TEMPERATURE AND HORMONAL EFFECTS ON REPRODUCTION IN CUCURBITS

by

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TABLE OF CONTENTS

INTRODUCTION

Cucumber, muskmelon and watermelon are important vegetable crops in the United States. Cucumbers are grown in the home garden, in market gardens, truck farms, and as a forcing crop in the greenhouse. Muskmelon is also a popular commercial vegetable crop. Watermelon is grown extensively on a commercial scale. All these species have a monoecious sex expression and vine extensively. These species produce flowers under a wide range of temperatures. In these species flower buds appear in the axil of the first leaf or even in the axil of the cotyledons. Moreover, clusters of both male and female flowers are formed on the main stem, but the number of flowers of each type may vary with individual clusters.

Although the work of Rosa (24) indicated that monoecism in Cucumis sativus L was relatively stable, the ratio of staminate to pistillate flowers varies greatly when plants are grown under different environmental conditions. In many instances the excessive production of staminate flowers on the one hand, and of pistillate flowers on the other has decreased yields, resulting in losses to growers. Consequently any means of regulating environmental factors or growth hormone treatment which might influence the ratio of staminate to pistillate flowers would be valuable since yields of high grade fruit is dependent, within limits, upon this ratio.

Previous workers have often used the ratio of pistillate to staminate flowers in cucurbits as a criterion of sex tendency. In order to determine this ratio, one must count all the pistillate and staminate flowers which appear during plant development, a very tedious and time consuming procedure. In plants of these species each node typically bears the following primordia, a flower primordia, a lateral shoot primordium, and a tendril primordium. The single axillary flower either develops stamens and shows no sign of an ovary or has a pistil but no functional stamens. Since in Cucurbitacea the ovary is inferior, the floral type can be distinguished early.

Because of the economic importance of these crops, this study was initiated to observe the effects of different temperatures on sex expression of selected cucumber varieties.

The response of cucumber, muskmelon, and watermelon to the growth hormone "B-995" is of considerable interest, especially in relation to stem elongation, induction of flowering and fruit set. Therefore this study was designed in order to determine the effects of this growth hormone on the sex expression of these species.

REVIEW OF LITERATURE

Most of the earlier work related to sex ratio was done concerning the interaction of light and temperature. It has been known for some time that sex expression in the cucurbits was subject to both genetic and non-genetic variations. There is a group of investigators of sex inheritance who recognize only genetic mechanisms, another group who claim that environment is the only cause of sex expression, and a third who take an intermediate position and consider the problems from several points of view.

Blaringhem (1), Emerson (9), and Sharp (25) first showed that sex was fundamentally hereditary in nature but concede that environment has its effects on sex expression.

Some workers base their conclusions on general observations rather than on controlled experiments, so that many of those in the first group may be classified differently on further investigations. In the first group there are a few who deny the possibility that heredity plays any part in the determination or expression of sex in plants.

If sex is determined by allelomorphic genes, as has been suggested by Emerson (9) it seems especially important that the genetic constitution of material used for environmental studies be definitely established. Thus if the factors are in a homozygous condition they would respond less readily to changes in environment than if they were in heterozygous or weakened condition and would be more or less in harmony with Janchen's (16) suggestion that weakness does exist in certain individuals.

Heyer (12) as early as 1884, working with sex ratio in cucumber and pumpkin found that the proportion of staminate to pistillate flowers could be materially changed by environmental conditions.

Tiedjens (29) succeeded in isolating strains of cucumber which differ in the ratio of pistillate to staminate flowers in individual plants. He also showed that high nitrogen level in the soil, shorter light duration, and reduced light intensity tend to increase the proportion of pistillate flowers.

Currence (6) reported that there was an increase of pistillate nodes as the vines lengthen. Currence (6) also called attention to the fact that the laterals developed a greater number of pistillate nodes than did the main stems, because they were later in developing than the main stems. Moreover, a larger percentage of the first lateral nodes were pistillate.

Edmond (8) working with the cucumber "Extra Long White Spine" found that plants grown from June 27 to September 6 produced 154.4 male flowers compared with 7.3 female flowers per plant; from December 15 to April 15 the count was 0.67 males and 93.67 females; and from February 17 to May 25, 1.67 males and 134 females. According to Edmond (8) when the varieties possessed a wide ratio, the staminate and pistillate flowers usually occured at separate nodes. In varieties with a narrow ratio both staminate and pistillate flowers frequently developed at the same node.

