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The Effect of 1-Naphthaleneacetic Acid and Kinetin on Leaf Abscission in Coleus blumei Benth

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THE EFFECT OF
1-NAPHTHALENEACETIC ACID AND KINETIN
ON LEAF ABSCISSION IN COLEUS BLUMEI BENTH.
(TITLE)

BY

Armand R. Loffredo

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INTRODUCTION

In 1933, Laibach showed that auxins were important in organ abscission. Three years later, LaRue (1936), using synthetic auxins, was able to delay leaf-abscission in Coleus. This effect has been since demonstrated by many workers using a variety of plants. Generally, the auxin content of a young leaf is high but, as the leaf matures, it gradually declines. When the auxin content reaches a low level, as is common in the stem, the leaf will soon abscise. The decline of auxin content usually begins as the leaf approaches full size. In addition, the basipetal polarity of movement and probably the transport effectiveness are adversely affected (Mai 1934). Thus, the movement of auxin becomes non-directional and there probably is a decrease in its velocity.

The movement of auxin is probably an active transport since its velocity is greater than the velocity of diffusion and it can move against a concentration gradient. Active transport relies on metabolic processes as is indicated by its sensitivity to metabolic inhibitors (duBuy & Olson, 1940) or low oxygen levels (Gregory and Hancock, 1955). In addition, Hertel (1962) thought that the transport of auxin out of tissues was a secretory process since triiodobenzoic acid inhibited its movement.

The work of Sacher (1967), who used subcellular fractions of bean endocarp, indicates that auxin acts primarily to stimulate synthesis of RNA and, therefore, indirectly enhances the production of protein. It may be that this effect is not primary in leaf blades. During the growth of leaves of vascular plants, there is usually a relatively large amount of auxin produced but, as Miller and Kuraishi (1959) demonstrated, the effect of auxin on the growth of the leaf-blade is usually minute. It seems reasonable to assume that a decrease of auxin may be directly related to a decline in the metabolic efficiency of the leaf cells. With senescence, there is a decline of protein and RNA content (Bottger and Wollgiehn, 1958). In addition, carbohydrates are hydrolyzed, there are losses of organic acids (Vickery et al, 1935), and many nutrients move out of the leaf.

During senescence, there are many changes in the biochemistry of a leaf, thus making it difficult to determine exactly which of the chemical changes are responsible for the abscission phenomenon. It should be noted that Leopold considers abscission to be an active process. This theory is supported by data which illustrate that abscission is suppressed by a deficiency of carbohydrate (Biggs and

Leopold, 1957) or oxygen (Carns et al, 1951).

Several theories have been postulated concerning the cause or causes of abscission. Gawadi and Avery (1950) proposed that a senescent leaf produces ethylene gas which initiates abscission when the accelerating effect of the ethylene is greater than the delaying influence of auxin. In 1955, Addicott, Lynch and Carns proposed that the concentration gradient of the auxin in the leaf, as related to the stem, was responsible for abscission. This theory is based upon the following observations: When auxin is applied to the blade (distal to abscission layer), abscission is delayed, but when applied to the stem (proximal to abscission layer), abscission is accelerated. This theory sounds reasonable, but research of Gaur and Leopold (1955) and other workers indicates that the absolute concentration of auxin at the abscission zone is more important in determining whether abscission will or will not occur than is the gradient across the abscission layer. In 1958, Biggs and Leopold developed a theory stating that high concentrations of auxin inhibited abscission but low concentrations promoted it. This idea has been since shaken by the observation that abscission of old leaves is neither promoted nor suppressed by low auxin concentrations. In addition, the amount of time that elapses after the blade is excised and before the auxin is applied can determine whether abscission is delayed or accelerated. Since the work of Osborne (1955), which showed that diffusates of old leaves contained a substance or substances that promoted abscission of petiole explants, a new and possibly more accurate theory has been developed. According to Leopold (1964), "Abscission appears, then, to be a correlative effect in which the leaf blade or other organ (flower, fruit) suppresses the cellular changes which lead to separation, and this suppression involves the flow of auxin from the leaf to the abscission zone. As deterioration processes set in, however, many materials are exported from the leaf, including some which can stimulate abscission development." Supporting this point of view is the fact, observed by many workers, that the older a leaf is the smaller will be the effect of auxin treatment. In addition, blockage of the flow of auxin (in young leaves) will cause premature abscission. This has been demonstrated by the work of Sequeira and Steeves (1954) with coffee plants and the pathogenic fungus Omphalia flavida. Lesions on the petiole of coffee leaves resulted in early abscission. It was found that the fungus produced an enzyme which destroyed indoleacetic acid (IAA), therefore preventing a sufficient supply of auxin from reaching the abscission zone. Abscission of infected leaves could be prevented by the addition of IAA below the lesion.

Kinetin is noted to have an effect upon the mobilization of nutrients (Mothes et al, 1959). Tissues treated with kinetin show an increase in nutrients, protein (Mothes, 1960), and RNA (Wollgiehn, 1965). It has been demonstrated that when kinetin is applied proximally or distally to the abscission zone, leaf abscission is accelerated. However, when it is applied to the abscission zone, abscission is delayed (Osborne and Moss, 1963). The probable effect of the kinetin is the mobilization of nutrients from the surrounding tissues. These nutrients are then transported to the area of high kinetin content. Some of these compounds may stimulate the abscission process. For example, when these compounds pass through the abscission zone, the effect may be the acceleration of abscission. The reason for the delay of abscission when the kinetin is applied to the abscission zone may be the result of an increase in various metabolic processes which use these stimulating compounds as fast as they move into the area. An indication of other metabolic effects of kinetin may be shown by the experiments of vonAbrams and Pratt (1967). They found that when 1-naphthaleneacetic acid (NAA) was added to kinetin, its senescence-retarding effect was reduced but the accumulation of labeled metabolites was enhanced. Therefore, NAA may have interfered with an effect of kinetin which was involved with a process other than mobilization. The reduction of the kinetin senescence-retarding effect by NAA was greater in young leaves than in old leaves (vonAbrams and Pratt, 1966). In addition, it should be noted that Sacher (1967) reported the variability of kinetin effect on

RNA synthesis in subcellular fractions of bean endocarp. In some of the experiments, kinetin stimulated, and in some, inhibited, RNA production; this may indicate that very slight differences in environment may have a great influence on the action of kinetin.

