T H E S I S

PHENOTYPIC EFFECTS OF JOINTLESS GENE IN TOMATO

Submitted by

Mohamed M. K. El Sayed

In partial fulfillment of the requirements

for the Degree of Master of Science

Colorado State University

March, 1962

COLORADO STATE UNIVERSITY

March 1962

WE HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER OUR SUPERVISION BY MOHAMED N. K. EL SAYED

ENTITLED PHENOTYPIC EFFECTS OF JOINTLESS GENE IN TOMATO

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE.

Committee on Graduate Work

R. L. Foskett — Robert D. Parke — H. W. Chapman

Major Professor

A. M. Binkley

Head of Department

Examination Satisfactory

Committee on Final Examination

H. W. Chapman — R. L. Foskett

Robert D. Parke

A. D. Dobzhansky

A. M. Binkley

Chairman

Permission to publish this report or any part of it must be obtained from the Dean of the Graduate School.

ACKNOWLEDGMENT

The author wishes to express his sincere appreciation to the following members of the Colorado State University staff who helped with the preparation of this manuscript:

Dr. Richard L. Foskett, of the Department of Horticulture; Dr. Harold W. Chapman, of the Department of Horticulture; and Dr. Robert V. Parke, of the Botany and Plant Pathology Department.

Appreciation is also extended to Professor A. M. Binkley, Head of the Department of Horticulture and Dr. F. B. Salisbury, of the Department of Botany and Plant Pathology.

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Chapter I

INTRODUCTION

The pedicels of all common tomato varieties are geniculate and have a swollen abscission joint at a point midway between the peduncle and the calyx. This abscission joint usually forms the place of detachment when the fruit is picked.

In 1936 Butler (1) noticed that when the fruits of some tomato plants were picked, the calyxes always remained on the plant instead of coming off with the fruit as they usually do. These plants lacked the characteristic abscission joint.

The jointless character is a potentially valuable one for tomato breeders. Since no stem remains on the fruit after picking, damage to other fruits in the basket due to the sharp ends of abscissed pedicels could be averted. The expense necessarily incurred in the removal of stems when the fruit is marketed would also be eliminated (19).

Since the time of Butler's (1) discovery of *j* and his description of its action and studies of its inheritance, this gene has been incorporated in several tomato varieties, for example, Stemless Pennorange (21), Stemless Pennred (19) and Dwarf Champion.

The problem

Phenotypic effects of jointless gene in tomato.--Because apparent interactions with other genes and pleiotropic effects of the jointless gene have been noted, this study of the phenotypic effects of the gene was initiated. The relationship between the jointless character and the determinate character, both controlled by single genes, needed clarification. In addition, the effect of the presence of the jointless character on leafy inflorescence, number of flowers per inflorescence and time of flowering have been included in this study of the effects of the jointless gene.

Problem analysis.--The problem may be subdivided into the following phases:

A. Vegetative growth and flower initiation.
    1. Initiation of first inflorescence.
        a. Date of flowering.
        b. Number of nodes before first inflorescence.
    2. Number of leaves between inflorescences.
    3. Leafy inflorescences.
B. Flower development and fruit set.
    1. Number of flowers per inflorescence.
    2. Fruit set.

Delimitations.--This problem was confined to Fort Collins in northern Colorado. The study was conducted both on the Horticulture Farm of Colorado State University and in the Horticulture Department greenhouses.

The source of all jointless material used in this study was the Dwarf Champion tomato variety.

Definition of terms

Jointless - The jointless character produced by the presence of the gene j_1 in the homozygous condition.

j - The symbol j is used to denote the gene producing the jointless character. The j used in this study is j_1.

Tomato - Cultivated varieties of Lycopersicon esculentum and their crosses.

Chapter II

REVIEW OF LITERATURE

Description of genes

1. Jointless gene (j)

Most tomato varieties have an abscission joint in the pedicel (12). Thus, when the fruit is picked, the calyx and part of the pedicel remain attached to the fruit. The jointless gene suppresses the formation of this joint, and in jointless plants the calyx remains attached to the plant instead of coming off with the fruit. Butler (1) determined that the jointless gene is a simple recessive which came from the French variety Rouge Maine Native.

2. Determinate growth (sp)

The determinate growth character has also been referred to as both self-pruning (3, 17, 20, 25) or self-topping (4, 26). Indeterminate varieties of tomato have three leaves between inflorescences; but Burpee's self-pruning, from which the gene description was made, has only one leaf instead of three. Furthermore, Yeager (25) described its "remarkable characteristic of determinate growth, producing blossom clusters at the tips of the branches." He used, but did not publish, the symbols T for indeterminate, and t for terminate so that the term "determinate" is widely used to denote the self-pruning type (20). The gene symbol sp was used by MacArthur (17) and is now officially used.

The self-pruning plant type according to MacArthur (17) is one in which some of the stem segments are shortened to one or two internodes; and also in this plant type the flower clusters begin at the usual height (the first blossom cluster on the ninth to the thirteenth internode), and then tend to recur on every internode or every second internode. They sometimes skip three leaves, but are then invariably closely spaced again. Because of terminal inflorescences, and resulting cessation of vegetative growth, determinate plants cover less space than do indeterminate ones.

Determinate growth is a recessive character (3, 4, 17, 25, 26). The F_2 segregation is 3 indeterminate (*spt* -) to 1 determinate (*sp sp*).

3. Leafy inflorescence

Most of the commercial varieties of tomato do not have leaves on the inflorescence, but some varieties do (3). The term leafy inflorescence is used to describe situations in which a small leaf grows out of an otherwise normal flower cluster. The other extreme is one in which the inflorescence becomes an elongated leafly stem with fruits borne singly along their side (2). Boswell (4), Young and MacArthur (26), Butler (3), and others, reported that the leafy inflorescence character behaves as a simple recessive. According to Rick and Sawant (21), leafy inflorescence is a pleiotropic effect of jointless.

Jointless interactions

1. Jointless-leafy inflorescence relationship

A horticulturally unsatisfactory condition associated with *j* is the leafy inflorescence. Instead of bearing exclusively reproductive

structures as do normal clusters, the inflorescence of j first produces one to three flowers and then continues growth as a normal vegetative shoot, bearing leaves and additional inflorescences, which, in turn, repeat the same cycle. This abnormal development leads to such proliferation of branches that growth may become very dense and stems consequently attenuated (21). It became apparent that, whereas leaves might be found on the first inflorescence of a plant, later inflorescences of the same plant may be normal, or vice versa (21). Leaves can also be found occasionally on inflorescences of most tomato varieties as an abnormality of growth.

In the early investigations involving j, the jointless and leafy traits were assumed to be separable by crossing over; consequently, two linked genes, j and lf, were proposed to account for these relationships in the fifth linkage group. Thus, Butler in his earlier work (1) reported that the jointless pedicel was closely linked with leafy inflorescence in the fifth linkage group and the two genes are separated by 1 to 1.5 units of crossing over. Later, Butler (2) reported a value of two, whereas, Young and MacArthur indicated an interval of 10 units (21).

Butler (3) in 1952 mentioned that the loci lf and j continue to give unequal recombinant classes, and he obtained an F_2 coupling ratio of 4,601 jointed non-leafy: 96 jointless non-leafy: 34 jointed leafy: 1,478 jointless leafy. One jointless non-leafy selection was grown all summer and did not produce a single leafy inflorescence, but cuttings from this plant did have leafy inflorescences. Another selection which was non-leafy and jointless, refused to self, but set

fruit readily when other pollen was used. Rick and Sawant (21) also encountered plants that apparently represented crossovers, but their accumulated data reveal that only one type of crossover was recovered, namely, jointed leafy, and none of the reciprocal crossover, jointless non-leafy.