Danielson (7) reported that cucumber plants growing during the short days of winter were weakly vegetative and possessed short internodes, while those of extreme pistillate varieties exhibited the rosette type of growth with fasciated stems bearing large clusters of pistillate blossoms.

The experiments of Nitsch et al (22) performed with various cucurbits, in the fully controlled enviroment of the phytotron, provide the most positive evidence concerning the effect of temperature on sex expression in monoecious species. They found while working with the Boston Pickling variety of cucumber that at high temperature (86°F day and night) no female flowers developed on the first twenty five nodes, long days (16 hours) greatly diminished the number of female flowers, and the night temperature seemed also to play a critical role. So Nitsch et al (22) stated that high temperature and long days tend to keep the vines in the staminate phase, whereas low temperature speeded up the development, so that the pistillate phase was reached with fewer nodes.

Shifriss and Galun (28) studied the development pattern of sex expression in the monoecious varieties of cucumbers with particular emphasis on pistillate flower distribution. From the point of view of flowering habit and sex expression, the whole cucumber plant is regarded as a compound inflorescence bearing staminate flowers at the base and pistillate flowers out toward the end of vines. According to the authors this interpretation leads to two important turning points in the nodal sequence. The first is the turning point from strict maleness to monoecism and the second is the turning point from monoecism to strict femaleness.

Shifriss (27) reported that sex expression in cucumber is due to genetic variation. He explained that at first a few qualitative genes determine the kinds of flowers which can be potentially differentiated. All cucumber plants have the genetic potentiality to differentiate staminate flowers and in addition, monoecists carry gene "G" for pistillate flowers and andromonoecists gene "g" for perfect flower. Secondly, polygenes govern the rate of accummulation or depletion of as yet an unknown substrate. Thirdly, a gene "Acr" markedly accelerates the rate of the physiological process controlled by the polygenes.

Shifriss and Galun (28) reported that non-genetic factors such as photoperiodism, naphthalene acetic acid and gibberellins may affect the substrate which channels the action of the genes for different kinds of flowers.

Laibach and Kribben (19,20) and Laibach (18) have shown that the proportion of female flowers produced by cucumber may be substantially increased by treatments during early growth with beta-indoleacetic acid (IAA) and alpha naphaleneacetic acid (NAA) applied either in lanolin paste medium or by spraying in aqueous solution. Nitsch et al (22) reported earlier female flower bud formation in squash by spraying aqueous solution of N.A.A. Wittwer and Hillyer (31) obtained similar results with squash as well as cucumber. Similar results were also reported in a series of papers by Ito and Saito (14,15) with different plant regulators.

Choudhury and Phatak (3) reported that even under long days and high temperature conditions it was possible to modify the sex expression and ratio in cucumber by spraying with certain plant regulators.

MATERIALS AND METHODS

This study was conducted in the Horticultural Greenhouse at Kansas State University in 1961 and 1962.

Two experiments were designed to show the effects of different temperatures and growth hormones on the sex expression of cucumber, Cucumis sativus L; muskmelon, Cucumis melo L; and watermelon, Citrullus vulgaris L.

Two different temperatures were maintained in two parts of the greenhouse range. In one section of the greenhouse, the temperature remained high and was uniform during the day and night (average 90°F day and 60 - 65°F night). In the other part of the greenhouse, the temperature was lower and was uniform during the day (70 - 75°F) and night (60 - 65°F). Sunlight was the only source of light. The plants were covered with black plastic during the night to protect them from exposure to any other source of light.

The growth hormone "B-995" was obtained from the Naugatuck Chemical Division, U. S. Rubber Company, Naugatuck, Connecticut.

Seedbed Preparation

Field soil from the Ashland Horticulture Farm was placed in five inch pots and steam sterilized to provide a good growing medium for the seedlings. After planting the seeds for both experiments, the pots were labeled carefully as to treatment and crop varieties.

Plant Culture

Four seeds were planted in each pot to a depth of about half an inch and all pots were watered regularly to obtain uniform germination.

Seeds of the cucumber varieties for the first experiment were planted on February 15, 1962. A total of twenty pots for each variety were included. The pots were placed in flats for convenience of watering. All flats were kept in the high temperature greenhouse for four days to induce early germination. On February 19, germination started and four flats, one for each variety, were moved to the lower temperature greenhouse section. The other four flats remained in the high temperature greenhouse section. After germination, seedlings were thinned to one per pot.