Another effect of auxin is the phenomenon of apical dominance in which auxin, produced by the apical bud, inhibits the growth of the lateral buds. Jacobs and Case (1965) found that indoleacetic acid plus gibberellic acid, when applied to decapitated _Pisum_ stumps, maintained apical dominance more effectively than indoleacetic acid alone. Their work indicated that gibberellic acid may increase the transport of IAA or may be "auxin saving" since it resulted in a greater amount of functioning IAA to be present at a greater distance from the site of application. Not only did there appear to be a synergism between IAA and GA but also between IAA and kinetin (Davis, Seth, Wareing, 1966). Davis, Seth and Wareing demonstrated an enhancing effect when kinetin was applied with IAA. They thought the effect of kinetin was possibly a result of an increased uptake and transport of IAA or that the metabolites are mobilized from the lateral buds to the area of kinetin application. It seems reasonable that both modes of action may occur simultaneously.

Another example of the synergistic effect of kinetin and IAA was demonstrated by Seth and Wareing (1967). In their experiment, peduncles of developing fruits (fruits removed) were treated with kinetin and IAA. Their results showed an increase in the transport of radioactive metabolites in the kinetin and IAA treated plants as compared to the plants treated only with IAA.

Since a synergistic effect of kinetin and auxin was demonstrated in apical dominance and in metabolite transport in peduncles of developing fruits, it may be that a similar effect occurs in the phenomenon of leaf abscission. In this study, the effects of kinetin and NAA will be observed to see if they are synergistic in leaf abscission.

MATERIALS AND METHODS

*Coleus blumei** Benth. (Figure 1) plants, which originated from the same clone, were used for this experiment. These plants were grown in the greenhouse using a sterile potting mixture. To avoid possible adverse environmental influences, the plants were planted in five-inch pots which were spread out to avoid crowding.

The hormones were mixed in lanolin, using the following concentrations: (1) 10 mg. 1-naphthaleneacetic acid (NAA) in 20 ml. of lanolin and (2) 10 mg. NAA plus 10 mg. of kinetin in 20 ml. of lanolin. These mixtures were stored at 5°C until needed.

In order to insure that the petioles would fall off the stem when the abscission layer formed, weighted glass caps were used. These glass caps also simplified the application of the hormones. The hormone was injected into each cap with a hypodermic syringe. Therefore, application of hormone and weighting of the petiole could be accomplished in one operation.

The glass caps were made from 6 x 50 mm test tubes by cutting off approximately 1/4" of the sealed end with a nichrome wire.

*yellow-green variety from Eastern Illinois University greenhouse

Then, a one inch length of #8 string was glued to the side of the 1/4" cap near its open end. Finally, a weight consisting of lead shot was clamped to the opposite end of the string (Figures 2 and 3). In this experiment, black strings were used to indicate auxin and brown strings, auxin plus kinetin. In order to facilitate numbering, the following color code was devised.

(1)	no paint	(9)	green - red - green
(2)	red	(10)	green - yellow - green
(3)	green	(11)	yellow - red - yellow
(4)	yellow	(12)	yellow - green - yellow
(5)	red - green	(13)	red - green - yellow
(6)	red - yellow	(14)	green - red - yellow
(7)	red - green - red	(15)	yellow - red - green
(8)	red - yellow - red		

The color combinations were painted on the glass caps with the first color being applied to the tip. One set of weighted glass caps consisted of fifteen pairs, half with black strings and half with brown strings. Six sets of glass caps were made. These were distinguished from each other by the color of the lead weights.

In this experiment, the main stem refers to the largest stem. Stems a, b, c, etc., are lateral stems growing from main stem. The first 4 - 6 leaf pairs of the upper portion of the stem were not

Figure 1

Coleus blumei Benth.

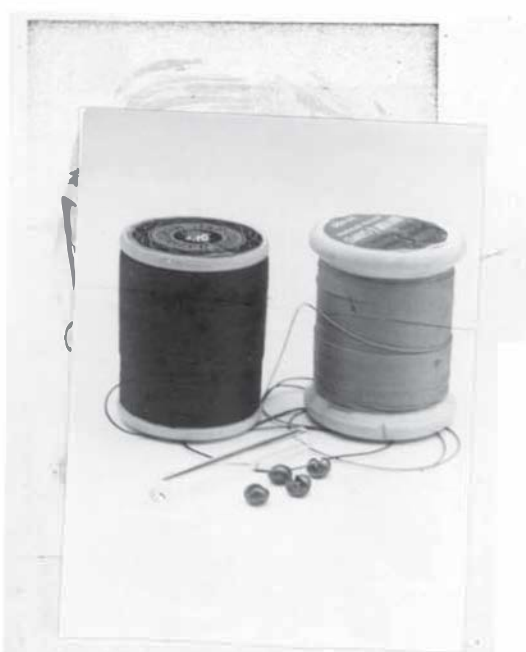


Figure 2

Materials used to make weighted glass caps

Figure 3

Weighted glass caps

Figure 4

Weighted glass caps on petiole stumps

used. Petioles from these younger leaves take several weeks to fall off and were, therefore, not considered in this study. The leaf pairs were numbered from the top of the stems to the base. When it had been determined which leaves were to be used, the blades were excised, marked, and saved for later weighing. In addition, the petioles were measured before the glass caps containing hormone were placed over the petiole stumps. After the plants had been prepared and placed in the growth chamber, the blades were weighed and the weights recorded.

The first two groups of plants were treated in the following manner. One of the petiole stumps of each opposite pair was treated with lanolin only and this was compared to the other stump which was treated with either NAA or NAA plus kinetin. Since the leaf pairs varied in age, the age not determined, it was impossible to use this date for comparison with later experiments but, the results did demonstrate the effectiveness of the hormones. In the last four experiments, one petiole stump of each pair of opposite leaves was treated with auxin and one with auxin plus kinetin. This arrangement gave a comparison of two leaves of equal age. Unfortunately, the micro-environment of each leaf varied, as evidenced by the differences in blade weights and petiole lengths of opposite pairs. However, since the age of a leaf has a very pronounced effect on the time required for the formation of the abscission layer, it seemed reasonable to assume that the best comparison could be made using leaves of equal age.