An attempt was made by Rick and Sawant (21) to obtain crossovers between j and lf. From a total of 2,603 plants they obtained 1,330 jointed non-leafy, 1,273 jointless leafy, and no plants with recombination of these two traits. Mertens and Burdick (18) also reported the absence of crossovers between j and lf in their studies of the linkage relations of bi (bifurcate inflorescence).

Attention should be called to other tomato mutants in which modifications of the joint are accompanied by leafy inflorescences. Inflorescences of mc (macrocalyx) (26) either lack the joint or have only slight swelling or ill-defined joint without the associated abscission layer (3, 21), and simultaneously always continue growth as leafy structure. Similarly pi (pistillate) is also characterized by the absence of joint and by leafy inflorescences (21). The two effects are not invariably associated, however, for bu (bushy) (26), which shifts the joint to a position very close to the fruit and interferes to some extent with abscission (3), scarcely ever shows leafy inflorescences. The observations on all of these mutants, nevertheless, permit the generalization that elimination or severe reduction of the joint is usually accompanied by a leafy inflorescence, but that the leafy inflorescence is not necessarily associated with a modified joint (21).

2. Pleiotropic effects

Dodson (6) explained the meaning of this Greek word (Pleion, many + trope, change). Dunn (7) mentioned Mendel's observation that a given unit could have effects on different parts of the organism which differed to some degree; effects of this kind are included in what is called now "pleiotropy". The term "pleiotropy" was introduced by Plate (1910) for the phenomenon of a single factor expressing simultaneously different characteristics in different organs (23). Many examples of genes with more then a single effect have been discovered. It has even been suggested (10) that all genes may be pleiotropic, even though their various effects are not recognized at present. Even though a gene may have many end effects, quite possibly every gene influences only one primary function in the chemistry of the developing individuals (10).

The latest list of gene mutants reports 282 single gene mutants in the common tomato. Most of these have only a single known effect, although a few are to some degree pleiotropic. There may, of course, be other undetected effects of apparently nonpleiotropic mutations but this is a matter of conjecture. An example of pleiotropy in tomato is a mutant named cabbage cb (15), which occurred spontaneously and behaves as a simple recessive. The gene mutation concerned has numerous and varied effects on the sporogenous tissue, pollen mother cells, and fertility.

The tendency for leafiness and jointless to appear together in so many mutants hints very strongly that they are closely associated in

development and this lead Rick and Sawant (21) to the conclusion that leafiness and jointless are but pleiotropic effects of a single gene, j. Therefore, they proposed that leafy be considered an additional effect of j and that lf be dropped from the tomato gene list. The latest revision of the gene list (24) adopted this change.

3. Jointless-determinate relationship

The undesirable leafiness encountered with j can be effectively reduced by interaction with sp (20, 21). To obtain concise information on the effects of this gene interaction, Rick and Sawant (21) made a cross between plants of the constitution jt, j and sp+ sp. The degree of leafiness was measured in four different phenotypes of the resulting dihybrid F_2. With jointless indeterminate plants they obtained 0 per cent inflorescences with no leaves, 7.8 per cent with 1-3 leaves, and 92.2 per cent with more than three leaves. With jointless determinate plants they obtained 10.3 per cent inflorescences with no leaves, 76.0 per cent with 1-2 leaves, and 13.7 per cent with more than three leaves. Their conclusion was that the tendencies of sp to suppress vegetative growth, apparently also greatly subdue further vegetative growth of the inflorescences, and sp therefore offers a solution to the problem of leafiness associated with j.

4. Jointless fruit attachment

The freedom from joints is usually accompanied by a very tight attachment of the pedicel to the fruit. It may become so difficult to separate fruits from the vine that portions of fruit tissue are torn away in harvesting. The factors affecting tightness of attachment in j phenotypes have not been investigated extensively, but sufficient information has been obtained to indicate that, as with leafiness, the

nature of attachment can be greatly affected by interaction with genes from other stocks (21). The evidence was obtained from hybrids between large-fruited jointless lines and small-fruited jointed lines of San Marzano type. Rick and Sawant were not prepared to state whether the tightness of attachment is determined solely by cross-sectional area of attachment, but they suspect that it may also be influenced by other anatomical features.

Leaf removal effect on flowering

There has been much speculation concerning the part played by leaves in flower initiation, and the work has been reviewed by Lang (13), Livermann (16), and Salisbury (22). Guttridge (11) has obtained convincing evidence in the strawberry that the leaf may produce an inhibitor of flowering. The production of this inhibitor may be stopped by the act of induction in light sensitive plants and also by removal of the leaves was shown by his work. Removal of the leaves to induce flower initiation in tomatoes was demonstrated by De Zeeuw (5).

Fisher and Loomis (9) showed that removal of immature leaves of soybean plants as they formed forced young plants into early flowering. Also they showed that spraying immature leaves with anti-auxin was more effective in inducing flowering than spraying entire plants, and was much more effective than spraying only mature leaves.

Fisher (8) in 1955 showed that continuous removal of the immature leaves in soybeans was more effective in stimulating early flowering than either removing mature leaves or detopping. Detopping

markedly delayed flowering, while removing mature leaves tended to delay flowering, but not to the extent noted with the detopped plants. Removing the immature leaves after four, five, or six trifoliolate leaves had reached maturity stimulated earliest flowering. Fisher observed that the plants which flowered earliest flowered at lower nodes and more profusely, and flowering at lower nodes was correlated with earliness of flowering.

De Zeeuw (5) results shows that the tomato seedlings which were completely and continuously defoliated, but with their cotyledons intact, were able to initiate and develop flower clusters. This treatment moreover advanced the flower initiation, shortened the period from macroscopic flower primordia to the opening of the first flower and increased the number of flowers.

Leopold and Lam (14) in 1960 studied the leaf factor influencing tomato earliness. They observed that the number of flowers in the first cluster increased with the removal of increasing numbers of young expanding leaves, up to and including those above the fourth node. The date of the first bloom was also earlier with the removal of young expanding leaves, the greatest effect being obtained with the removal of leaves above the third node. The removal of the mature leaves had an apparent inhibitory effect on the date of first bloom.

Leopold and Lam (14) concluded that in the intact plant the young expanding leaves apparently do inhibit the number of flowers and the earliness of bloom in the first flower cluster, the leaves at the fourth, fifth, and sixth nodes having the greatest inhibitory effect. A suggestion of an opposite effect for mature leaves is also evident.

Chapter III

METHODS AND MATERIALS

The experiments involved in this study of jointless gene in tomato were conducted both in the greenhouse and in the field. The purpose of the greenhouse experiments was to obtain environmental control over the plants for accurate measurements. The field plots were planted to obtain information under natural growing conditions and to have larger populations than were possible in the greenhouse.

Greenhouse experiments

Greenhouse trials were conducted during 1961 to observe F_1 and F_2 progenies of test crosses between a jointless variety, Dwarf Champion, and two jointed varieties: one determinate, Fireball, and one indeterminate, Rutgers.