In the second experiment seeds of cucumber, muskmelon, and watermelon were planted on September 12, 1962 for both treatments. Seeds for the soaking treatments were soaked separately for 24 hours in an aqueous solution containing the growth hormone "B-995" at the same concentrations as described in the description of experiments. Three pots were used for each species and for each treatment. Three pots of unsoaked seeds from each species served as the control.

The growth hormone "B-995" was applied as a spray treatment to seedlings in the first true leaf stage with a hand atomizer on September 27. Spray applications were made at weekly intervals until each group of plants had received three treatments. Treatments were started on September 27 and concluded on October 4 and 11.

Collection of Data

The temperature for the first experiment was recorded twice daily at 1:00 p.m. and 11:00 p.m. In the higher temperature greenhouse a thermograph was also used to record the temperature.

For a period of about thirty days after germination the rate of plant growth in both experiments were fairly uniform. The plants were healthy, dark green in color except in the later stage of development nitrogen became deficient and was corrected by an application of a nitrogenous fertilizer.

The following data were taken for each node, beginning at the first node. All nodes were numbered successively to the tip of the vine. The flower buds at each node were counted and the number and sex were recorded. Internode length was also measured. These data were taken for the main stem of each plant.

An average of one plant in each flat failed to develop properly making it impossible to include all of them in the records. The plants of the first experiment were attacked by thrips about thirty days after germination so they were sprayed with thiodin once a week for three times. At the conclusion of both the experiments the vines were less than 25 nodes in length and for this reason the data for nodes beyond this were thought to be of limited value. The height of the plants was measured at the conclusion of the experiments.

Description of Experiments

Experiment One

Four varieties of cucumber viz; A Japanese introduction, Model, Palomar and Marketer were used to study the effects of high (average 90°F day, 60 - 65°F night) and low (70 - 75°F day, 60 - 65°F night) temperatures on the sex expression of cucumber.

Experiment Two

Three species of cucurbits viz; cucumber (Palomar), watermelon (Blackstone) and muskmelon (PMR - 45) were used for the study. The purpose of the experiment was to evaluate the effects of the growth hormone "B-995" on the sex expression of these species. Two treatments were made with the growth hormone. In one, the seeds for three species were soaked in an aqueous solution containing the growth hormone for 24 hours prior to planting. In the second, the seedlings were sprayed with an aqueous solution containing the growth hormone.

The following treatments were used at the concentrations indicated:

Seed Soaked	Seedling Sprays
500 ppm	500 ppm
1000 ppm	1000 ppm
1500 ppm	1500 ppm
	1000 ppm (weekly interval, three times)

EXPERIMENTAL RESULTS

Experiment One

Responses of the cucumber plants to high and low temperatures were strikingly different. Forty days after germination, the plants subjected to higher temperature showed nothing but male flowers whereas, those grown at the lower temperature produced both male and female flowers. Moreover, in the beginning the buds produced at high temperature had all desicated without opening whereas those of lower temperature plants opened normally. Later on subsequent flowers on plants produced under higher temperatures developed to full maturity and opened like those of plants grown at lower temperature.

By comparing data columns 4 and 5 of Table I, it can be observed that by lowering the temperature the first female flower appeared earlier on the vine. Also there was an increase in the percentage of female flowers at subsequent nodes. In brief, data in Table I shows a distinct correlation between lowering the temperature and the number of pistillate flowers and a lower node location of first pistillate flower. For example, in Palomar and Marketer, at the lower temperature the first pistillate flowers developed at the 8th and 9th nodes, but at the higher temperature at the 14th node. At the lower temperature the plants of Japanese and Model produced pistillate flowers on the 7th and 8th nodes whereas at the higher temperature they were located at the 11th and 12th nodes.

A few laterals which developed on some plants in the later stages showed a greater number of pistillate nodes than did the main stems. This occured with the changing from the staminate to the pistillate condition since the laterals were later to develop than the main stems.