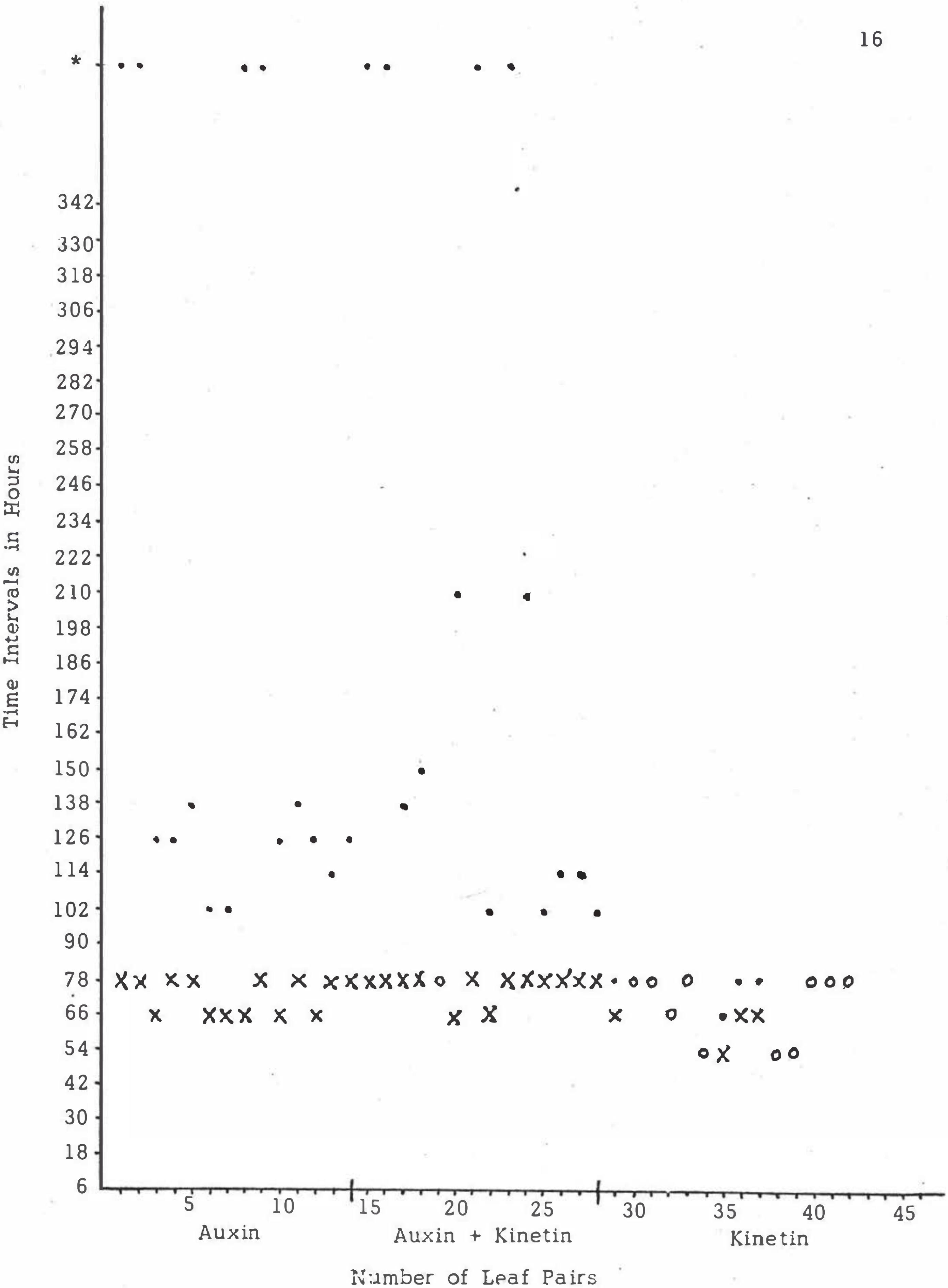
The prepared plants (Figure 4) were placed in a Sherer plant growth chamber, model number CEL 25-7. Full fluorescent and incandescent lighting was used. The photoperiod was adjusted to sixteen hours daylight and eight hours darkness with a day temperature of 80°F and a night temperature of 70°F. A stream of air was bubbled through a container of water to help maintain the humidity in the chamber. The pots were placed in dishes which contained one inch or less of water. The plants were checked every twelve hours and the positions of the petioles that had fallen were recorded.

RESULTS AND DISCUSSION

The tables and charts (Figures 5 - 10 and Tables 1 - 4) indicate the results of the experiments. In experiments 1 and 2 (Figures 5 and 6), the auxin and auxin-plus-kinetin-treated petiole stumps fell first in 26 out of 28 leaf pairs. This demonstrates the effectiveness of the hormones since most of the treated petioles fell before the untreated petioles. In addition, the leaf pairs in which the treated petioles did not fall first were lower leaves and, therefore, older. According to Osborne and Moss (1963), kinetin accelerates abscission when applied distally to the abscission zone. In this study, the kinetin treated petioles show a tendency to delay abscission slightly as indicated by the following data: The treated and untreated petioles fell during the same time interval in 18 leaf pairs (Figures 5 and 6). Kinetin-treated petioles fell first in 2 leaf pairs and, in 8 leaf pairs, the untreated petiole fell first. These results are not similar to those reported by Osborne and Moss and the reasons for this difference are not known.

