 pollen grains, insuring a sufficient amount of pollen for effective pollination (8, 33).

The pistillate flower occurs as an inconspicuous terminal inflorescence on current season shoots (17). The shoots with the highest probability of producing pistillate flowers develop from primary lateral buds located near the apical end. Pistillate flowers differentiate on one year old wood in late winter or early spring of the year they appear. Common numbers of pistillate flowers are three, four, five and six, occasionally, there will be a larger number (8, 33).

Pollen is transferred from the anther to the stigma by wind (33). Ten to 15 days are required from the date of pollination until fertilization takes place (27).

The low quality and the depressed price of the crop of the "on years" and the small crops of the "off years" are the main disadvantages of alternate bearing (4). Carbohydrate levels within the tree are important to fruit set (4, 12, 18). The large crop causes a decrease in the leaf to fruit ratio (4, 30). Crane (13) and Dodge (15) reported that six to ten leaves per pecan is optimum for assuring adequate filling of the nuts present and the accumulation of sufficient carbohydrate reserves for pistillate flower set the following year.

Because thinning of nuts increases the leaf to fruit ratio, this procedure has been one method used to control alternate bearing. In 1935, Crane (13) reported that hand thinning of nutlets resulted in improved kernel filling of the pecans left on the tree, and an increased fruit set the following year. However, hand thinning is not practical because of the time and labor involved.

Two alternative thinning procedures suggested by Brison (8) are permissive thinning and chemical thinning. Permissive thinning entails the use of the pecan nut casebearer insect to thin the nuts on heavy crop years. The obvious disadvantage of this method is the inaccuracy of insect population control with pesticides. The other method, chemical thinning, has been studied for many years on several fruit crops. Apple thinning work was first started in the 1930's. The use of chemical thinning agents instead of hand labor reduced the cost considerably (11).

The first use of chemicals in connection with pecan nut drop was reported by Smith (29) and Blackmon (6) in the 1940's. Both men used the growth regulator, napthalene acetic acid (NAA) to control preharvest drop. Results from their experiments indicate that this growth regulator increased pecan abscission rather than the prevention of drop.

Sharpe (28) reported that 2,4-D (2,4-dichlorophenoxyacetic acid) at 20 ppm concentration caused a 65 percent reduction in the crop on trees of the cv. Moneymaker, but this same concentration had no effect on the fruit set of the cv. Moore. He found that maleic hydrazide (1,2-dihydro-3,6-pyridazinedoine) at concentrations of up to 660 ppm had no thinning effect, and concentrations greater than these rates produced some phytotoxic effects on the trees. Forty-seven percent of the nuts on the cvs. Curtis, Randall, Success and Moneymaker abscised when 20 ppm 2,4,5-T (2,4,5-trichlorophenoxy acetic acid) was applied. The cvs. Kennedy and Stuart had a 60 percent nut reduction at the 100 ppm rate, but no nut drop at 20 ppm. The most successful results were obtained with the early June application of the chemical.

Harris and Smith (18) found the thinning ability of maleic hydrazide (MH), 2,4,5-T and CIPC (isopropyl N-3-chlorophenyl carbamate) varied among pecan cultivars. The nuts from the Moore trees sprayed with MH ceased growth and appeared hardened, but there was no visible effect on Stuart and Mahan. Moore trees were also sensitive to CIPC at 200 ppm, but Philema #1175 was not effected at this same rate. All the cultivars tested responded to 2,4,5-T, but Schley and Stuart had the highest percent of thinning. Harris and Smith (18) also concluded that concentration and timing of application, as well as variety were important considerations in chemical thinning.

Amling and Dozier (3) applied 3-chlorophenoxypropionic acid (CPA) at concentrations of 50, 100, 150 and 200 ppm on June 1. The resulting fruit set was 52, 26, 12 and 2 percent, respectively. The untreated limbs had a 57 percent fruit set. There was an increase in the number of nuts which stopped growth but remained on the tree, when concentrations greater than 150 ppm were applied. Phytotoxicity was also more severe at the higher concentrations. These same rates when applied at a later date (July 1) did not thin as effectively.

In preliminary tests using CPA, Hinrichs (22) used three rates, 100, 150, and 200 ppm and three application dates: May 23, June 6 and June 20. He found that the best thinning results were achieved with the 100 ppm concentration applied on June 6. The May 23 applications resulted in severe over-thinning of the San Saba Improved and the Western cultivars.

Hopfer (23) used CPA at 40, 80, and 160 ppm, CIPC at 200 and 400 ppm, and ethephon (2-chloroethane phosphoric acid) at 50 and 100 ppm on Western pecans. Each chemical was applied three, five, and seven weeks after pollination (June 3, June 17 and July 1). He found that the applications made on June 3 were most effective in thinning.

Ramming (27) tested ethephon as a thinning agent on Stuart pecans by making applications of 30, 40, and 50 ppm, three, four and five weeks after pollination. He found the June 1 treatment (third week after pollination) resulted in over-thinning. The June 8 application (fourth week after pollination) at 30 ppm produced the best thinning results. Studies by Hinrichs using ethephon showed the most effective thinning was obtained when applications were made four weeks after pollination.

As with tree fruits, correct timing of application appears to be an important factor in chemical thinning of pecans (3, 9, 14, 24, 32). The most effective thinning of peaches by ethephon and CPA occurs at endosperm cytokinensis. The applications of these chemicals must be made during a four-day period to obtain the best thinning results (10, 26, 31, 32). Fruit size has been used as an indicator for when to make applications, but this size will vary from cultivar to cultivar. The length of the ovule has been used on peaches to determine the time of application. The desirable length on the Johnson peach cultivar is from 4.0 mm to 7.2 mm (26). On Cardinal, Redhaven, and Redskin peach cultivars the ovule length should be between 7.9 mm and 11.1 mm for the best thinning results. *Hopfer (23) found the most effective thinning on Western pecan occurred when the nut diameter was 2.85 mm and the nut length was 8.15 mm. On the Stuart pecan the optimum size for thinning was 10.12 mm in length and 3.5 mm in diameter (27).