There was no appreciable difference in general growth habit early at the different temperatures. A significant difference in rate of axis elongation became evident after floral inception. At the conclusion of the experiment the plants grown at the higher temperature increased in stem elongation (Table I, column 7). The average stem length in Model grown at the lower temperature was 15.4 inches as compared with 34.7 inches at the

Table I
Effects of Temperature on Sex Expression of Cucumber

Variety	Av. Temp. Night	Av. Temp. Day	Av. No. of Nodes after 75 days	Av. No. of flowers* Staminate	Av. No. of flowers* Pistillate	Av. Node location of first pistillate flower	Av. stem length in inches
Japanese Introduction	$60^{o}F$	$70-75^{o}F$	16	29	1.1	7	13.6
"	$60-65^{o}F$	$90^{o}F$	20	42	0.4	11	25.5
Model	$60^{o}F$	$70-75^{o}F$	17	27	4.8	8	15.4
"	$60-65^{o}F$	$90^{o}F$	24	55	1.9	12	34.7
Palomar	$60^{o}F$	$70-75^{o}F$	16	39	1.7	8	21.0
"	$60-65^{o}F$	$90^{o}F$	22	44	0.9	14	26.1
Marketer	$60^{o}F$	$70-75^{o}F$	18	35	1.8	9	26.5
"	$60-65^{o}F$	$90^{o}F$	22	41	0.7	14	35.5

* Only fully developed flowers

high temperature. Moreover, the plants grown at high temperature had a greater internode length as compared to the plants grown at lower temperature.

It was also observed that the staminate nodes always developed flowers in clusters whereas the pistillate flowers were ordinarily born singly. This situation resulted in an excess of staminate flowers.

SEQUENCE IN FLOWER BUD DEVELOPMENT

Continued observation of the cucumber vines showed a sequence of flower types occured (Fig. 1) when a uniform temperature was maintained. This type of sequence was also reported by Nitsch et al (22) in squash.

Incompletely developed male flowers developed in the axils of the first leaves and dried up. These flowers were classified as "undeveloped male flowers". At later nodes on the same vine normal male flowers developed, followed by a section containing both male and female flowers. As the vine elongated further, peculiar male flowers appeared which produced no pollen. The female flowers in the same area, on the other hand, increased in size. Finally, the vines produced a flower with an extremely enlarged ovary, which developed into a fruit without having been pollinated. In some plants when this occured, subsequent growth of the vines was inhibited.

Experiment Two

Growth observation of the main stems of plants of these species were recorded twice during the studies. The first observation was recorded 42 days after germination. Pictures were also taken on the same date. The second observation was made at the end of the experiment, 38 days after the first one.

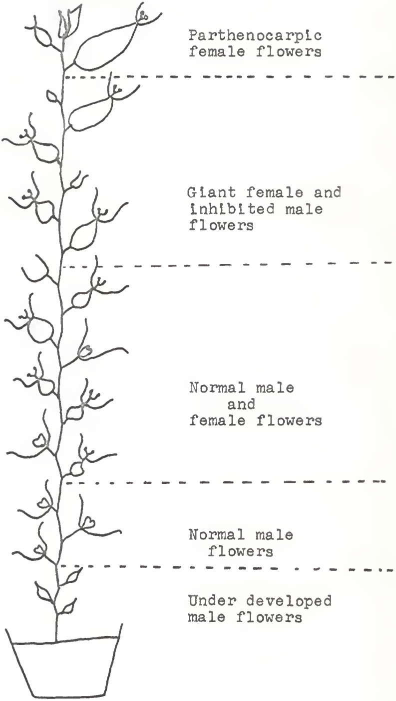


Fig. 1 Schematic representation of the sequence of flower types in the cucumber.

Cucumber

Neither soaking nor spray treatments suppressed terminal growth of cucumber except at a dosage of 1000 ppm "B-995" at weekly intervals (w.i.), which was very effective at the beginning (Plate I). However, plants later resumed normal growth. By the end of the experiment the average internode length for the 1000 ppm (w.i.) treatment was 0.786 inches as compared to 0.993 in control plants both having an equal number of nodes (Table 2).

There appears to be a correlation between the appearance of the first female flower on the main axis and male to female flower ratio. The soaking treatments at 500 ppm and 1000 ppm and aqueous sprays at 1000 ppm and 1000 ppm (w.i.) induced formation of the female flowers at earlier nodes (Table 2). For example, the aqueous spray at 1000 ppm and 1000 ppm (w.i.) induced female flower formation at the 5th and 7th nodes as compared to control plants which developed the first female flower at the 11th node. The spray treatments at 500 ppm and 1500 ppm produced reverse effect, in that the female flowers developed at the 13th and 15th nodes.