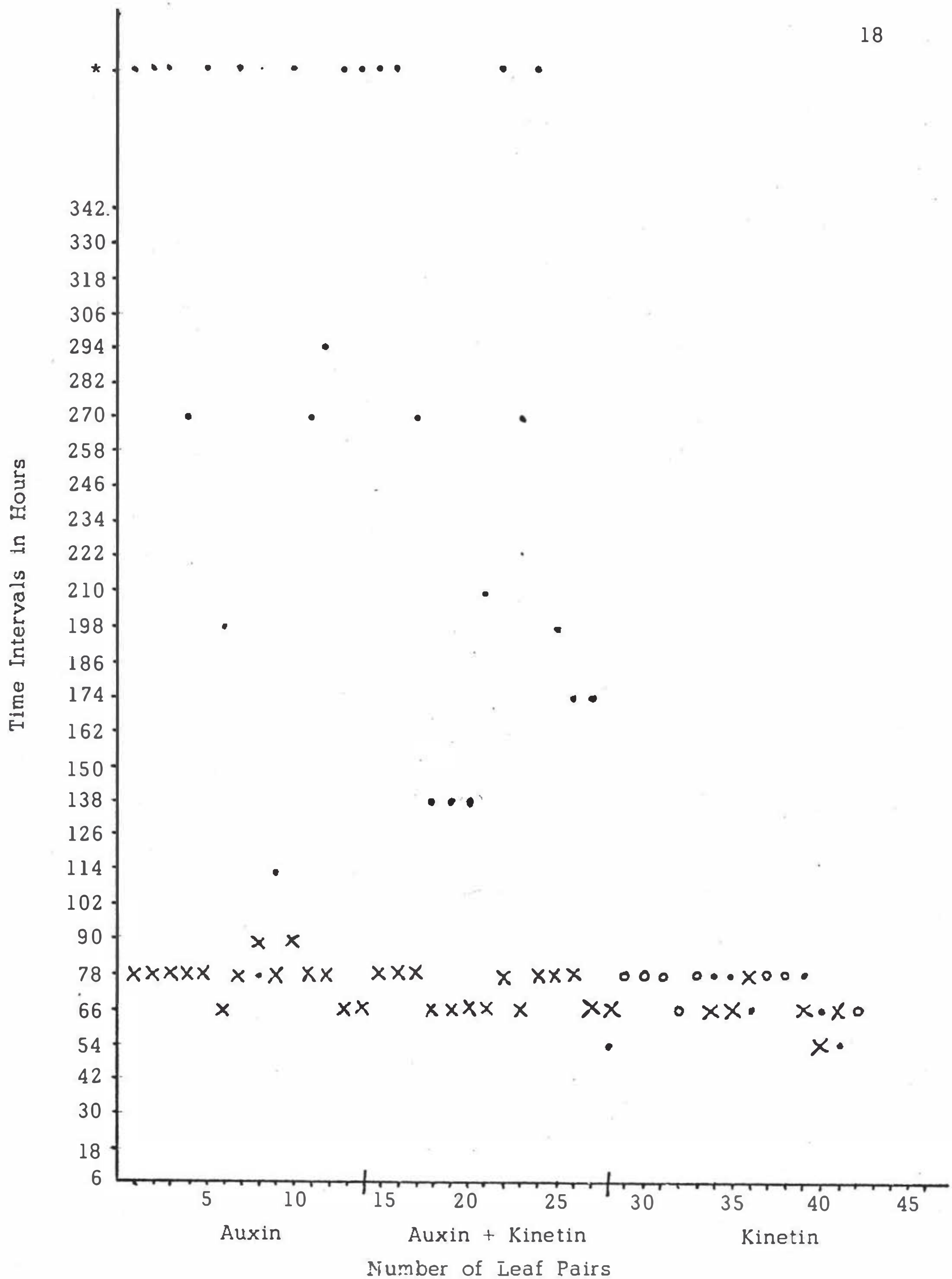
In 21.3% of the leaf pairs, the NAA-treated petioles fell off first and in 67.2%, the NAA-plus-kinetin-treated petioles fell off

Figure 5 Experiment number 5 started on February 18, 1968. Hormone treated petioles • , untreated petioles × . Both petioles fell during same interval o . The treated petioles of leaf pairs 1 - 14 were treated with auxin, 15 - 28 with auxin plus kinetin, and 29 - 42 with kinetin.



*These petioles did not fall within the time allotted.

Figure 6 Experiment number 6 started on March 1, 1968. Hormone treated petioles • , untreated petioles ×. Both petioles fell during same interval o . The treated petioles of leaf pairs 1 - 14 were treated with auxin, 15 - 28 with auxin plus kinetin, and 29 - 42 with kinetin.



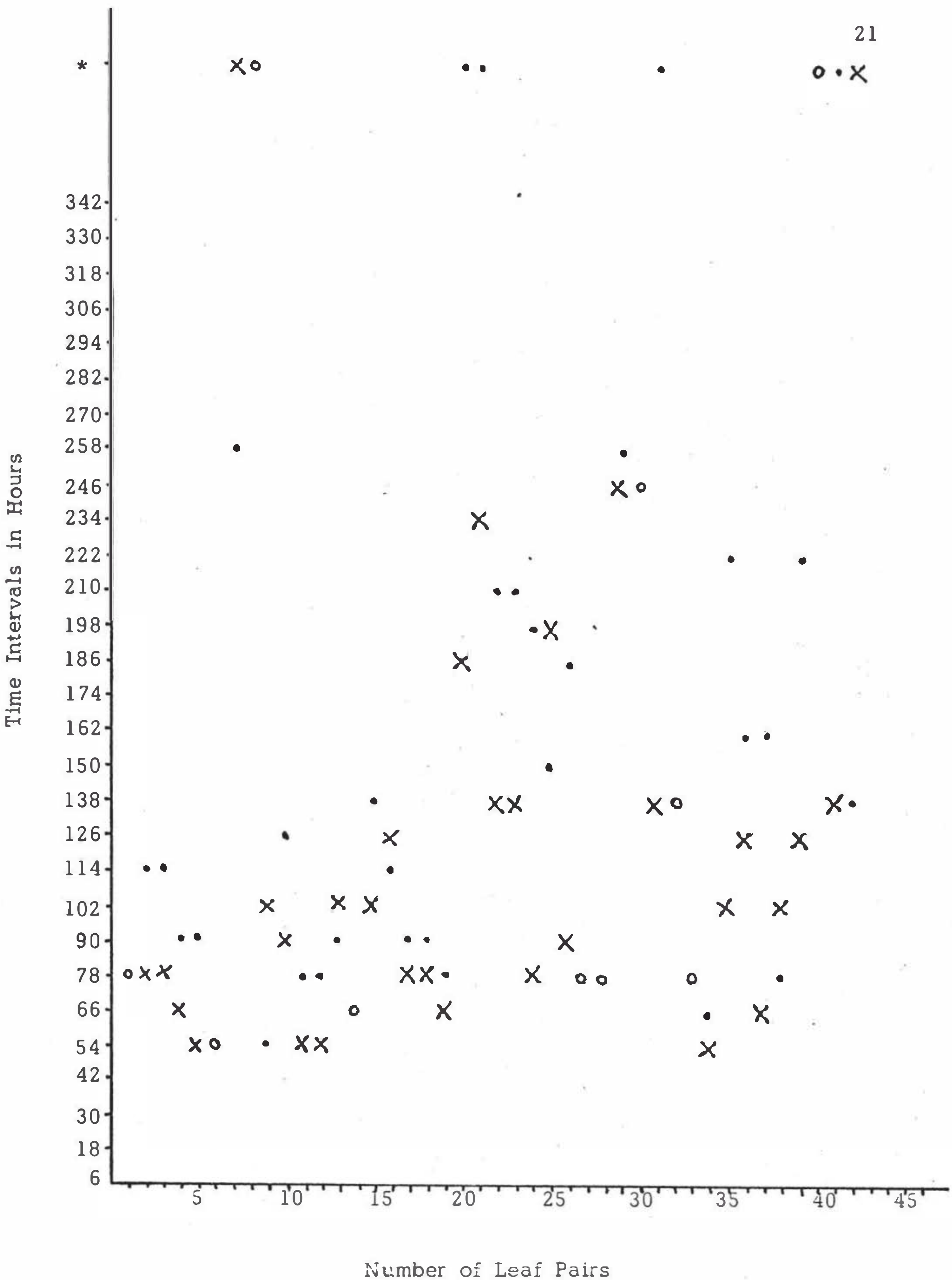
*These petioles did not fall within the time allotted.