F_1 Observations

The following crosses were previously made by Dr. R. L. Foskett:

a. Dwarf Champion x Rutgers. (G-60-129)

b. Rutgers x Dwarf Champion. (G-60-106)

c. Dwarf Champion x Fireball. (G-60-127)

d. Fireball x Dwarf Champion. (G-60-121)

e. Puck x Rutgers. (G-60-132)

The F_1 plants were planted in the greenhouse during the spring of 1961. Two plants of cross a and four plants each of crosses b, c, d, and e were planted. The four varieties used as parents, Dwarf Champion, Rutgers, Fireball, and Puck, were also planted at the same time as the F_1's for comparison. During the growth of the plants all the auxiliary buds which developed were removed and the plants were staked because of limited growing space. The following data were recorded:

a. Number of nodes on the main stem between the cotyledons and the first inflorescence.

b. Number of leaves between the first and second inflorescence.

c. Number of leaves between the second and third inflorescence.

d. Number of flowers in the first inflorescence.

e. Number of flowers in the second inflorescence.

f. Number of flowers in the third inflorescence.

g. Pedicel type (jointless or jointed).

Seeds were collected after fruit ripening and seeds from all plants of each pedigree were bulked together and saved to produce F_2 plants.

F_2 Observations

F_2 seeds from the above mentioned F_1 plants were planted in the greenhouse on July 12, with each progeny planted in a separate four inch pot. On August 4, the seedlings were transplanted into benches in the greenhouse with approximately one square foot allowed for each

plant. The greenhouse night temperature was approximately 65°F and the day temperature was held to approximately 75°F. The auxiliary buds were removed.

In addition to the data which were recorded for the F_1 plants, the F_2 data also included the date of the opening of the first flower of each plant and whether or not first and second inflorescences were leafy.

A second replication of the same F_2 progenies were planted on September 29 and the seedlings were transplanted into the greenhouse benches on October 19. The environmental conditions were similar to those in the first replication. Data were recorded for the same observations made in the first replication. A total number of 134 plants were planted in the first and second replication. The number of F_1 and F_2 plants of each progeny and the parents are shown in Table 1.

Leaf removal experiment

It was decided to conduct an experiment on jointless material similar to that conducted by Leopold and Lam (14), removing the young expanding leaves above the fourth node. Since Leopold and Lamobserved that the greatest response to young leaf removal appeared in late flowering, indeterminate varieties, and since the jointless character induces late flowering and extreme indeterminateness, it was considered to be of interest to test the leaf removal treatment on jointless material.

This treatment was made to test its effect on the earliness and the number of flowers per inflorescence in F_2 generation of the crosses between Dwarf Champion and Rutgers and between Fireball and

Table 1.--PLANTS USED IN GREENHOUSE PROGENIES OBSERVATIONS.

Parents, F_1 and F_2 progenies	Number of plants planted in		
	Spring 1961	Summer 1961	Fall 1961
Parents			
Dwarf Champion	4	6	6
Rutgers	4	2	10
Fireball	4	8	4
Puck	4	5	7
F_1 progeny			
Dwarf Champion x Rutgers	2		
Rutgers x Dwarf Champion	4		
Dwarf Champion x Fireball	4		
Fireball x Dwarf Champion	4		
Puck x Rutgers	4		
F_2 progeny			
Dwarf Champion x Rutgers		10	6
Rutgers x Dwarf Champion		2	12
Dwarf Champion x Fireball		6	14
Fireball x Dwarf Champion		8	8
Puck x Rutgers		6	14
Total	34	53	81

Dwarf Champion. Dwarf Champion variety was used in these crosses as a source of jointless character. The seeds were planted on October 17, 1961. After the first two leaves appeared, the seedlings were transplanted into six inch pots, one plant per each pot. Three replications were grown at approximately 65°F night temperature. Each replication included two plots composed of the two F_2 progenies. Within each plot were two sub-plots composed of seven pots each. The young expanding leaves of the plants in one sub-plot were removed above the fourth node and the other sub-plot was used as a control.

The young expanding leaves were removed as soon as they were large enough to catch with a fingernail (about one-half inch long). The date of flowering was recorded as well as the number of flowers in the first inflorescence.

Field experiment - Summer 1961

The material grown in the field during the summer of 1961 was a group of F_3 populations obtained from Dr. R. L. Fosket, who had previously crossed the jointless variety Dwarf Champion with breeding line 56-12. Dwarf Champion contains the genes for jointless pedicel and dwarf plant type and is phenotypically indeterminate. Line 56-12 has genes for jointed pedicel, non-dwarf plant type, and indeterminate growth. This line resulted from selections following a cross between the varieties, Alpine and Loran blood.

In the F_2 progeny of the cross Dwarf Champion x 56-12, two observations attributable to the presence of the jointless gene were noted. One observation was that in the F2 population some of the jointed

plants, but none of the jointless ones, were typically determinate in having only one or two leaves between the first and second inflorescence. This result was not expected, since both Dwarf Champion and 56-12 were phenotypically indeterminate with three leaves between inflorescences. The other observation was that, while indeterminate tomato plants normally have three leaves between inflorescences, many of the jointless plants in the F_2 population produced more than three leaves between their inflorescences (Table 2).

Seeds from several F_2 plants were planted in the greenhouse on April 30, each progeny being in a separate four inch pot. The soil used was a greenhouse potting soil composed of 2 part loam, 1 part sand, and 1 part peat. The greenhouse night temperature was 65°F. Table 2 shows the number of seeds planted from each of the F_2 plants and the per cent germination of each of these progenies.

After the first two leaves appeared, the seedings were transplanted into flats and the plants were grown in the greenhouse with approximately two square inches allowed for each plant. On June 1, the plants were transplanted in the field at a spacing of six feet between rows and three feet between plants in each row. One cup of Bonro starter solution at a concentration of three pounds in 50 gallons of water was applied to each plant at transplanting time. The field was irrigated the next morning.

On June 4, the field received severe hail damage and as a result 447 of the original 690 plants were lost (Table 2). The original plan was to get the required information from the main stem

Table 2.--F_3 PROGENIES OF THE CROSS DWARF CHAMPION X 56-12 GROWN IN THE FIELD AT FORT COLLINS, COLORADO.

F_2 Parents				F_3 Progenies			
Plant number	Plant type	Pedicel	Number leaves between 1st and 2nd inflorescence	Number seeds planted	Germination percentages	Number plants set in field	Number plants surviving hail
12	Dwarf	Jointed	1	30	83	25	5
24	Non-dwarf	Jointed	1	30	100	30	7
45	Dwarf	Jointed	2	30	97	29	6
46	Dwarf	Jointed	2	40	100	40	7
48	Dwarf	Jointed	1	35	94	33	1
58	Dwarf	Jointed	1	40	100	40	6
59	Dwarf	Jointed	1	25	96	24	14
61	Dwarf	Jointed	1	25	96	24	11
66	Dwarf	Jointed	1	40	90	36	19
26	Non-dwarf	Jointed	3	40	87	35	16
38	Non-dwarf	Jointed	3	40	47	19	1
40	Non-dwarf	Jointed	3	40	75	30	2
43	Dwarf	Jointed	3	40	80	32	12
51	Dwarf	Jointed	3	35	89	31	9
52	Dwarf	Jointed	3	35	66	23	6
55	Dwarf	Jointed	3	40	87	35	28
27	Non-dwarf	Jointless	3	40	100	40	21
31	Non-dwarf	Jointless	6	8	63	5	4
34	Non-dwarf	Jointless	5	4	50	2	2
37	Non-dwarf	Jointless	4	35	97	34	23
49	Dwarf	Jointless	4	35	100	35	11
60	Dwarf	Jointless	5	25	92	23	17
62	Dwarf	Jointless	6	30	97	29	0
67	Dwarf	Jointless	4	30	87	26	12
69	Dwarf	Jointless	4	10	100	10	3

of each plant, but after the hail damage to the remaining plants it was decided to obtain the following data as an average of the most vigorous four branches of each plant. Data were recorded for the number of leaves between the first and second inflorescence, number of leaves between the second and third inflorescence, number of flowers in the first inflorescence, number of fruits in the first inflorescence, number of flowers in the second inflorescence, number of fruits in the second inflorescence, and whether or not the first and second inflorescences were leafy. In addition to these observations, it was noted whether the plants had jointless or jointed pedicels.