It was also observed that there were more female flowers as a result of those treatments which induced female flowers at the earlier nodes. The soaking treatments at 500 ppm and 1000 ppm and aqueous spray treatment at 1000 ppm produced 6, 5 and 9 female flowers respectively as compared to 3 for control. Plants treated with an aqueous spray of 1000 ppm (w.i.) produced fewer staminate flowers as compared to the other treatments.

Table 2

Effects of Growth Hormone "B-995" on the Sex Expression and Vegetative Response in Cucurbits

Species and Treatments	Av. No. of Nodes after 80 days	Av. Internode length in inches	Av. No. of flowers Stam.	Pist.	First node at which 1st pist. flower appeared	Height of the plant in inches
Cucumber						
Seed Soak						
500 ppm	19	0.794	38	6	5	15.1
1000 ppm	18	0.900	44	5	5	16.2
1500 ppm	14	1.010	32	3	9	14.2
Check	15	0.993	44	3	11	14.9
Spray 500 ppm	16	0.806	49	4	13	12.9
1000 ppm	17	0.817	37	9	5	13.9
1500 ppm	18	0.894	43	2	15	16.1
1000 ppm (w.i.)	15	0.786	28	1	6	11.8
Muskmelon						
Seed Soak						
500 ppm	16	1.090	45	0	0	17.5
1000 ppm	17	0.917	49	0	0	15.6
1500 ppm	15	1.260	51	0	0	18.9
Check	17	1.017	51	0	0	17.3
Spray 500 ppm	17	0.530	30	0	0	9.11
1000 ppm	14	0.621	32	0	0	8.7
1500 ppm	16	0.850	39	0	0	13.6
1000 ppm (w.i.)	14	0.350	22	1	13	4.9
Watermelon						
Seed Soak						
500 ppm	21	0.814	32	1	16	17.11
1000 ppm	20	0.865	22	2	15	17.3
1500 ppm	23	0.926	26	2	14	21.3
Check	18	1.050	28	1	13	19.0
Spray 500 ppm	24	0.704	30	2	12	16.9
1000 ppm	24	1.030	20	3	15	24.9
1500 ppm	20	1.035	18	1	17	20.7
1000 ppm (w.i.)	17	0.635	11	0	0	10.8

EXPLANATION OF PLATE I

Cucumber - Left to Right:

500 ppm, 1000 ppm, 1500 ppm (seed soak)
1000 ppm (weekly spray - 3 applications)
Check - no treatment
500 ppm, 1000 ppm, 1500 ppm (one application first true leaf stage)

Muskmelon - Left to Right:

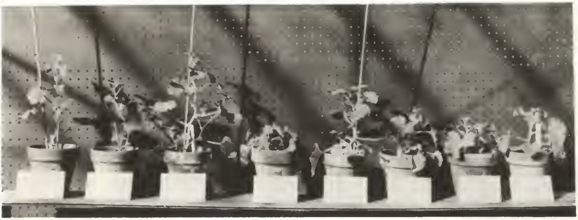
500 ppm, 1000 ppm, 1500 ppm (seed soak)
1000 ppm (weekly interval - 3 applications)
Check - no treatment
500 ppm, 1000 ppm, 1500 ppm (one application first true leaf stage)

Watermelon - Left to Right:

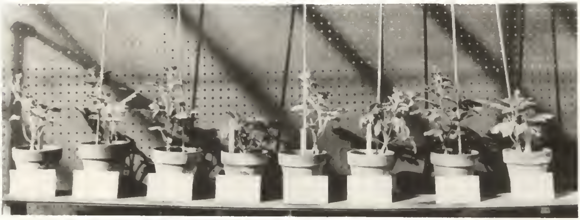
500 ppm, 1000 ppm, 1500 ppm (seed soak)
1000 ppm (weekly spray - 3 applications)
500 ppm, 1000 ppm, 1500 ppm (first true leaf stage)

PLATE I

Cucumber



Muskmelon



Watermelon

Muskmelon

In muskmelon, the growth hormone "B-995" produced the following result: All seed soak treatments stimulated the apical stem growth and all spray treatments produced a stunting effect. With 1000 ppm (w.i.) level spray the stunting was permanent resulting in a bush habit of growth. The 1000 ppm (w.i.) spray treatment reduced plant height to 4.9 inches as compared to 17.3 inches for the control plants (Table 2). With 500 ppm and 1000 ppm aqueous spray the average treatments plants heights were 9.11 and 8.7 inches respectively as compared to 17.3 inches for control plants. Average internode lengths for 500 ppm, 1000 ppm and 1000 ppm (w.i.) aqueous spray treatments were 0.53, 0.621 and 0.350 inches respectively as compared to 1.017 inches in control. However, the internode length was equal to the control for the seedlings produced from soaked seeds.