Hopfer's (23) study of petiole abscission suggested that CPA and ethephon have different modes of action for abscission. Ethephon promoted petiole abscission, while CPA appeared to promote petiole retention. Possible modes of action in fruit abscission have been suggested for the two chemicals.

Ethephon is probably taken up by the plant similar to any other weak alliphatic acid. The consequential breakdown in the cytoplasm releases the ethylene (16, 35). Ethylene, as a plant hormone, is known to promote abscission of leaves and fruits (1, 7). This action is believed by some to be the promotion of endogenous ethylene synthesis when exposed to exogenously produced ethylene (9, 14, 25). When ethylene levels are sufficiently high the abscission layer begins to form. Cellulase, the enzyme associated with the softening and digestion of cell walls, has been found to increase in the abscission layer just prior to cell separation. Ethylene has been known to stimulate the production of cellulase and the presence of ethylene is normally necessary before cellulase can be released from the cytoplasm (1, 36).

Stembridge and Gambrell (32) found that ethephon did not promote abscission when applied as a preharvest spray. They concluded from this work that the mode of action was not directly related to activity within the separation zone. Blanpied (7) discovered a clear cut relationship between levels of ethylene and the abscission of fruit with aborted seeds. Buchanan and Biggs (9) reported that ethephon required a much shorter time for the fruit to drop than other growth regulators used in fruit thinning. Their evidence suggests that ethephon interferes with some sexual process, probably the inhibition of pollen tube germination. Hopfer (23), however, found that ethephon used on pecans required the same amount of time for fruit abscission as CIPC and CPA.

There are two commonly accepted theories on the mode of action of CPA in fruit thinning. One concept hypothesizes that CPA, acting as a synthetic auxin, enhances ethylene production within the fruit which in turn either is or is not counteracted by auxin in the separation zone (5, 10). This theory suggests that ethephon and CPA have ultimately the same mode of action.

Stembridge and Gambrell (32) have suggested embryo abortion as another possible mechanism of action by CPA in fruit thinning. Martin and Nelson (25) used autoradiography to support this theory. They found a particularly heavy accumulation of CPA near the embryo in CPA treated peach fruit.

Another interesting aspect of fruit abscission is the position on the peduncle from which a nut is most likely to drop. Adriance (2) found that there was a definite relationship in untreated trees between the position of the nut in the cluster and the probability of it being shed. He found that in clusters of varying numbers of nutlets, the basal nutlet was the first most likely to drop. The nutlet next to the basal nutlet was the second most likely to drop. The apical nutlet was the third most likely to drop.

CHAPTER III

METHODS AND MATERIALS

Chemical Thinning of Pecan Nuts

Twenty-six year old Western and eight year old Wichita trees located on the Oklahoma Pecan Research Station in Sparks, Oklahoma were used in this study. All the trees were spaced 49.5 feet apart and a regular spray program using Benlate, Sevin and Malathion was carried out throughout the growing season to control pecan scab, pecan nut case-bearer, hickory shuckworm and pecan weevil. In the spring the Western trees were fertilized with 300 pounds 10-20-10 per acre. The Wichita trees were not fertilized.

Two chemicals, CPA[1] and ethephon,[2] were applied to the Wichita trees on June 14 and the Western trees on June 15. Stigma receptivity for Wichita began April 27 and lasted until pollination occurred on May 7. The receptive period for Western was from April 22 until May 7.

Fourteen trees of each cultivar were divided into two plots with the east and west sides of the tree representing separate plots. Three concentrations of CPA (75, 100 and 150 ppm), three concentrations of ethephon (20, 40 and 80 ppm) and a control (non-treated) constituted the

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[1]CPA, supplied by Amchem Products, Inc.

[2]Cepha, tradename of ethephon, supplied by GAF Corporation.

seven treatments. On June 27, concentrations of 160, 200, and 300 ppm ethephon were made to one-half the Wichita plots which had received ethephon at the earlier date.

Tags with identification numbers were attached to shoots to identify the nut clusters which were used in the test.

The statistical design was a randomized complete block for the Western trees with 100 nuts tagged per plot. A completely randomized design was used for the Wichita trees, 25 clusters of four nuts per cluster were tagged in each plot. The seven treatments were replicated four times on each cultivar.

A hand sprayer was used to spray the nuts in each cluster and the surrounding foliage. A surfactant was used in all of the spray applications. On the Wichita trees Tween 20 (polyoxyethlene-20-sorbitan monolaurate) at 4.5 ml per gallon was used. Biofilm[3] was used at 4.5 ml per gallon as a surfactant on the Western trees.

The nuts were counted each week for five weeks, beginning on June 21 for Wichita and June 22 for Western and extending through July 19 and July 20.

Beginning on July 6 and at weekly intervals until September 28, the abscised pecans were collected from the ground under each Wichita tree, to determine the cause of nut drop. The nuts were categorized into one of three groups, hickory shuckworm, pecan nut casebearer, or unknown.

The final nut count was made on September 9 on the Wichita and September 13 on the Western trees. The shucks began to loosen on the

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[3]Trademark for a material containing alkylarylpolyethoxy ethanol, free and combined fatty acids, glycol ethers, di-alkyl benzene-dicarboxylate, isopropanol.

Western pecans on October 19 and October 21 on Wichita. However, an early freeze and a large population of wildlife in the area destroyed the pecans before they could be harvested.

Determination of Nut Size

Beginning on May 24 and extending through October 19, ten nuts from each cultivar were randomly selected and measured for length and diameter, weekly. On the Western trees five nuts were collected from each of the two blocks. Because of the limited number of pecans available, the nuts were not removed from the trees for measuring. The dates when the shell began to harden and when the shell had completed hardening were noted.

Position of the Abscised Nut

Since the Wichita trees had clusters with a uniform number of nuts they were used to study the relative position of the abscised nut. The position of the abscised nutlet was determined by the scar left on the peduncle. Weekly tabulations were made of the vacated positions. The nuts were numbered one through four, with the apex nut being number one and the basal nut being number four (Figure 1).