Chapter IV

RESULTS AND DISCUSSION

Greenhouse experiments

F_1 Results.--All plants of the F_1 progenies of the crosses Dwarf Champion x Rutgers, Rutgers x Dwarf Champion, Dwarf Champion x Fireball, Fireball x Dwarf Champion, and Puck x Rutgers were jointed. Since Dwarf Champion was the only jointless variety used, complete dominance of *j+* for jointed pedicels is indicated.

The data in Table 3 show how the parents and their F_1 progenies compare for various measurements. From these data it appears that the jointless plants of Dwarf Champion have more nodes on the main stem between the cotyledons and the first inflorescence, more leaves between inflorescences, and fewer flowers per inflorescence than the plants of the jointed varieties. F_1 progenies of the crosses in which Dwarf Champion was one parent had fewer nodes before the first inflorescence and greater number of flowers.

A number of interesting results appear among the F_1 progenies. The Dwarf Champion plants had an average of 12 nodes between the cotyledons and the first inflorescence. The Rutgers plants had an average of nine nodes. The plants resulting from a cross between Dwarf Champion and Rutgers, as well as those from the reciprocal cross, had an average of eight nodes. Similar results were obtained from crosses between Dwarf Champion and Fireball. While the Fireball plants had an

Table 3.--MORPHOLOGICAL OBSERVATIONS OF JOINTLESS AND JOINTED VARIETIES AND THEIR F_1 PROGENIES. NOTATIONS ARE BASED ON THE AVERAGE OF THE PLANTS WITHIN EACH LINE.

Parents and F_1 progeny	Number of plants	Number of nodes before first infl.	Number of leaves between 1st & 2nd infl.	Number of leaves between 2nd & 3rd infl.	Number of flowers in 1st infl.	Number of flowers in 2nd infl.	Number of flowers in 3rd infl.
Parents -							
Dwarf Champion	4	12	3	2.75	3.75	2.50	3.50
Rutgers	4	9	3	3	5.50	7	6
Fireball	4	8	1	1.25	6.50	6.50	6.25
Puck	4	7	1	1.50	8.75	9	8
F_1 progenies -							
Dwarf Champion x Rutgers	2	8	3	3	6.50	6.50	5
Rutgers x Dwarf Champion	4	8	3	3	7.75	6.25	6
Dwarf Champion x Fireball	4	7.50	1.50	1.75	7.75	7.75	7.50
Fireball x Dwarf Champion	4	8.25	1.25	1.25	7.25	6.25	7.50
Puck x Rutgers	4	8.25	2.75	2.25	9.25	8.75	9.25

average of eight nodes, the F_1 progeny of Dwarf Champion x Fireball produced 7.50 nodes; and with Fireball as a female parent, there were 8.25 nodes.

These results indicate that jointless delays flowering until there has been more vegetative growth than does the jointed character. This indication is supported by the results of crossing two jointed, or normal, varieties. In this case, in which the varieties Puck and Rutgers were used as parents, the F_1 was intermediate between the two parents in number of nodes before the first inflorescence. This intermediate nature of the F_1 suggests that inheritance of position of the first flower may be due to genes not showing dominance, but that where jointless is present, the jointless gene delays flowering and masks the genes controlling flower position.

The epistatic effect of jointless over another gene is further demonstrated by observation of the numbers of leaves between inflorescences. The sp+ gene typically produces three leaves between inflorescences, as in the indeterminate variety Rutgers, and its allele sp typically produced only one or occasionally, two. Such determinate varieties as Fireball and Puck are of the genotype sp sp.

When Dwarf Champion and Rutgers are crossed, the F_1 progeny are clearly indeterminate, as would be expected from a cross of two indeterminate plants. A cross between an indeterminate and a determinate plant would also be expected to produce the same results, since sp+ is dominant. When Dwarf Champion and Fireball were crossed, however, the results were not what one would expect from these

phenotypes. Dwarf Champion, being phenotypically indeterminate, produced determinate plants in the F_1 of a cross with the determinate variety Fireball. This strongly indicates that Dwarf Champion carries the genotype sp sp but that it is masked by j.

The number of flowers per inflorescence appeared also to be fewer because of the jointless character, although from an observation of the F_1 progeny alone it cannot be determined that this is not a characteristic of the variety Dwarf Champion.

F2 Results.--The data collected from the two replications of F_2 progenies were combined together for analysis. The original parent varieties were again grown with each replication of F_2 progenies for direct comparison.

Number of nodes before the first inflorescence are shown in Fig. 1. This figure shows that jointless plants usually have more nodes before the first inflorescence than jointed plants. The first inflorescence in jointless plants initiate after the tenth to the fifteenth node, while in jointed plants it initiates after the sixth to the twelfth node depending on the variety. The means of numbers of nodes before the first inflorescence are shown in Table 4. These means show that in every progeny segregating for jointless plants, the mean number of nodes below the first inflorescence is greater for jointless plants than for jointed.

Number of days from seeding to the opening of the first flower of each plant are shown in Fig. 2. In the F_2 progenies of the crosses Rutgers x Dwarf Champion, Dwarf Champion x Rutgers, and Fireball x Dwarf Champion, where there was segregation for jointless character,

Figure 1.—Number of nodes on the main stem between the cotyledons and the first inflorescence in F_2 progenies and the original parents.