It was also noticed that there were fewer staminate flowers on sprayed plants than on those produced from soaked seeds. There were no pistillate flowers observed on the vines except for those treated with the 1000 ppm (w.i.) spray. Plants treated with aqueous sprays of 500 ppm, 1000 ppm and 1000 ppm (w.i.) had 30, 32 and 22 staminate flowers respectively as compared to an average of 51 on the control plants.

Watermelon

The growth hormone only supressed stem elongation with the 1000 ppm (w.i.) spray treatment (Plate I). There was no difference between the number of nodes developed on the vines. The plant height at 1000 ppm (w.i.) was 10.8 inches as compared to 19 inches for the control (Table 2). The average internode length at 1000 ppm (w.i.) spray was 0.635 inches as compared to 1.050 inches for the control plants.

At the end of the experiment there were no visible effects either in stem length or flower buds as a result of the "B-995" treatments.

DISCUSSION OF RESULTS

Temperature responses of the cucumber grown under the experimental conditions are similar to those reported by other investigators (6,7, 22,29) on a variety of plants. One response was an increase in stem length with an increase in temperature in the later stage of development. No appreciable difference in general growth habit appeared during the early growth stage at the different temperature levels. Significant differences in rate of axis elongation became evident after floral inception. The high temperature (average 90^{o}F day, 60 - 65^{o}F night) favored stem elongation whereas the lower temperature (average 70 - 75^{o}F day, 60^{o}F night) retarded it (Table 1). The fact that vegetative response to temperature became especially evident with the onset of flowering in the cucumber suggested that the temperature reaction of the stem is in some manner physiologically related to the onset of flowering itself.

Low temperature retarded stem growth and favored pistillate flower differentiation. Varieties which produced weak growth had a tendency to bear more pistillate flowers than those which showed strong growth tendency. Pistillate flowers set at the lower nodes under low temperature conditions and were accompanied by restricted vegetative growth. Hastening of plant growth by temporary high temperature during the sensitive stage stimulated male flower induction.

A change of the plant from male to female flower initiation was apparent by observing the number of male and female flowers. This situation as well as the results obtained with the cucumber varieties showed that environmental conditions influenced sex differentiation by inducing a physiological change of the primordia in the stage of sexual differentiation.

Whatever the possibilities are, it was evident that the cucumber in this study produced male flowers first, at relatively high temperature, then female flowers appeared more readily at the low temperature level. Tiedjens (29) and Whitaker (30) attempted to develop a classification system for cucurbits based on sex ratio as influenced by environmental conditions. Environment, of course, can only bring about potentialities of the plant which are determined by its genotype. Thus as already pointed out by Tiedjens (29) certain varieties may be more easily influenced to produce 100 percent male, others 100 percent female flowers.

Nitsch et al (22) found that if both light and temperature were simultaneously modified, a more complex picture was obtained. Lowering the temperature induced female flowers earlier and in greater numbers than high temperature, but by increasing the day length the production of female flowers was retarded. Thus the change in light conditions might cancel the effects of temperature.

So it may be true that only temperature influences differentiation flower primordia regardless of photo period or there may be an interaction between the two. Inspection of flower primordia in the Japanese cucumber, Somahanhiak, revealed that both staminate and pistillate primordia were present in each flower and sex expression at anthesis was apparently dependent upon the relative growth rates of the two types of primordia (14,15). Perhaps this is also true in other species of cucurbits.

Before the possible role of gibberellins in flower sex expression of the cucumber was discovered, Heslop and Harrison (11) suggested that development of staminate primordia of monoecious plants was favored by a low auxin level and the pistillate primordia by a high auxin level at the differentiating apex.