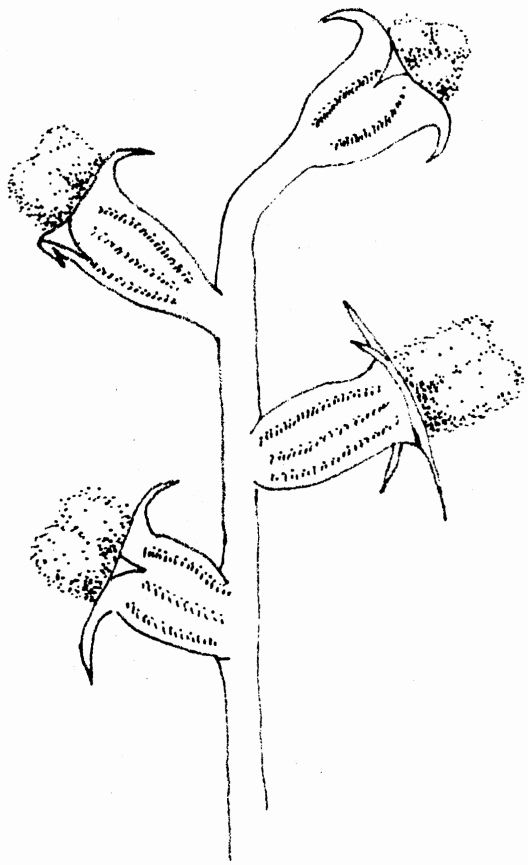

Figure 1. Diagrammatic Sketch of the Four Nutlet Positions on the Peduncle

CHAPTER IV

RESULTS AND DISCUSSION

Chemical Thinning of Pecan Nuts

The cumulative number of nuts thinned by CPA treatments on Western is presented in Table I. There was no significant difference between treatments, however, the plots treated with 150 ppm CPA did drop 20.25 percent more nuts than did the control plots, indicating some effect due to chemical. The increased drop in the 150 ppm treatment was observed between the fourteenth and twenty-first day following application. The chemical appeared to have no effect by the fourth week after application (Figure 2).

The unsatisfactory thinning results obtained with CPA on Western were probably due to the late application date (five weeks after pollination). Hopfer (23) found that CPA applied on Western trees three weeks after pollination effectively thinned the pecans, but applications made the fifth week after pollination were not effective. The difference in nut drop between the control plots and 150 ppm CPA plots was much greater in this study than in Hopfer's study. The smaller pecan size in 1976 could have been responsible for the increased thinning over the 1970 late application. In 1970, on the fifth week after pollination, the Western nuts had an average diameter of 4.20 mm and length of 12.60 mm, as compared to the 1976 nut size of 4.06 mm and 9.23 mm.

TABLE I

THINNING EFFECT OF CPA ON WESTERN PECAN NUTS

			Cumulative Number of Nuts Abscised					
			Weeks After Treatment					
Treatment[x]	ppm	Number of Nuts Sprayed	1	2	3	4	5	%
CPA	0	400	75 a	96 a	103 a	104 a	107a	26.75 a[z]
CPA	75	400	67 a	107 a	125 a	134 a	135a	33.75 a
CPA	100	400	59 a	121 a	134 a	139 a	141a	35.25 a
CPA	150	400	71 a	154 a	176 a	182 a	188a	47.00 a

[x]Applications were made June 15.

[z]Numbers in a column followed by the same letter are not different at the .05 level of significance using least squares difference (L.S.D.) test.