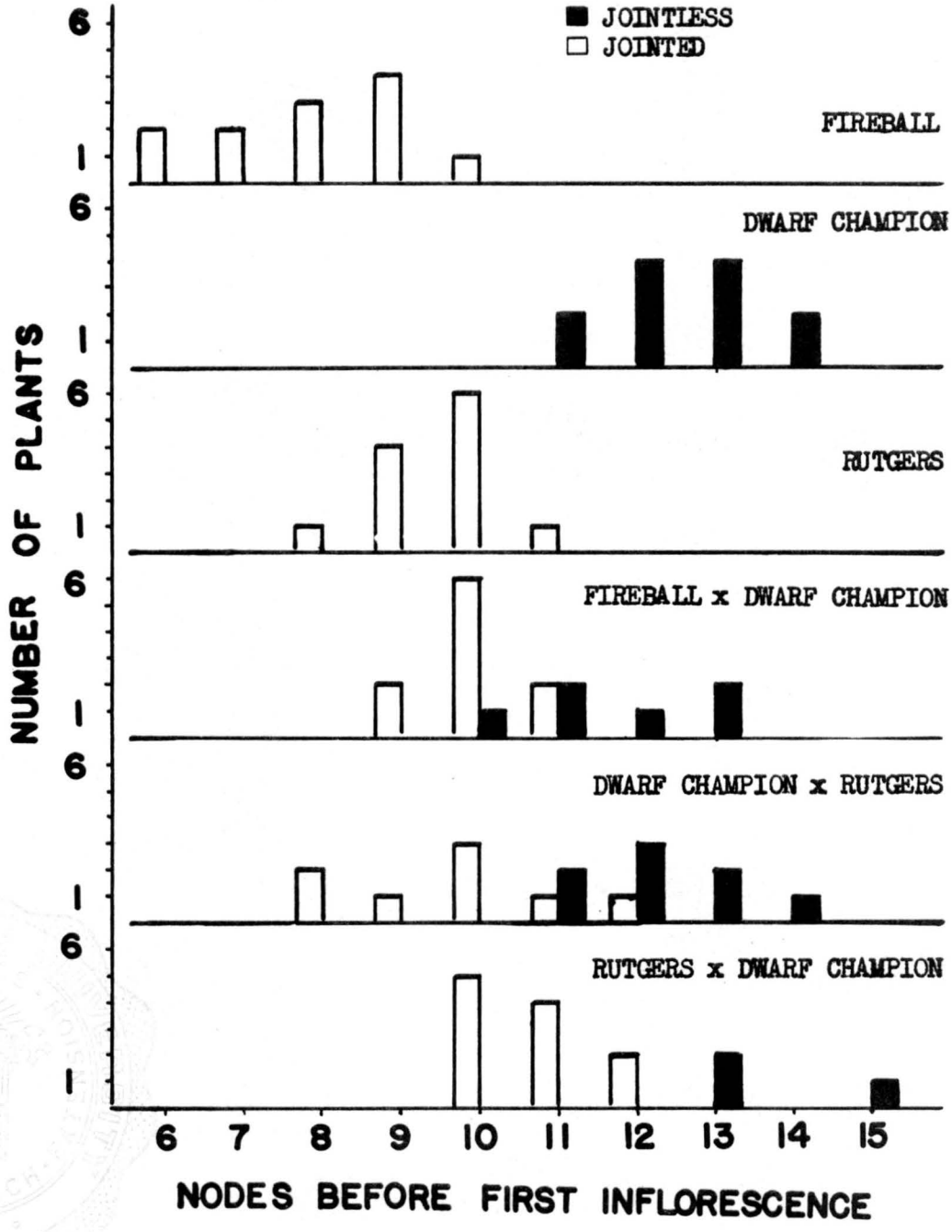
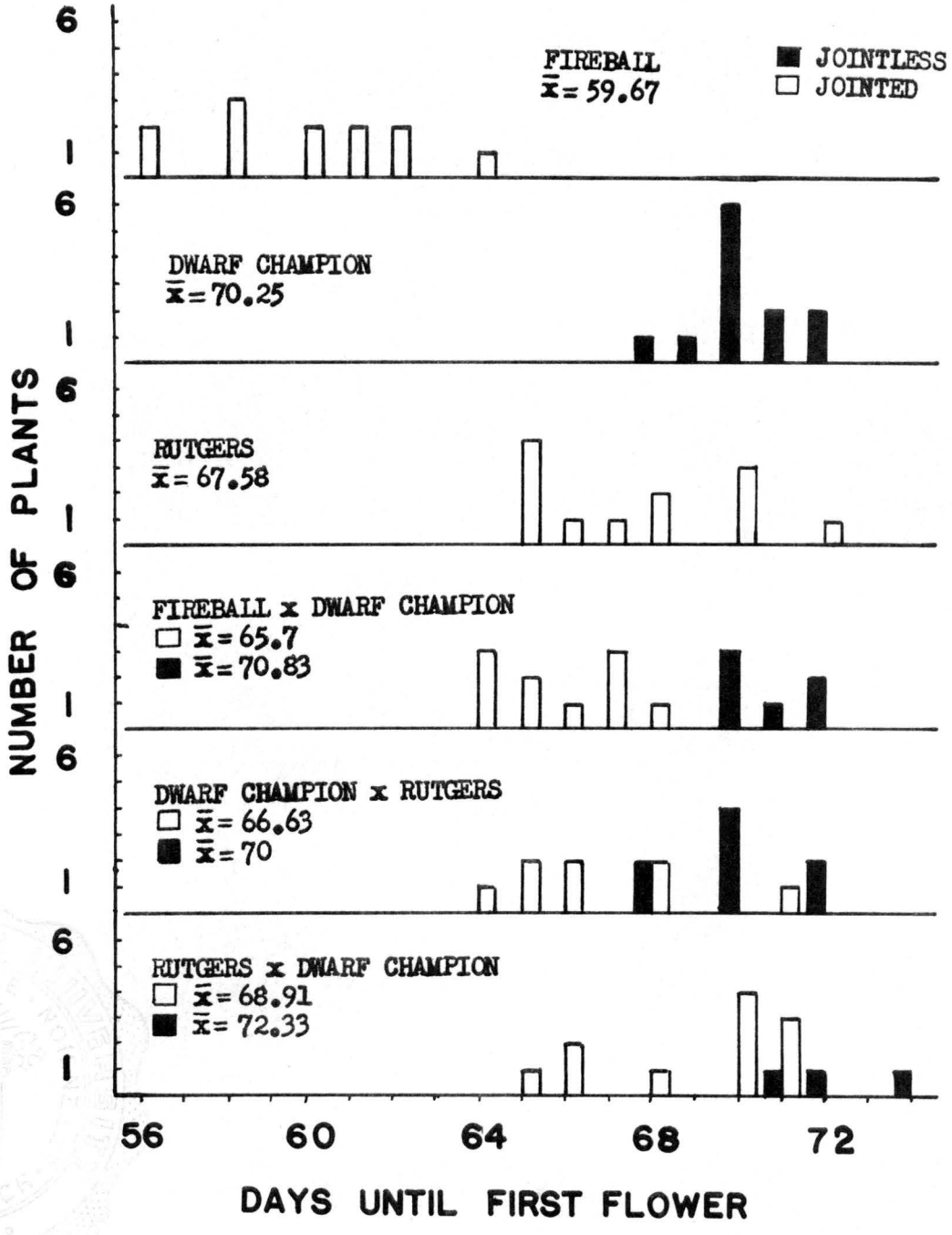


Table 4.--THE MEANS OF NUMBER OF NODES ON THE MAIN STEM BETWEEN THE COTYLEDONS AND THE FIRST INFLORESCENCE IN F_2 PROGENIES AND THE ORIGINAL PARENT VARIETIES.

Parents and F_2 progeny	Pedicel type	Number of plants	Mean of number of nodes before first inflorescence
Parents -			
Dwarf Champion	Jointless	12	12.50
Rutgers	Jointed	12	9.58
Fireball	Jointed	12	8.00
Puck	Jointed	12	7.58
F_2 progenies -			
Dwarf Champion x Rutgers	Jointed	8	9.75
	Jointless	8	12.25
Rutgers x Dwarf Champion	Jointed	11	10.73
	Jointless	3	13.67
Fireball x Dwarf Champion	Jointed	10	10.00
	Jointless	6	11.67
Dwarf Champion x Fireball	Jointed	20	9.40
Puck x Rutgers	Jointed	20	9.40

Figure 2.—Number of days from seeding to the opening of the first flower of F_2 progenies and the original parent varieties.



the jointed plants required from 64 to 71 days until the opening of the first flower, while the jointless plants required from 68 to 74 days. In every segregating progeny, the mean number of days from planting to first flower for the jointless plants was longer than for the jointed. Furthermore, although the varieties Dwarf Champion and Rutgers are considered to be late varieties, the jointless plants in the F_2 progeny from the cross between the two varieties are later than the jointed plants in the same line. In general it seems that jointless plants require three to six days more than the jointed plants in the same line.