first (Figures 7 - 10). In the remaining 11.3%, both petioles fell during the same twelve hour interval. In addition, there were ten leaf pairs of which neither petiole had fallen when the experiments were terminated. The percentages were computed using only the pairs of which one or both petioles had fallen in the time allotted.

Interpretation of the data indicated that NAA plus kinetin treatment is less efficient at delaying abscission than the auxin alone. No correlation with delay or acceleration of abscission could be found by comparing leaf weights or petiole lengths (Tables 1 - 4) with the time required for abscission. A correlation may have been possible if the leaf pairs could have been separated according to age and each age group compared.

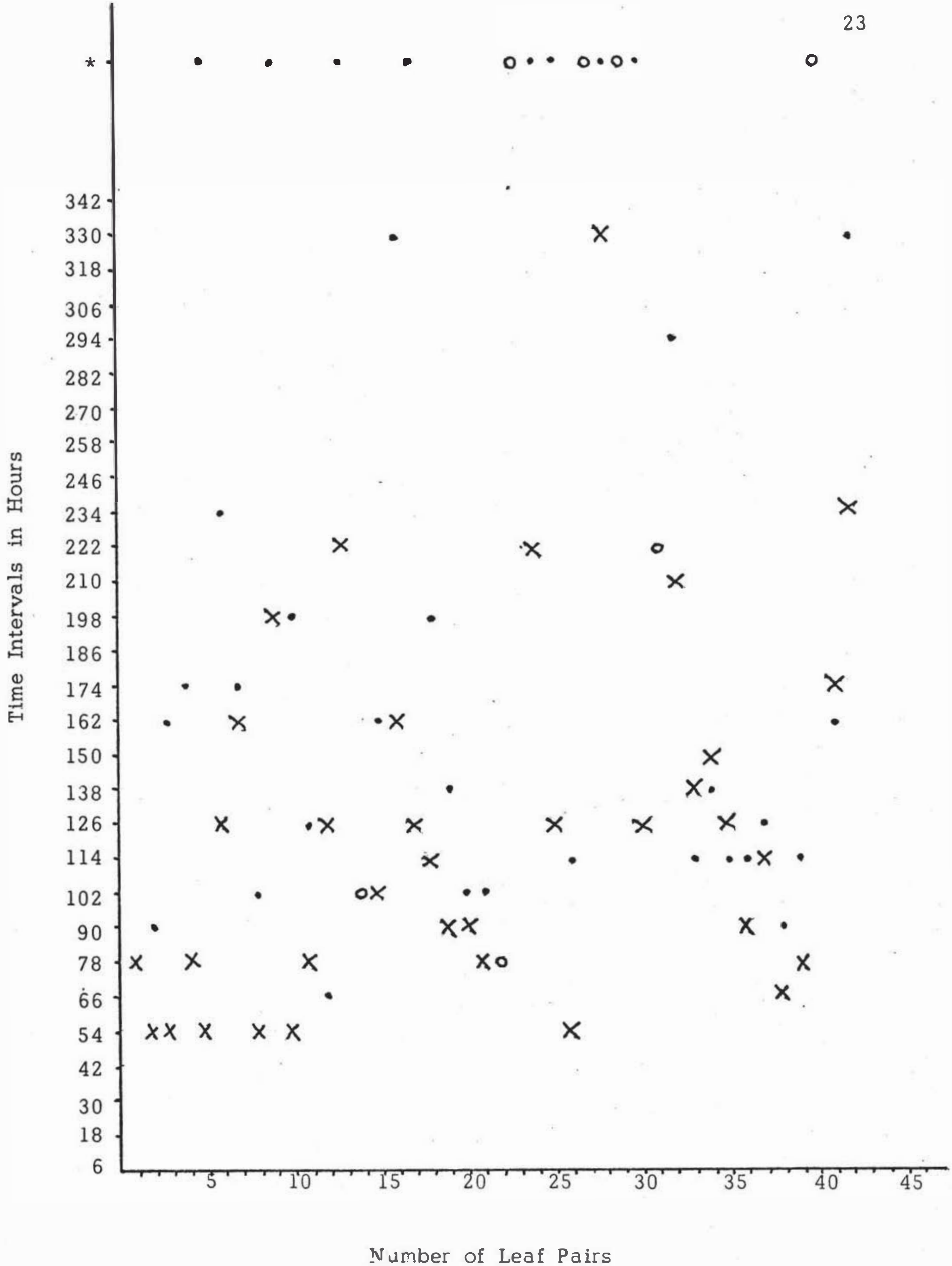
Kaushikz (1965) noticed a definite seasonal change in the time interval required for abscission of both controls and IAA-treated petioles of Coleus. The time required for abscission in winter was much longer than in summer. The same tendency is noticed in this study when the approximate averages of the time required for abscission in these experiments are compared. The average time of abscission decreases with the increase of day length (e.g., auxin-treated - April - 152 hours and - June - 140 hours). Even though the plants were placed in a growth chamber with controlled conditions, the data indicate that the pre-treatment environment may have influenced the results. In addition, all the plants used for

Figure 7 Experiment number 7 started on April 7, 1968. Auxin treated petioles • , auxin plus kinetin treated petioles ×. Both petioles fell during the same time interval ○ .