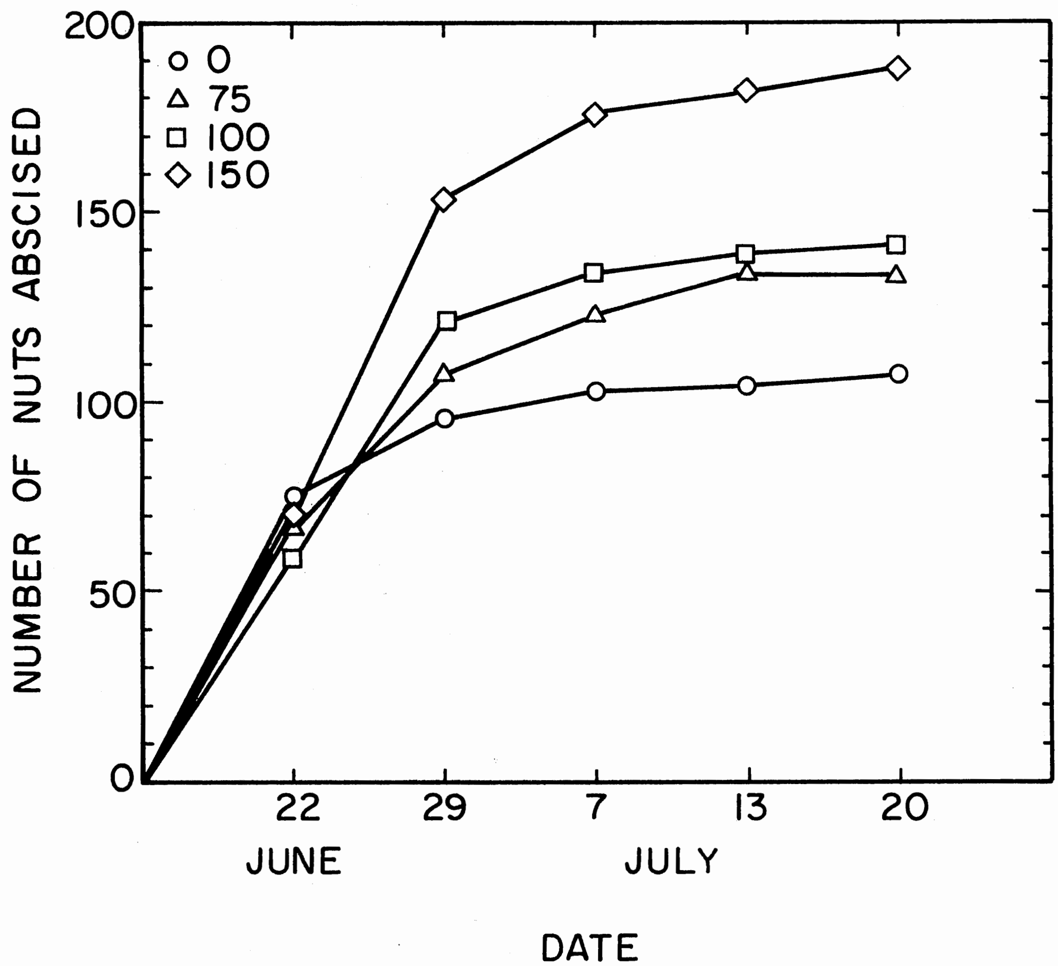

Figure 2. Thinning Effect of CPA Treatments on Western Pecan Nuts (4 replications, 100 nuts per replication)

The cumulative number of nuts abscised from Wichita trees treated with CPA is presented in Table II. The thinning trend had began by the seventh day after application (Figure 1). The greatest effect on thinning had occurred by the fourteenth day after thinning. The pecans showed no response to the chemical after the twenty-eighth day. The cumulative nut drop from the 150 ppm CPA was 3.9 times greater than the control. All the CPA treatments were different from each other and the control at the .05 level of significance by the second week following application. The best thinning response on the Wichita trees was with the 100 and 150 ppm treatments of CPA.

Both cultivars exhibited some phytotoxicity at the 100 and 150 ppm CPA concentrations. The 100 ppm treatments showed minimal damage, but the trees in the 150 ppm treatments had chlorosis, distortion, and necrosis of the terminal leaflets.

The percentage of nuts which abscised from the Wichita and Western trees treated with ethephon (0, 20, 40 and 80 ppm) are presented in Tables III and IV. The percentage of nuts abscising from the Wichita trees which received the higher concentrations of ethephon (160, 200 and 300 ppm) on June 28 are presented in Table V. The ethephon treatments did not effectively thin pecan nuts. There was no significant difference in the ethephon treatments (0, 20, 40 and 80 ppm), applied June 14, on either cultivar (Figures 3 and 4). On the June 28 applications, there was not a significant difference in the 0, 160 and 300 ppm treatments. The 200 ppm treatment was significantly different from the other treatments, but only 29.0 percent of the pecans were thinned. The reason the 200 ppm rate produced more thinning is unknown but since the 300 ppm concentration did not effect thinning, the assumption can be

TABLE II

THINNING EFFECT OF CPA ON WICHITA PECAN NUTS

Treatment[x]	ppm	Number of Nuts Sprayed	Cumulative Number of Nuts Abscised					
			Weeks After Treatment					
			1	2	3	4	5	%
CPA	0	400	21 a	41 a	46 a	53 a	62 a	15.50 a[z]
CPA	75	400	33 ab	86 b	100 b	106 b	113 b	28.25 b
CPA	100	400	41 b	133 c	155 c	161 c	164 c	41.00 c
CPA	150	400	54 c	185 d	221 d	231 d	242 d	60.50 d

[x]Applications were made June 14.

[z]Numbers in a column followed by the same letter are not different at the .05 level of significance using L.S.D. test.

TABLE III

THINNING EFFECT OF ETHEPHON ON WESTERN PECAN NUTS

Treatment[x]	ppm	Percentage of Nuts Abscised Date of Count 6-22	6-29	7-7	7-13	7-20
Ethephon	0	18.75	24.00	25.75	26.00	26.75 a[z]
Ethephon	20	19.00	24.50	25.75	26.75	28.00 a
Ethephon	40	16.75	21.00	23.25	24.75	25.25 a
Ethephon	80	16.50	21.25	22.25	24.00	24.25 a

[x]Treatment applications were made on June 15.

[z]Numbers in a column followed by the same letter are not different at the .05 level of significance using L.S.D. test.

TABLE IV

THINNING EFFECT OF ETHEPHON ON WICHITA PECAN NUTS

Treatment[x]	ppm	Percentage of Nuts Abscised Date of Count 7-6	7-12	7-19
Ethephon	0	11.50	13.25	15.50 a[z]
Ethephon	160	14.50	15.00	16.00 a
Ethephon	200	24.50	28.00	29.00 b
Ethephon	300	16.50	17.50	18.50 a

[x]Treatment applications were made on June 14.

[z]Numbers in a column followed by the same letter are not different at the .05 level of significance using the L.S.D. test.

made that the two plots treated with 200 ppm had other factors which contributed to the pecan thinning.

TABLE V

THINNING EFFECT OF HIGH CONCENTRATIONS OF ETHEPHON ON WICHITA PECAN NUTS

		Percentage of Nuts Abscised		
		Date of Count		
Treatment[x]	ppm	7-6	7-12	7-19
Ethephon	0	11.50	13.25	15.50 a[z]
Ethephon	160	14.50	15.00	16.00 a
Ethephon	200	24.50	28.00	29.00 b
Ethephon	300	16.50	17.50	18.50 a

[x]Treatment applications made on June 28.

[z]Numbers in a column followed by the same letter are not different at the .05 level of significance using the L.S.D. test.

All the conclusions drawn from the tables, figures and analysis of variance were based on the data available after the fifth count (July 19 and July 20). But the statements made about that information held true after the final count (September 9 and 13). The chemical effect on thinning had ceased before July 19-20. The drop during the time between July 19-20 and September 9-13 was due primarily to insect and disease, therefore, there was a fairly consistent number of nuts which abscised from each treatment.