It was noticed in the F_2 progenies that jointless plants have a limited number of flowers per inflorescence, usually one to five flowers in each. Some inflorescences of jointless plants first produce from one to three flowers and then continue growth as normal vegetative shoots, bearing leaves and additional inflorescences. The number of inflorescences of F_2 plants producing various numbers of flowers are shown in Table 5. This table shows that most inflorescences in jointless plants have three flowers. It also shows that the jointed plants in F_2 progenies have a greater number of flowers than the jointed parents in the original cross, possibly due to heterosis, while the jointless plants did not have any response for increasing the number of flowers.

In F_2 progeny of the cross Dwarf Champion x Rutgers, 16 plants were planted, 8 were jointed and 8 were jointless. From these 8 jointless plants there were 4 which gave one terminal inflorescence,

Table 5.--NUMBER OF INFLORESCENCES OF F_2 PLANTS AND ORIGINAL PARENTS IN GREENHOUSE EXPERIMENT PRODUCING VARIOUS NUMBERS OF FLOWERS PER INFLORESCENCE. NOTATIONS BASED ON THE FIRST THREE INFLORESCENCES IN EACH PLANT.

Parents and F_2 progenies	Pedicel type	No. of plants	Number of flowers per inflorescence									Mean
			1	2	3	4	5	6	7	8	9+	
Parents -												
Dwarf Champion	j	12		10	14	9	2					3.09
Rutgers	j+	12			1	10	22	1	2			4.86
Fireball	j+	12			4	4	10	9	3	4	1	5.57
Puck	j+	12				2	13	9	1	3	3	6.23
F_2 progenies -												
Dwarf Champion x Rutgers	j+	8		1	1	7	5	4	3	1	2	5.50
	j	8	4	3	6	3						2.50
Rutgers x Dwarf Champion	j+	11				1	14	9	5	2	2	6.03
	j	3	2	1	6							2.44
Dwarf Champion x Fireball	j+	20			5	2	8	31	7	2	5	6.07
Fireball x Dwarf Champion	j+	10			2	2	4	5	7	8		6.32
	j	6		2	12	4						3.11
Puck x Rutgers	j+	20					3	16	16	11	13	7.44

with one flower in each, accompanied by a large leaf. The peduncles of these one flower inflorescences appeared to be continuations of the main stems. It was also noticed that the calyxes of these flowers were longer than normal ones and were similar to the character macrocalyx (mc).

When Dwarf Champion as the female parent was crossed with Fireball as the male parent no jointless plants were obtained from a total of 20 F_2 plants.

It was observed that the leafy inflorescence character was completely associated with jointless pedicels. Some jointless plants had leaves on one inflorescence and the rest of the inflorescences did not have any leaves or vice versa. Leaves were found on all inflorescences of most of the jointless plants. No jointless-non-leafy plants were obtained. These results confirm the results obtained by Rick and Sawant (21) in 1955.

The jointless plants were found to be more vegetative than jointed plants and some jointless plants had more leaves between inflorescences than the expected three of normal indeterminate plants. In F_2 progenies in the greenhouse it was noted that jointless plants had 2-5 leaves, usually three leaves, between the first and second inflorescence and between the second and third inflorescence. No jointless plants with one leaf or no leaves between inflorescences were obtained. The mean numbers of leaves between the first and second and the second and third inflorescence are shown in Table 6.

It appears that the jointless gene suppresses the expression of the determinate growth character; hence, the jointless plants look

Table 6.--MEAN NUMBER OF LEAVES BETWEEN FIRST AND SECOND INFLORESCENCE AND BETWEEN SECOND AND THIRD INFLORESCENCE IN F_2 PROGENIES AND THE VARIETAL PARENTS.

Parents and progenies	Phenotype	No. of plants	Mean no. of leaves between	
			First and second inflorescence	Second and third inflorescence
Parents -				
Dwarf Champion	Jointless	12	2.92	2.82
Rutgers	Jointed	12	3.17	3.00
Fireball	Jointed	12	1.33	1.27
Puck	Jointed	12	1.08	1.00
Progenies -				
Dwarf Champion x Rutgers	Jointed	8	2.75	2.75
	Jointless	4	3.25	3.75
Rutgers x Dwarf Champion	Jointed	11	2.64	2.73
	Jointless	3	3.33	4.00
Dwarf Champion x Fireball	Jointed	20	1.60	1.50
Fireball x Dwarf Champion	Jointed	10	1.30	1.38
	Jointless	6	2.50	2.17
Puck x Rutgers	Jointed		2.65	2.79

like indeterminate plants, having 2-5 leaves between adjacent inflorescences, even though the determinate gene sp is present.

From observations of the greenhouse trials, the following conclusions concerning jointless plants were reached:

1. The number of nodes on the main stem between the cotyledons and the first inflorescence were 11 to 15 nodes, two to four nodes more than jointed plants of the same line.
2. The jointless plants were three to six days later in flowering than jointed plants.
3. Limited number of flowers per inflorescence are associated with jointless plants which in most cases are three flowers.
4. The leafy inflorescence character is associated with jointless pedicel and at least one inflorescence of every jointless plant had one or more leaves.
5. The jointless gene suppressed the determinate growth character and in general produced more vegetative growth.

Leaf removal results.--Plants of the F_2 progeny of the cross Fireball x Dwarf Champion were used to test the effect of removing young expanding leaves from jointless plants. There were 21 plants from which all leaves above the fourth leaf were removed when very small, and 21 plants were left as a control. Since these plants were segregating for the jointless character, it was not known until flower buds were well formed which plants were jointless. Of the treated group, 14 were

jointed and seven were jointless. Of the control group 17 were jointed and four were jointless.

The purpose of this test was to determine whether or not some of the pleiotropic effects of the jointless gene, such as few flowers per inflorescence, could be overcome by the above mentioned treatment. According to Leopold and Lam (14) this treatment increased number of flowers per inflorescence and decreased number of days to flowering more noticeably in extremely vegetative varieties. Because jointless plants are extremely vegetative, this trial was conducted.

The results shown in Fig. 3 indicate that leaf removal was effective in increasing the number of flowers per inflorescence of jointed plants. The mean number of flowers in the control group was 4.77, and this number was increased in the treated group to 6.14. This same treatment, however, did not appear to be effective in increasing the number of jointless flowers. The mean of the control group was 3.25 flowers, whereas, the mean of the treated group was 2.71 flowers. The modal number in both cases was three. Of the seven treated jointless plants, six of these produced three flowers on the first inflorescence, the same number of flowers as were frequently encountered among jointless plants in other parts of this study.

There was no striking effect of the treatment on earliness of flowering, as seen in Fig. 4. Because of the small population number, a statistical analysis would be meaningless, although it might be noted that among both treated and control plants there was a slight decrease in the mean number of days before flowering.

Figure 3.—F_2 progeny of the cross Fireball x Dwarf Champion showing the number of jointed and jointless plants having different number of flowers per inflorescence. Plants were grown in the greenhouse at night temperature of 65° F.