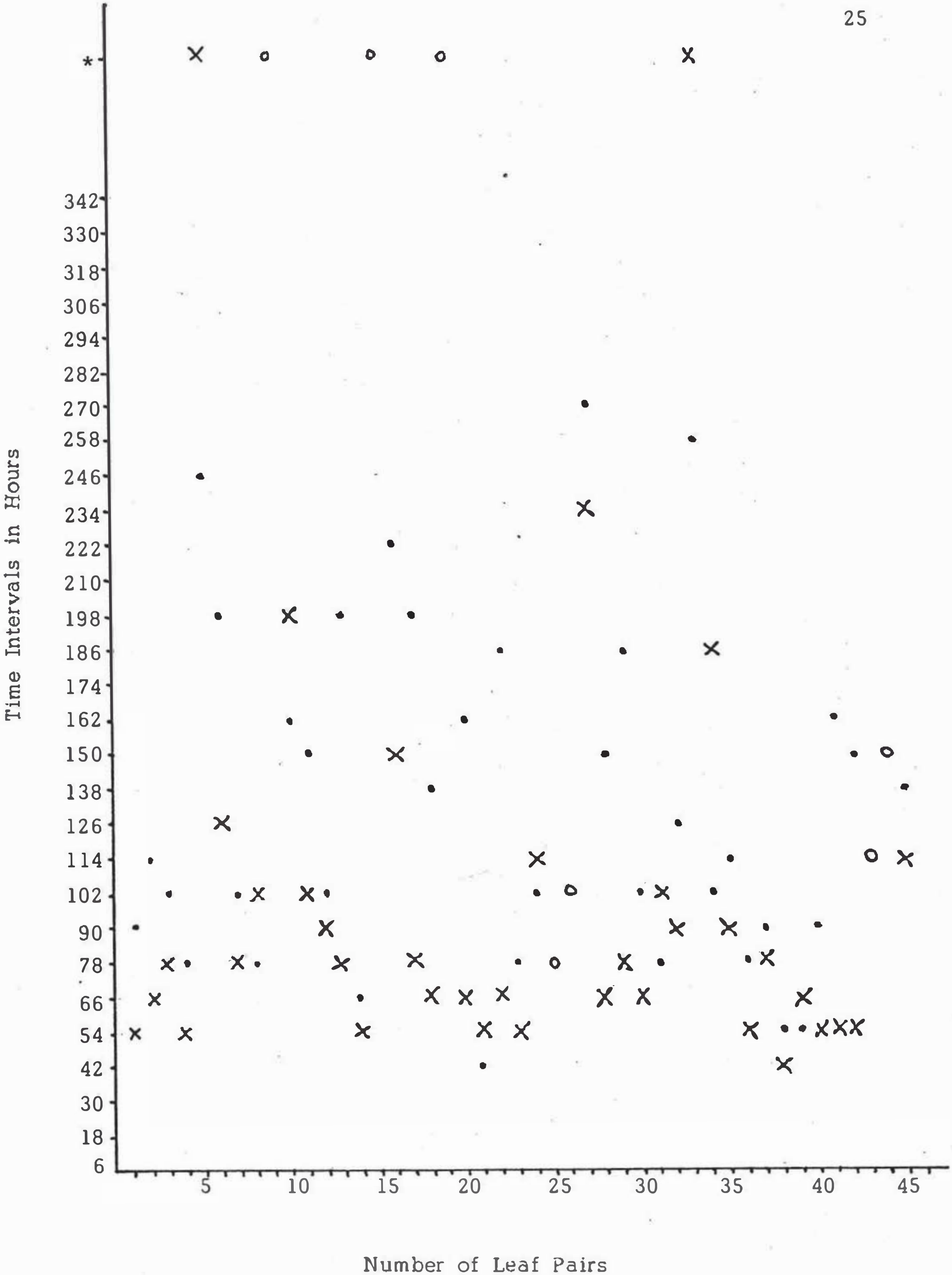
*These petioles did not fall within the time allotted.

Figure 8 Experiment number 8 started on May 12, 1968. Auxin treated petioles • , auxin plus kinetin treated petioles X . Both petioles fell during the same time interval o .



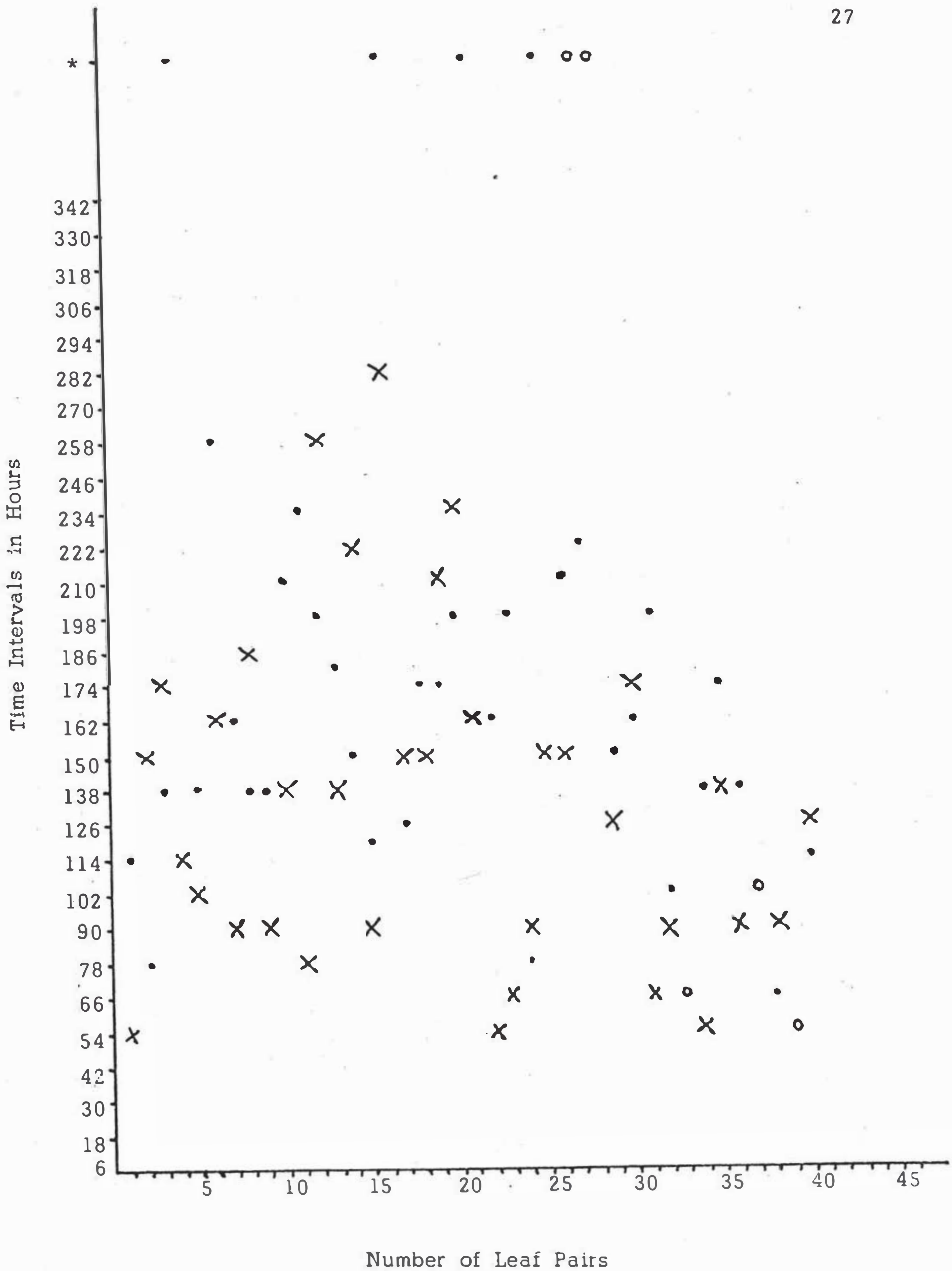
*These petioles did not fall within the time allotted.