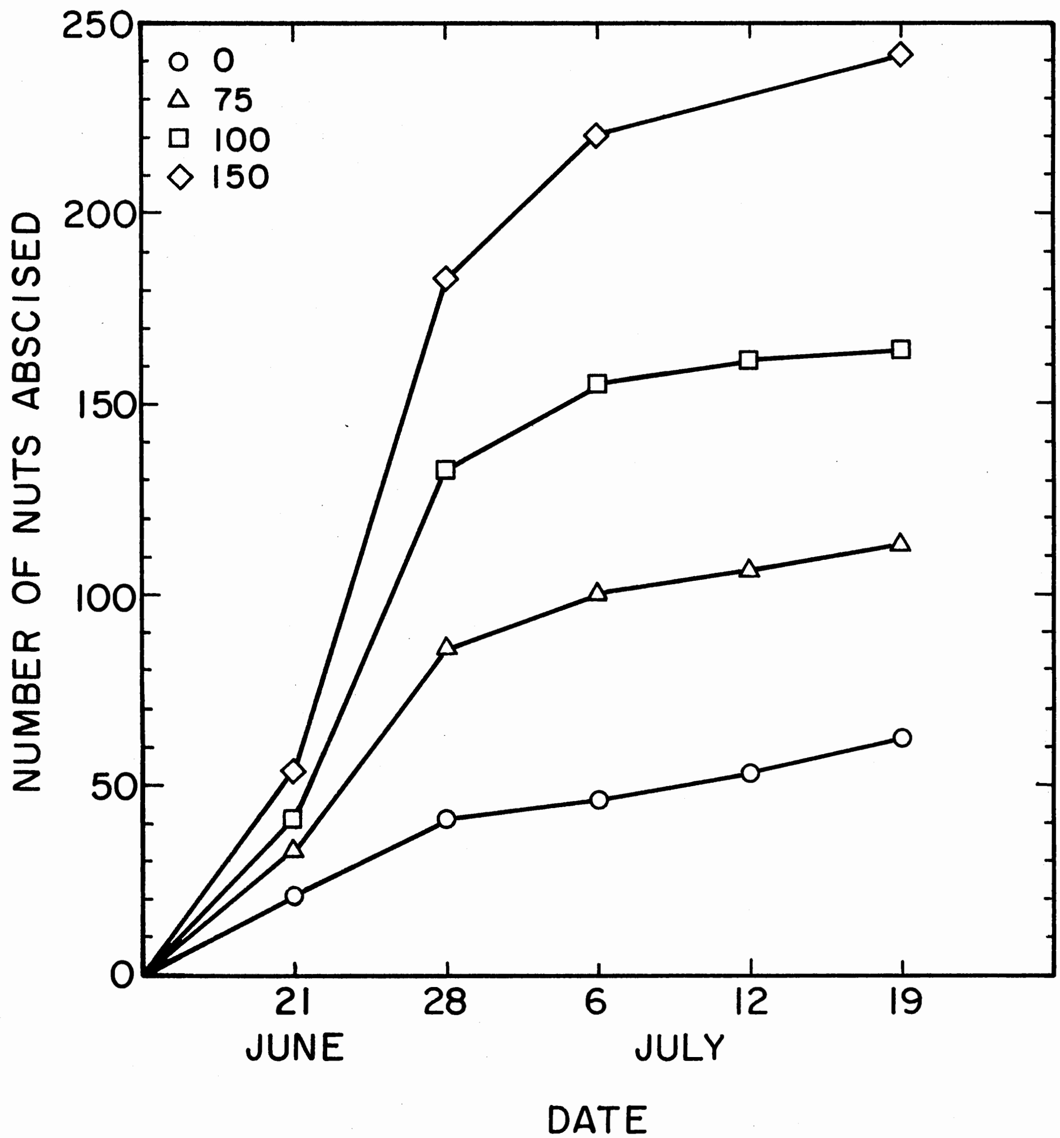

Figure 3. Thinning Effect of CPA Treatments on Wichita Pecan Nuts (4 replications, 100 nuts per replication)