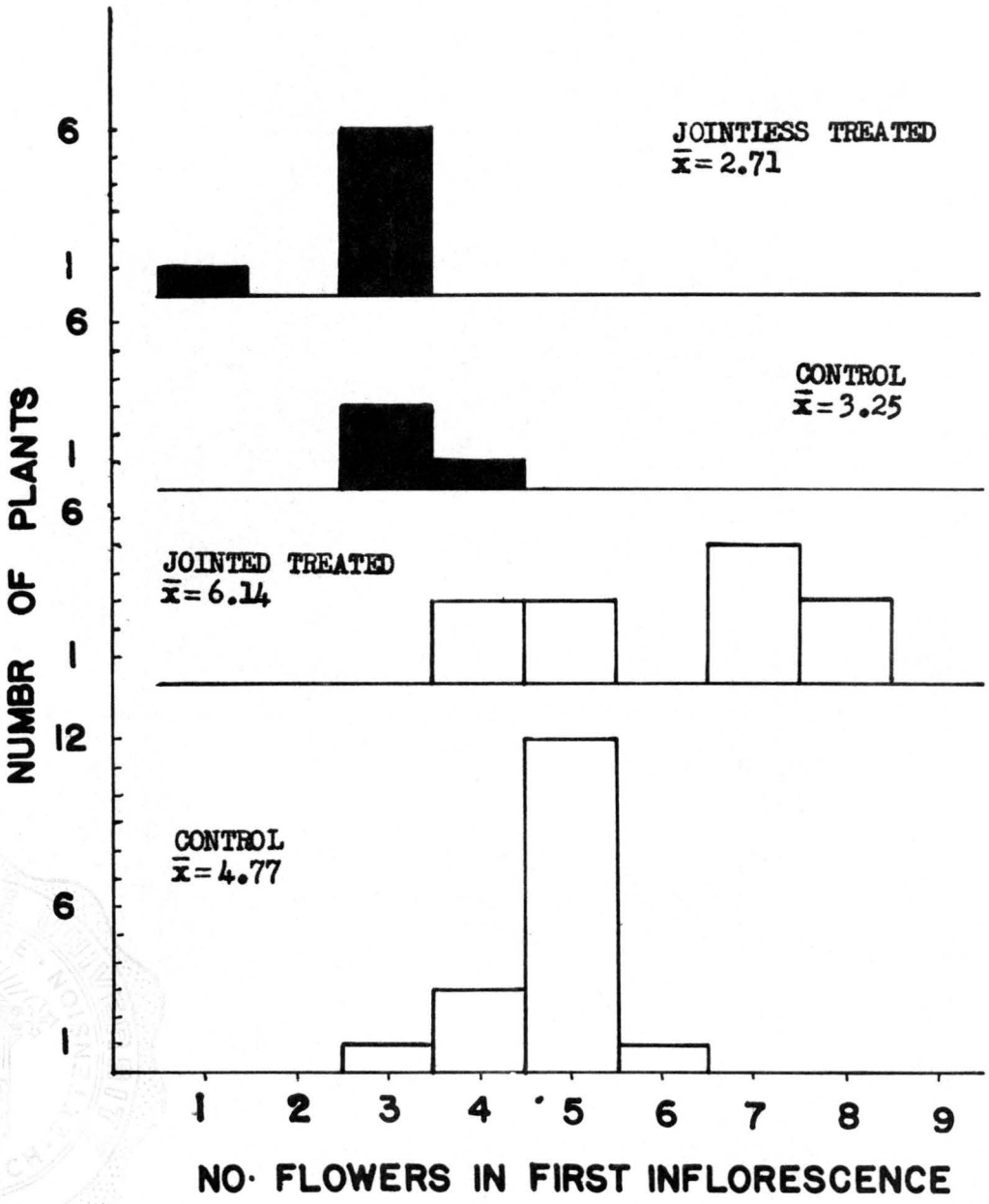
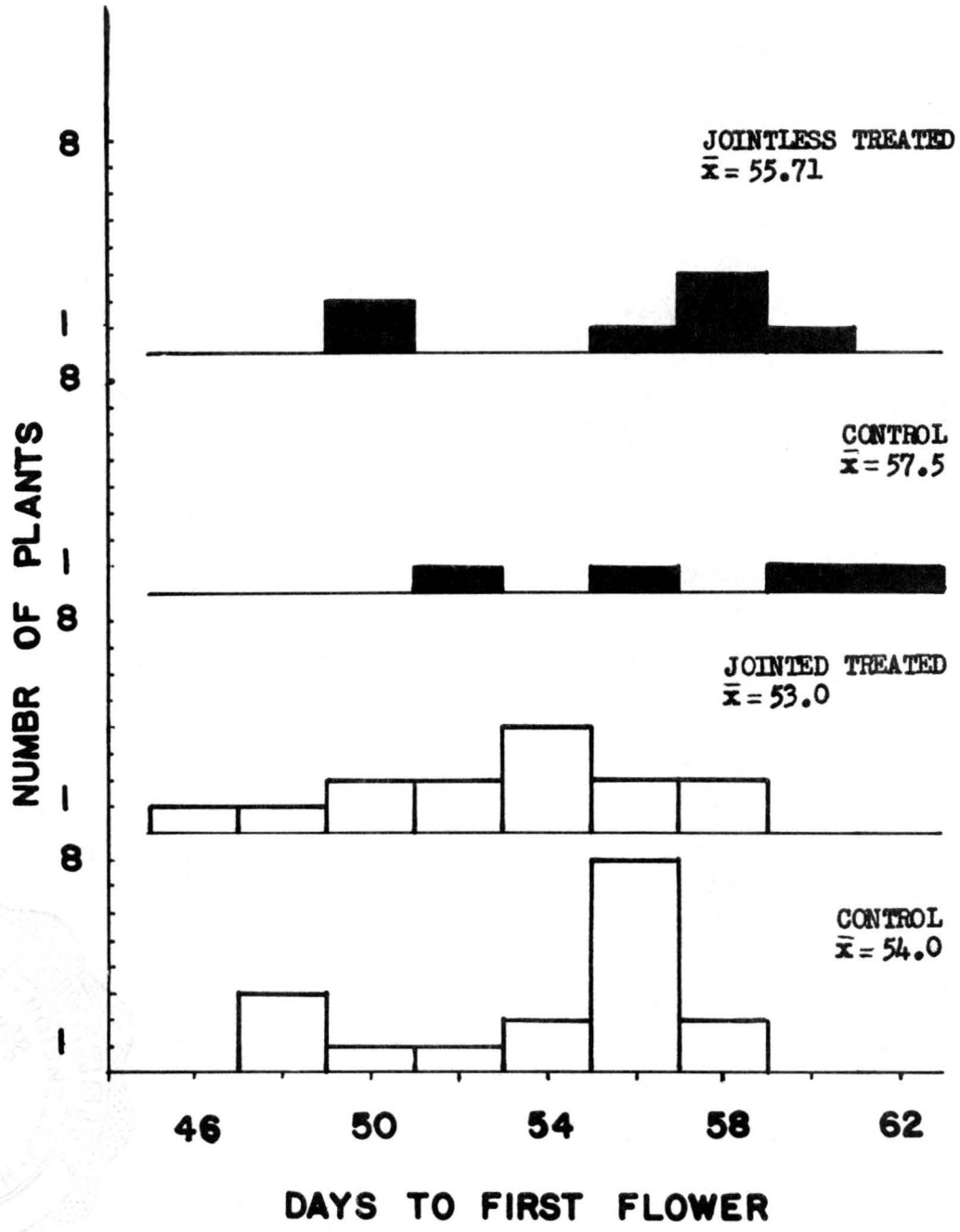


Figure 4.—Number of jointed and jointless plants in F_2 progeny of the cross Fireball x Dwarf Champion showing different number of days to the first flower. Plants were grown in the greenhouse at 65°F night temperature.