Based on results obtained during this study with cucumber, the growth hormone "B-995" apparently did not suppress apical growth. However, the seed soak treatments at 500 ppm and 1000 ppm and the aqueous sprays at 1000 ppm and 1000 ppm (w.i.) produced more pistillate flowers at earlier nodes. In muskmelon the spray treatments at all concentrations stunted apical growth and suppressed the staminate flowers. The 1000 ppm (w.i.) spray treatment reduced plant height to 4.9 inches as compared to 17.3 inches for the control plants (Table 2). This showed that at 1000 ppm (w.i.) the stunting effect was permanent. This differentiation in internode length was assumed to be due to hormone effect. The effects of the growth hormone on muskmelon flower sex expression and internode length suggests that these results were controlled by endogenous hormonal type growth substances. This effect may be altered not only by varying either one of the two treatments, but by varying or applying different levels of growth substances which are antagonistic to, or enhance the activity of either.

Apparently internode length and sex ratio were not influenced by the hormone "B-995" in the watermelon.

SUMMARY AND CONCLUSION

This study was conducted to determine the influence of temperature and the growth retarding hormone "B-995" on the reproduction processes of cucumber, muskmelon and watermelon.

The study consisted of two experiments in the Greenhouse at Kansas State University during 1961-1962.

The growth hormone "B-995" was obtained from Naugatuck Chemical Division, U. S. Rubber Company. Two treatments were made with the growth hormone. In one, the seeds were soaked for 24 hours in aqueous solution containing the growth hormone and in the second the seedlings were sprayed with aqueous solution at the first true stage.

High average temperature (90°F day, 60 - 65°F night) increased the number of staminate flowers in cucumbers, whereas a lower average temperature (70 - 75°F day, 60°F night) increased the number of pistillate flowers. The lower temperature also resulted in an earlier appearance of the first pistillate flowers on the vine and also an increase in the number of pistillate flowers later. High temperature increased stem elongation whereas the lower temperature retarded stem elongation after floral inception.

Both treatments at all concentrations showed no effect on apical growth of cucumber. However, seed soaking treatment at 500 ppm and 1000 ppm and the spray treatment at 1000 ppm (weekly interval 3 times) induced more pistillate flowers and at earlier nodes in cucumber.

In muskmelon the spray treatments 500 ppm, 1000 ppm and 1000 ppm (weekly interval) suppressed apical growth. There was a considerable difference between treatments and the check for both foliar sprays and seed soaking. An aqueous spray at 1000 ppm (weekly interval) produced a permanent stunting effect. Moreover the plants produced fewer staminate flowers than those in the control.

None of the growth hormone treatments greatly affected watermelon plants regardless of concentration or method of application.

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TEMPERATURE AND HORMONAL EFFECTS ON REPRODUCTION
IN CUCURBITS

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Cucumber, muskmelon and watermelon are important vegetable crops in the United States. These species produce flowers and fruits under a wide range of temperatures. In many instances the excessive production of staminate flowers on the one hand, and of pistillate flowers on the other has decreased grower yields especially under forcing conditions. Yields of high quality fruit depend, within limits, upon the staminate and pistillate ratio and how early pistillate flowers are produced.

Earlier workers showed that long days, high temperatures and low auxin levels tended to keep the vines in the staminate phase whereas lower temperatures, short days and high auxin levels speed up the development of the pistillate phase.

In 1961-1962 two experiments were designed to show the effects of different temperatures and the growth hormone "B-995" on the sex expression of cucumber, Cucumis sativus L.; muskmelon, Cucumis melo L.; and watermelon, Citrullus vulgaris L.

From the first experiment with cucumber it was found that a relatively high temperature (Av. 90°F day, 60 - 65°F night) had a tendency to increase the number of staminate flowers whereas a lower temperature (Av. 70 - 75°F day and 60°F night) increased the number and advanced appearance of pistillate flowers. It was also found that high temperature increased stem elongation and lower temperature retarded the stem elongation.

In the second experiment the effects of two treatments with a new hormone "B-995" on cucumber, muskmelon and watermelon were studied. It was found in cucumber that the growth hormone "B-995" did not suppress apical growth. However, soaking the seeds for 24 hours at 500 ppm and 1000 ppm and an aqueous spray during the first true leaf stage at 1000 ppm and

1000 ppm (weekly interval - 3 times) produced more pistillate flowers and at earlier nodes.

In muskmelon the spray treatments at all concentrations stunted the apical growth and reduced the number of staminate flowers. At 1000 ppm (weekly interval) the stunting effect was permanent.

Apparently internode length and sex ratio were not influenced by the hormone "B-995" in watermelon.

More research is needed to further study the relationship of "B-995" especially with cucumber, muskmelon and watermelon.