Figure 9 Experiment number 9 started on June 7, 1968. Auxin treated petioles • , auxin plus kinetin treated petioles x . Both petioles fall during the same time interval o .



*These petioles did not fall within the time allotted.

Figure 10 Experiment number 10 started on June 8, 1968. Auxin treated petioles • , auxin plus kinetin treated petioles x . Both petioles fell during the same time interval o .



*These petioles did not fall within the time allotted.

Table 1.

Leaf blade weights and petiole lengths of experiment number 3.

Leaf Pair	Blade Weights (gm.) Auxin	Blade Weights (gm.) Auxin + Kinetin	Petiole Lengths (cm.) Auxin	Petiole Lengths (cm.) Auxin + Kinetin
1	.88	.87	3.8	3.6
2	.80	.75	4.0	3.6
3	.65	.49	4.0	3.0
4	.48	.39	2.8	2.6
5	.65	.53	4.3	4.0
6	.29	.21	2.0	2.2
7	.94	.81	3.6	3.8
8	.90	.87	4.2	3.8
9	.65	.83	3.1	4.0
10	.66	.82	3.8	4.8
11	.38	.52	4.2	4.4
12	.24	.17	3.0	2.4
13	.47	.48	3.2	3.0
14	.29	.40	3.2	2.0
15	.27	.28	2.4	2.5
16	1.08	1.21	3.1	2.8
17	1.21	1.39	4.1	3.9
18	1.29	1.53	4.5	4.8
19	1.37	1.41	4.7	4.0
20	1.47	1.80	4.1	4.0
21	1.21	1.24	4.0	3.9
22	.83	.96	3.7	3.6
23	.48	.68	2.6	2.8
24	.61	.72	2.5	2.5
25	.57	.86	2.9	3.2
26	.55	.59	2.7	2.5
27	.29	.37	2.8	1.9
28	.27	.25	2.0	1.9
29	.41	.32	2.9	2.4
30	.34	.32	2.2	2.1
31	1.35	1.21	3.0	2.8
32	1.48	1.31	3.5	3.8
33	1.68	1.44	4.2	4.4
34	1.40	1.34	4.4	4.8
35	1.22	1.19	4.5	4.8
36	1.04	1.14	4.3	4.2
37	1.10	1.11	3.9	3.9
38	.91	.73	3.6	4.1
39	.42	.37	2.9	2.7
40	.58	.59	3.1	2.5
41	.36	.54	2.4	3.5
42	.31	.22	2.7	2.3

Table 2.
Leaf blade weights and petiole lengths of experiment number 4.

Leaf Pair	Blade Weights (gm.) Auxin	Blade Weights (gm.) Auxin + Kinetin	Petiole Lengths (cm.) Auxin	Petiole Lengths (cm.) Auxin + Kinetin
1	1.15	1.30	4.1	4.6
2	1.04	.90	4.3	4.1
3	1.12	1.07	4.3	5.2
4	.95	1.27	4.1	4.4
5	.99	1.13	4.2	4.8
6	.93	1.15	5.0	4.8
7	.75	.75	3.4	3.3
8	.80	.70	3.7	3.2
9	.85	.84	3.7	3.8
10	.68	.19	4.7	4.7
11	.74	.72	3.9	5.0
12	.78	.67	4.3	4.9
13	.28	.41	2.5	3.0
14	.29	.39	2.4	3.6
15	1.18	1.21	3.9	3.5
16	1.28	1.15	3.8	3.8
17	1.22	1.07	3.9	4.0
18	1.13	.97	3.5	3.9
19	1.02	.74	3.8	4.1
20	1.09	1.35	3.0	3.1
21	1.17	1.52	3.0	3.2
22	1.05	1.42	3.5	3.7
23	.89	1.42	3.8	4.0
24	.88	.95	3.0	3.7
25	.24	.30	2.2	2.7
26	.28	.30	3.0	2.9
27	.17	.29	1.8	2.8
28	.17	.16	2.2	2.0
29	1.60	1.33	3.7	3.3
30	1.29	1.30	3.4	3.4
31	1.45	1.18	3.5	3.8
32	.90	1.26	3.7	3.9
33	.70	.76	3.7	3.5
34	.59	.65	3.7	3.5
35	1.48	1.26	3.5	3.9
36	1.20	1.16	3.6	3.9
37	1.19	1.17	3.5	4.3
38	.94	1.04	3.7	4.4
39	.75	.75	3.2	3.0
40	.55	1.16	2.7	3.6
41	.53	.64	3.8	3.2
42	.77	.49	2.8	2.7

Table 3.
Leaf blade weights and petiole lengths of experiment number 5.