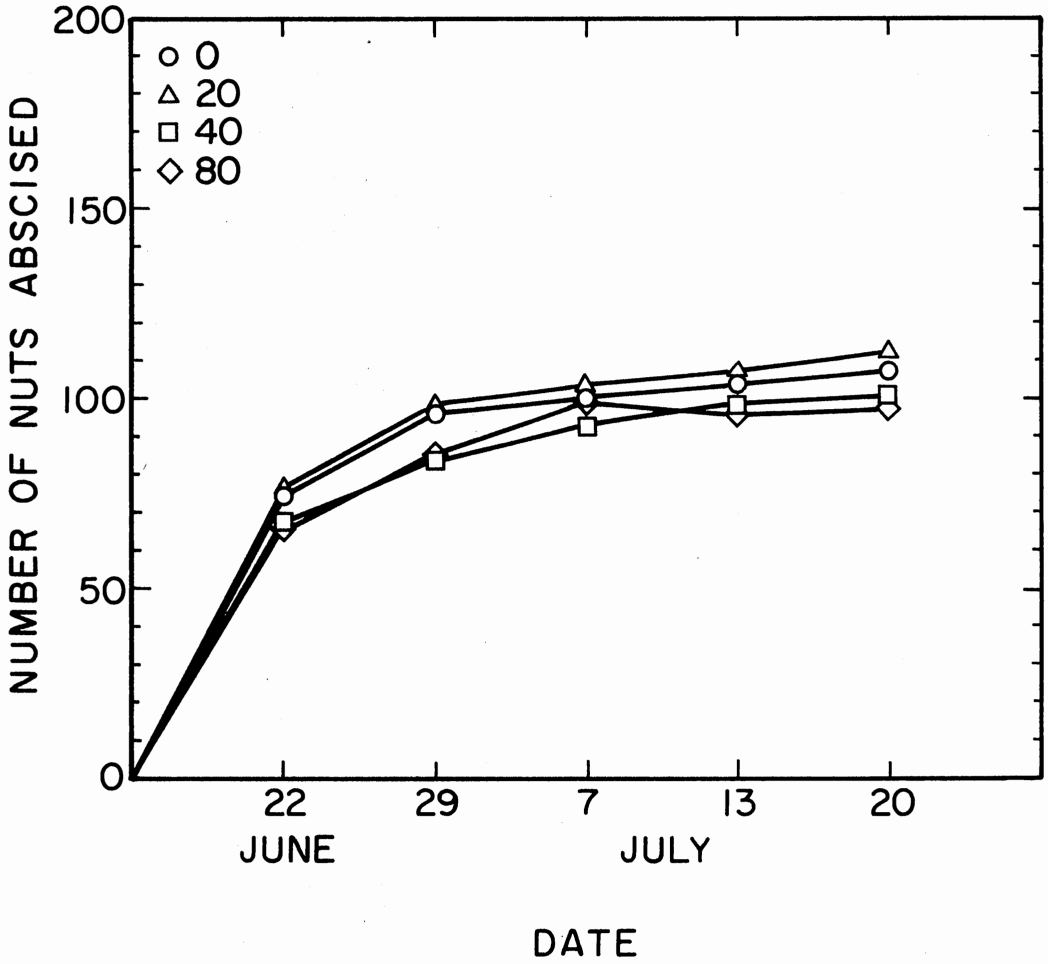

Figure 4. Thinning Effect of Ethephon Treatments on Western Pecan Nuts (4 replications, 100 nuts per replication)

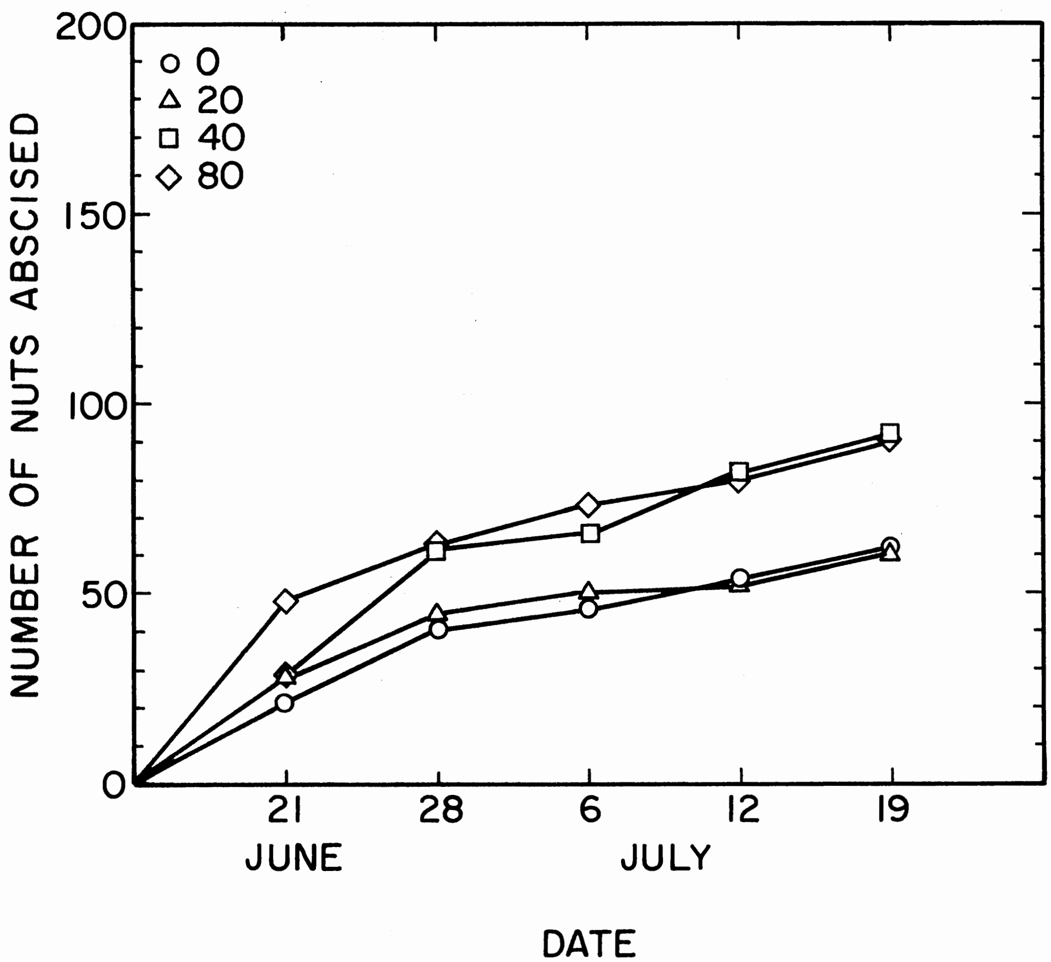

Figure 5. Thinning Effect of Ethephon Treatments on Wichita Pecan Nuts (4 replications, 100 nuts per replication)

The date of application was probably too late to induce thinning by the ethephon treatments. In a previous study on Western pecans, applications made the fifth and seventh week after pollination gave results similar to this study (23).

The number of weeks after pollination that effective applications can be made appears to vary from cultivar to cultivar. Ramming (27) was able to obtain substantial thinning from applications made on the third, fourth, and fifth week after pollination on the Stuart cultivar.

The Wichita trees in this study were only slightly infected with pecan scab (Fusicladium effusum) but the Western trees were severely infected. Disease and low vigor were probably responsible for the higher pecan drop on the control treatment of the Western than the control treatment of the Wichita.

The number of pecans collected from the ground each week are presented in Table VI. The low number of nuts collected indicates that only a small percentage of the crop was lost to insect damage. A rigorous spray program was partially responsible for the small amount of damage. The first collection, July 6, should not be considered as representing a weekly drop because many of the pecans may have abscised during the previous month.

Table VI shows that the shuckworm population was at a peak on July 12, indicating that the pesticide spray applications should have been made prior to July 7. Approximately six days are required from the time the shuckworm larva penetrates through the shell until the pecan drops. Pecan nut casebearer did not cause the nut to fall as soon as it abscised, as did the shuckworm. After the casebearer had infested the nut it spun a web around the pecan and twig keeping the nut from falling.

TABLE VI

EFFECT OF INSECT POPULATIONS ON WICHITA PECAN NUT ABSCISSION

Date 1976	Number of Nuts on Ground[1]	Nuts per Tree	Percentage of Pecans on the Ground Cause of Drop		
			Shuckworm[2]	Casebearer[3]	Unknown
7-6	499	35.6	2.20	40.08	57.72
7-12	471	33.6	59.02	16.56	24.42
7-19	281	20.1	58.36	8.90	32.74
7-26	317	22.6	67.82	4.73	27.45
8-2	414	29.6	49.52	1.93	48.55
8-9	364	26.0	45.88	2.47	51.65
8-16	165	11.8	13.30	6.67	60.03
8-23	288	20.6	12.50	3.13	84.37
8-31	319	22.8	5.33	5.33	89.34
9-7	239	17.1	7.11	1.67	91.22
9-14	281	20.1	5.33	1.07	93.60
9-21	185	13.2	4.86	2.16	92.98
9-28	124	8.9	0.81	3.23	95.96

[1]Number of nuts from 14 trees.

[2]Hickory shuckworm (*Lapseyresia caryana*).

[3]Pecan nut casebearer (*Acrobasis caryae*).

For this reason,* the information obtained from the nuts collected from the ground could not accurately indicate when the nut had became damaged by casebearer.

Determination of Nut Size

The nut size ascertained weekly from May 24 to October 19 is presented in Table VII. The average size of the pecan on Wichita at the time of application on June 14 was 4.15 mm in diameter and 10.60 mm in length. The average nut size of Western was 4.06 mm in diameter and 9.23 mm in length at application time (June 15). It was reported in 1970 that the best thinning results were obtained when the Western had an average diameter of 3.00 mm and an average length of 6.42 mm (23). June 7 was the 1976 date when the pecan was of a similar size.

Table VII shows the increase in size of the Western and the Wichita throughout the season, beginning May 24. According to this table, both cultivars began a period of rapid growth on June 7. The nut size and period of development indicate that the applications should have been made prior to June 7, at least one week earlier than they were actually made.

The nuts reached full size by September 7 for Western. The shell had hardened at this time. The Wichita nut continued to grow until September 21.

Position of the Abscised Nut

Figure 6 represents the number of nuts abscised from each of the four positions for each treatment. The data on the position of the

TABLE VII

AVERAGE DIAMETER AND LENGTH OF TWO CULTIVARS OF PECAN NUTS AT WEEKLY INTERVALS

Date 1976	Average Western Nut Size Diameter (mm)	Average Western Nut Size Length (mm)	Date 1976	Average Wichita Nut Size Diameter (mm)	Average Wichita Nut Size Length (mm)
5-24	2.50	4.60	5-24	2.20	4.50
6-1	2.50	5.30	6-1	2.41	6.12
6-7	3.13	6.42	6-7	2.63	6.37
6-15	4.06	9.23	6-14	4.15	10.60
6-21	4.52	11.20	6-21	5.41	15.05
6-28	6.37	15.98	6-28	6.69	16.98
7-6	7.35	17.96	7-6	7.76	20.62
7-12	8.88	21.29	7-12	9.10	24.64
7-19	9.90	24.54	7-19	12.12	30.99
7-26	11.82	26.25	7-26	15.71	39.02
8-2	14.18	31.05	8-2	16.54	42.92
8-9	15.48	33.65	8-9	19.82	45.73
8-17[1]	17.55	39.92	8-16[1]	21.50	46.88
8-24	17.57	39.23	8-23	23.27	51.05
8-31	21.09	42.56	8-31	24.63	52.23
9-7[2]	22.33	45.47	9-7[2]	25.54	54.85
9-14	22.84	43.99	9-14	26.87	54.82
9-21	24.23	42.99	9-21	29.57	56.39
9-28	24.47	47.26	9-28	28.79	56.51
10-5	24.77	46.79	10-5	28.67	55.31
10-12	23.68	43.25	10-12	27.59	54.40
			10-19	28.81	57.85

[1]The date the shell began to harden.

[2]The date the shell had completed hardening.