Leaf Pair	Blade Weights (gm.) Auxin	Auxin + Kinetin	Petiole Lengths (cm.) Auxin	Auxin + Kinetin
1	.89	1.00	4.3	4.5
2	.95	.95	4.4	4.4
3	.71	.61	4.4	4.0
4	.69	.57	4.3	3.7
5	.50	.65	3.4	3.7
6	.57	.60	4.1	4.1
7	.92	.57	3.0	4.0
8	.67	.61	4.4	4.0
9	.55	.69	3.3	3.1
10	.59	.76	3.6	4.1
11	.55	.69	3.7	4.5
12	.73	.71	4.5	3.8
13	.65	.65	3.6	4.7
14	.43	.49	4.1	4.2
15	.78	.83	3.2	3.5
16	.60	.81	3.5	4.0
17	.67	.89	3.8	4.7
18	.51	.75	3.5	4.5
19	.99	1.05	2.9	3.3
20	1.11	1.02	3.8	3.9
21	.83	.98	4.0	4.8
22	.68	.83	3.5	4.2
23	.77	.71	4.5	4.8
24	.66	.70	4.3	4.8
25	.55	.54	5.0	4.0
26	.38	.50	3.0	4.0
27	.67	.63	3.8	3.9
28	.44	.52	3.0	4.1
29	.49	.50	3.8	4.2
30	.26	.32	3.0	3.6
31	.28	.26	3.7	3.5
32	.20	.31	2.9	3.7
33	.34	.34	3.0	2.8
34	.23	.29	2.7	2.9
35	.31	.25	3.0	3.7
36	1.15	1.29	3.9	3.7
37	1.18	1.22	5.0	4.2
38	.92	.99	3.9	4.2
39	1.02	1.15	3.3	4.0
40	1.02	.98	4.0	4.4
41	.74	1.07	4.0	4.8
42	.55	.54	4.1	4.3
43	.42	.50	3.2	3.1
44	.34	.41	3.1	3.3
45	.41	.34	3.2	2.9

Table 4.
Leaf blade weights and petiole lengths of experiment number 6.

Leaf Pair	Blade Weights (gm.) Auxin	Blade Weights (gm.) Auxin + Kinetin	Petiole Lengths (cm.) Auxin	Petiole Lengths (cm.) Auxin + Kinetin
1	.87	1.03	3.7	4.0
2	1.15	.96	5.0	4.5
3	1.10	.91	5.3	4.0
4	.81	.97	4.2	5.5
5	.82	.79	4.9	5.0
6	.51	.77	3.8	4.2
7	.46	.69	3.8	5.8
8	.32	.53	2.9	3.7
9	.50	.48	4.0	4.7
10	.48	.42	3.7	3.5
11	.49	.64	3.3	5.0
12	.65	.56	3.2	3.5
13	.39	.40	3.8	4.0
14	.42	.37	3.2	3.0
15	1.45	1.56	4.7	4.8
16	.53	.63	3.0	3.2
17	.49	.55	2.9	3.2
18	.32	.34	3.3	2.9
19	.51	.59	3.0	3.0
20	.46	.44	2.8	2.8
21	.23	.36	2.0	2.7
22	.37	.35	2.8	3.0
23	.58	.41	3.8	3.0
24	.65	.42	3.3	4.4
25	.32	.34	2.5	3.1
26	.23	.26	2.3	2.6
27	.30	.29	2.9	2.4
28	.63	.62	2.3	2.2
29	.87	.64	3.3	2.8
30	.75	.64	4.0	3.0
31	.99	.65	3.9	3.7
32	.88	.81	5.6	4.7
33	.85	.71	3.5	3.5
34	.29	.22	3.5	3.3
35	1.37	1.02	2.7	3.0
36	1.09	1.10	3.7	3.4
37	1.05	.93	3.8	4.7
38	.97	.88	4.2	4.3
39	1.16	1.20	5.0	5.8
40	.31	.42	3.8	2.9

this study, except for those in the first two experiments (Figures 5 and 6), were started on the same day; therefore, the difference in age of the plants may have influenced the difference in abscission time. Since the NAA-treated petiole fell first in approximately 21% of the leaf pairs (Figures 7 - 10), it may be that the effect of kinetin is inhibitory under certain conditions. Sacher (1967) found, in an experiment with subcellular fractions of bean endocarp, a variable effect of kinetin with both inhibition and stimulation of RNA synthesis occurring. Thus, it may be that very slight environmental conditions may reverse the effect of kinetin. The general mode of action of the kinetin may be due to the mobilization of various metabolites into the petiole stump from the lower portions of the petiole and, possibly, from the stem. Thus, the metabolites are probably depleted faster than would occur when auxin alone is applied to the stump. Therefore, degradation of the cellular compounds may be enhanced and the production of abscission-stimulating molecules in appropriate concentrations would perhaps occur sooner than would be possible in the absence of kinetin. In addition, due to the decline of metabolites in the lower portion of the petiole, the active transport of auxin would probably decrease since this process is thought to be related to metabolic efficiency. It seems possible, in the phenomenon of leaf abscission, to compare the production and flow of auxin to a feedback mechanism whereby the status of the cells in the leaf blade is determined by the flow of auxin through the abscission zone. Therefore, as long as the flow of auxin is sufficient, abscission will not occur; but any condition that will decrease the flow of auxin will trigger abscission. Most modern machinery has a similar mechanism whereby, if the operation is abnormal, it will automatically turn itself off. Possibly the main effect of kinetin in this experiment was to accelerate the decrease of the flow of auxin by increasing the rate of atrophy of the petiole cells.

SUMMARY

The application of 1-naphthaleneacetic acid (NAA) to one petiole stump was more effective at delaying abscission than NAA plus kinetin used to treat the opposite petiole stump. In 67.2% of the leaf pairs, the NAA-plus-kinetin-treated petiole fell first and in 21.3%, the NAA-treated petioles fell first. In the remaining 11.3%, both petioles fell during the same twelve-hour interval. In addition, kinetin-treated petioles were compared to untreated petioles. In 18 leaf pairs, both petioles fell during the same time interval. The kinetin-treated petiole fell first in two leaf pairs and, in eight leaf pairs, the untreated petiole fell first. These results may indicate a tendency for kinetin to slightly inhibit abscission.

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