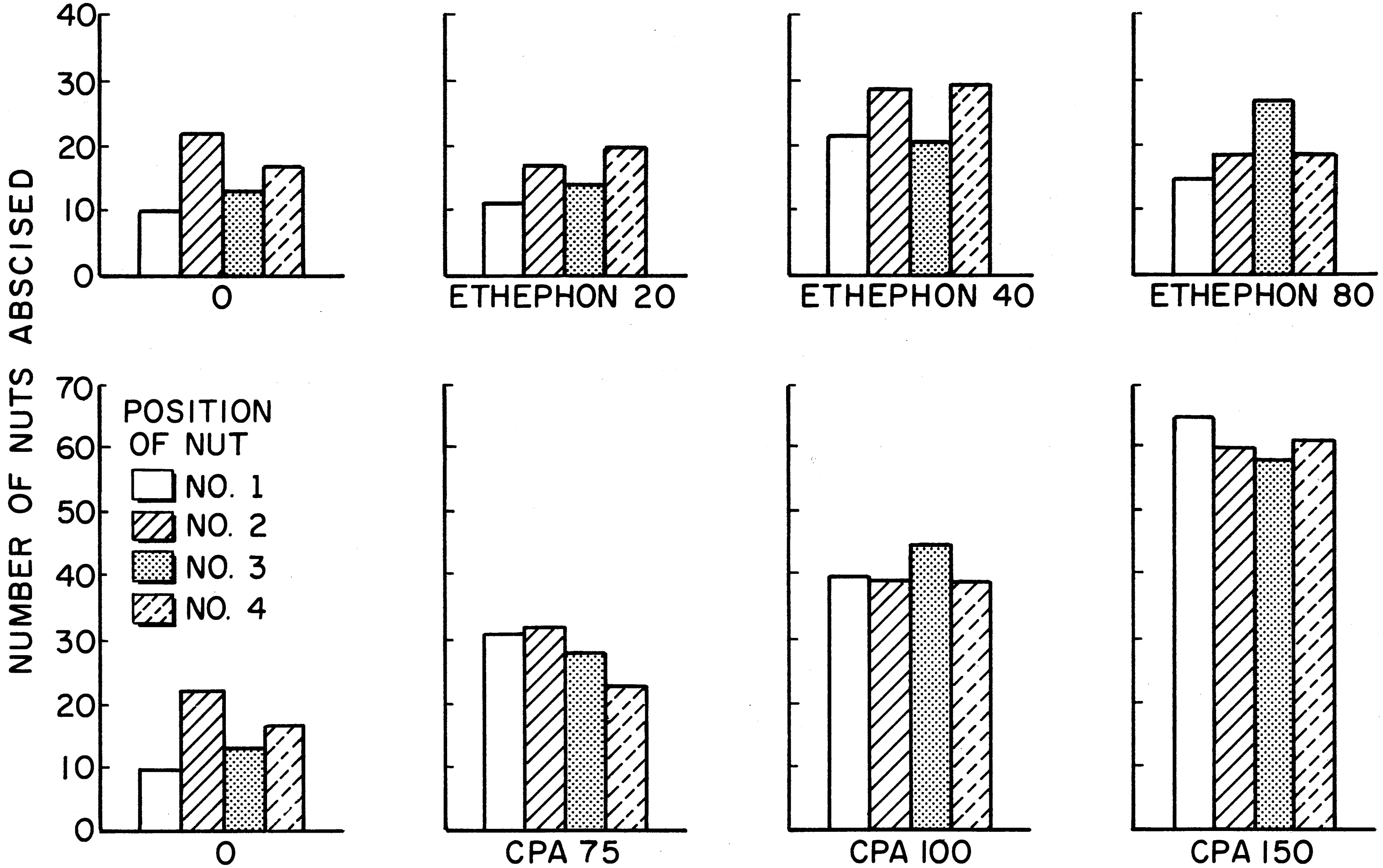

Figure 6. Cumulative Nut Abscission from Each of the Four Nutlet Positions on the Peduncle for Each of the Seven Treatments

abscised pecan was analyzed for each of the seven treatments using a Chi-Square test.

*The position of the nut on the peduncle had no effect on the nut abscission caused by the treatments. It was reported in an early study by Adriance (2) that the basal nutlet was the one most likely to abscise. The finding of this study disagrees with Adriance's work.

CHAPTER V

SUMMARY AND CONCLUSION

The major problem facing the pecan industry today is the alternate bearing of the trees. One possible solution to this problem could be the use of chemical thinning agents. By thinning the nuts on the "on years," the carbohydrate supply will not be depleted by an over abundant crop, thus there would be a sufficient food supply for the development of pistillate flowers the following year.

The objectives of this study were: (1) to determine the effect of three concentrations of two chemicals on pecan nut thinning, (2) to study the use of nut size as a means of determining the time of chemical application, (3) to determine the effect of the chemicals on abscission of the nutlet in relation to its position on the peduncle.

Thinning of the cv. Wichita was obtained from all the CPA treatments used. Thinning began within seven days after application and continued through the twenty-first day. There was no additional thinning after the twenty-eighth day. The CPA treatments on the Wichita were significantly different at the .05 level. The best thinning results were obtained with the 100 and 150 ppm treatments which gave 41.0 and 60.5 percent thinning, respectively.

There was no significant difference between CPA treatments on Western, however, there did appear to be some effect due to the chemical. There was 20.25 percent difference in nut drop between the control plots and the CPA 150 ppm plots.

The ethephon treatments were not effective for thinning on either of the cultivars. The applications appear to have been made too late. These conclusions substantiate work done by Hopfer (23). He obtained thinning of Western nuts with ethephon applications made the third week after pollination, but later applications were not effective.

On the date of application, June 14, the average Wichita nut was 4.15 mm in diameter and 10.60 mm in length. On June 15 the average Western nut was 4.06 mm in diameter and 9.23 mm in length. A period of rapid growth began about June 7 on both varieties. This period of rapid growth might indicate when chemical applications may become less effective in thinning.

This study did not show a relationship between the position of the nut on the peduncle and abscission caused by chemical applications.

Results from this study indicate:

(1) The CPA treatments used on the Wichita cultivar trees were significantly different at the .05 level.

(2) The 100 and 150 ppm CPA concentrations gave the best thinning results on Wichita, with 41.0 and 60.5 percent thinning, respectively.

(3) There were no significant differences between CPA treatments on the Western trees, however, there did appear to be some effect due to the chemical.

(4) The 150 ppm CPA concentration gave the best thinning response on the Western pecans, with 47 percent of the nuts abscising.

(5) CPA caused slight phytotoxic effects at the 100 and 150 ppm concentrations.

(6) The ethephon treatments were not effective in thinning the Western or Wichita cultivars.

(7) The lack of thinning by ethephon was probably due to the late application.

(8) The abscission of the nutlet caused by the treatments, was not related to the nutlet's position on the peduncle.

Further investigation is needed to determine:

(1) The optimum size of different cultivars of pecans for thinning.

(2) The relationship between timing and the concentrations of CPA and ethephon which give the best thinning results.

(3) Possible differences in the mode of action of CPA and ethephon.

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APPENDIXES

TABLE VIII

ANALYSIS OF VARIANCE FOR THE TREATMENTS ON THE WICHITA CULTIVAR

Source of Variation	df	MS
Total	15	412.2292
Among Treatments	3	1473.5626
Between Treatments	12	146.8953

TABLE IX

ANALYSIS OF VARIANCE FOR THE TREATMENTS ON THE WESTERN CULTIVAR

Source of Variation	df	MS
Total	15	128.8958
Block	1	203.0625
Treatment	3	282.3958
Experimental Error	3	93.5625
Residual	8	75.3125

VITA ɣ

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