In general, removal of young expanding leaves above the fourth node did not appear to increase the number of flowers per inflorescence in jointless as it did in jointed plants, but it appeared to effect on the earliness slightly in both types.

Field trial results

The phenotypic ratios in the field trial for tall and dwarf, jointed and jointless, and indeterminate and determinate in progenies of more than 11 plants that were segregating for these characters are shown in Table 7. This table indicates that since segregation was in the expected 3:1 ratio for each character listed, the hail damage mentioned in the materials and methods section did not selectively kill any one of the phenotypes.

Number of leaves between the first and second inflorescence for jointed and jointless plants are shown in Fig. 5 and Table 8. It is clear that where the jointless character is present, the plants tend to have more leaves between the inflorescences than jointed ones. The mean number of leaves between the first and second inflorescence for all jointless plants in the trial is 3.30 and for jointed plants is 2.37 leaves. This would not be expected from independently segregating genes, if j effected only pedicel abscission layer and sp effected only plant type. The gene sp is located on linkage group IV and j is on linkage group V (24), precluding the possibility of linkage.

Table 8 shows that jointless plants derived from determinate parents (lot numbers 24, 59, 61, 66 and possibly 46) had averages for

Table 7.--PHENOTYPIC RATIOS IN FIELD TRIAL FOR TALL AND DWARF, JOINTED AND JOINTLESS, AND INDETERMINATE AND DETERMINATE IN PROGENIES OF MORE THAN II PLANTS THAT WERE SEGREGATING FOR THESE CHARACTERS.

Observed phenotypic ratio		Expected ratio	Chi square for goodness of fit
Tall	34	33	0.121
Dwarf	10	11	
Jointed	51	54	0.667
Jointless	21	18	
Indeterminate	22	21	0.191
Determinate	6	7	

Figure 5.—Number of leaves between first and second inflorescence. Data were recorded from four branches of each plant of the 120 jointless in the field trial and 120 randomly selected jointed plants.

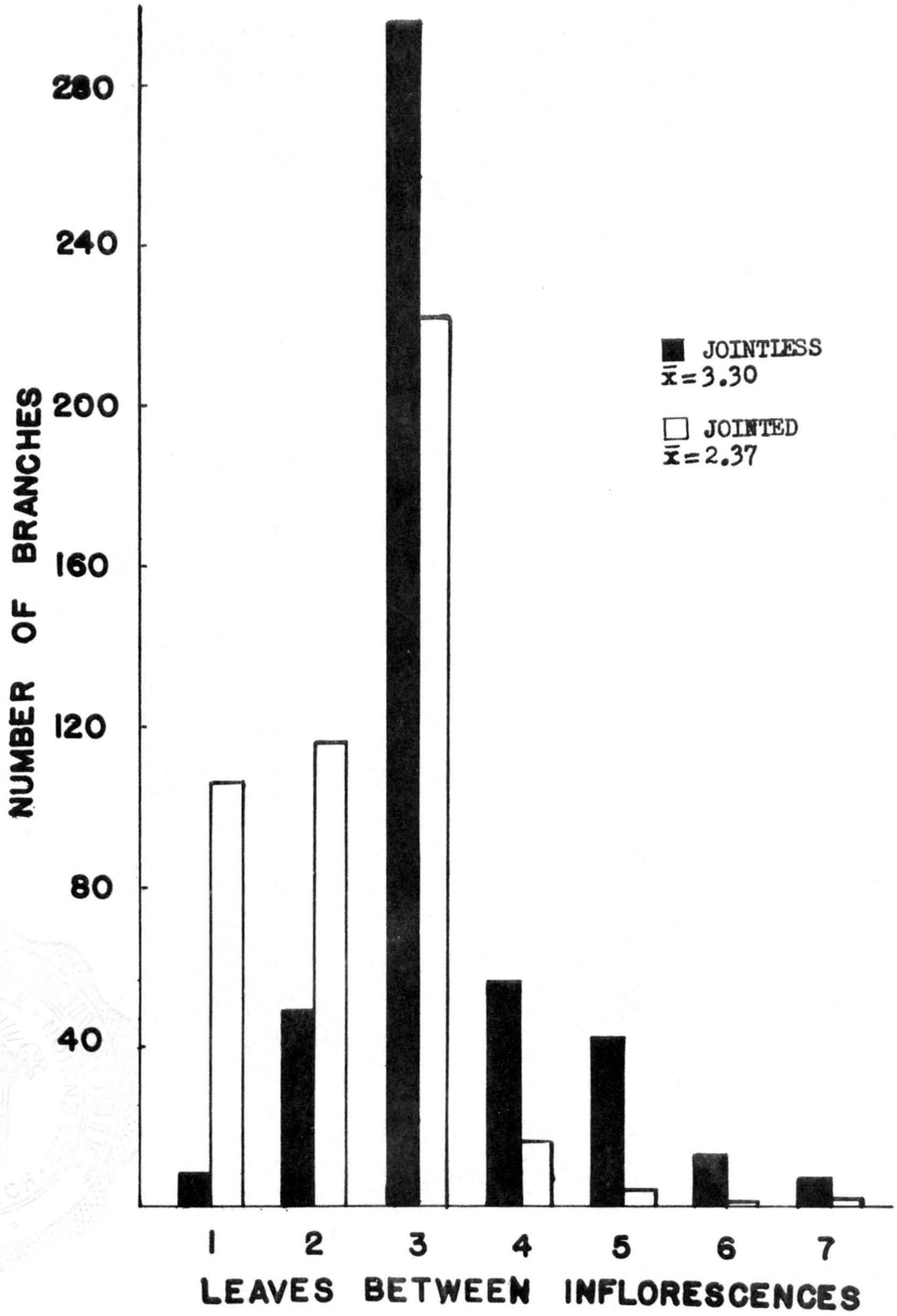


Table 8.--NUMBER OF LEAVES BETWEEN FIRST AND SECOND INFLORESCENCE IN F_3 PROGENY LINES WHICH SHOWED SEGREGATION FOR JOINTLESS. NOTATIONS BASED ON THE AVERAGE OF FOUR BRANCHES FROM EACH PLANT.

Lot number	Parent		F_3 progeny					
	Pedicel type	Leaves between 1st & 2nd	Pedicel type	Number of plants having different number of leaves between 1st and 2nd inflorescence				
				1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	Total
24	j+	1	j+	3	1			4
			j		1	2		3
59	j+	1	j+	4	7			11
			j		3			3
61	j+	1	j+	5	4			9
			j		1	1		2
66	j+	1	j+	13	2			15
			j		3	1		4
46	j+	2	j+		4	1		5
			j			1	1	2
26	j+	3	j+	1		8	1	10
			j			5	1	6
43	j+	3	j+	1	2	3		6
			j		1	4	1	6
52	j+	3	j+	1	1	3		5
			j			1		1

each plant of two or three leaves between inflorescences. No jointless plants with an average one leaf between inflorescences was obtained. A few plants had one leaf between two inflorescences but three or more leaves were always found between other inflorescences of the same plant.

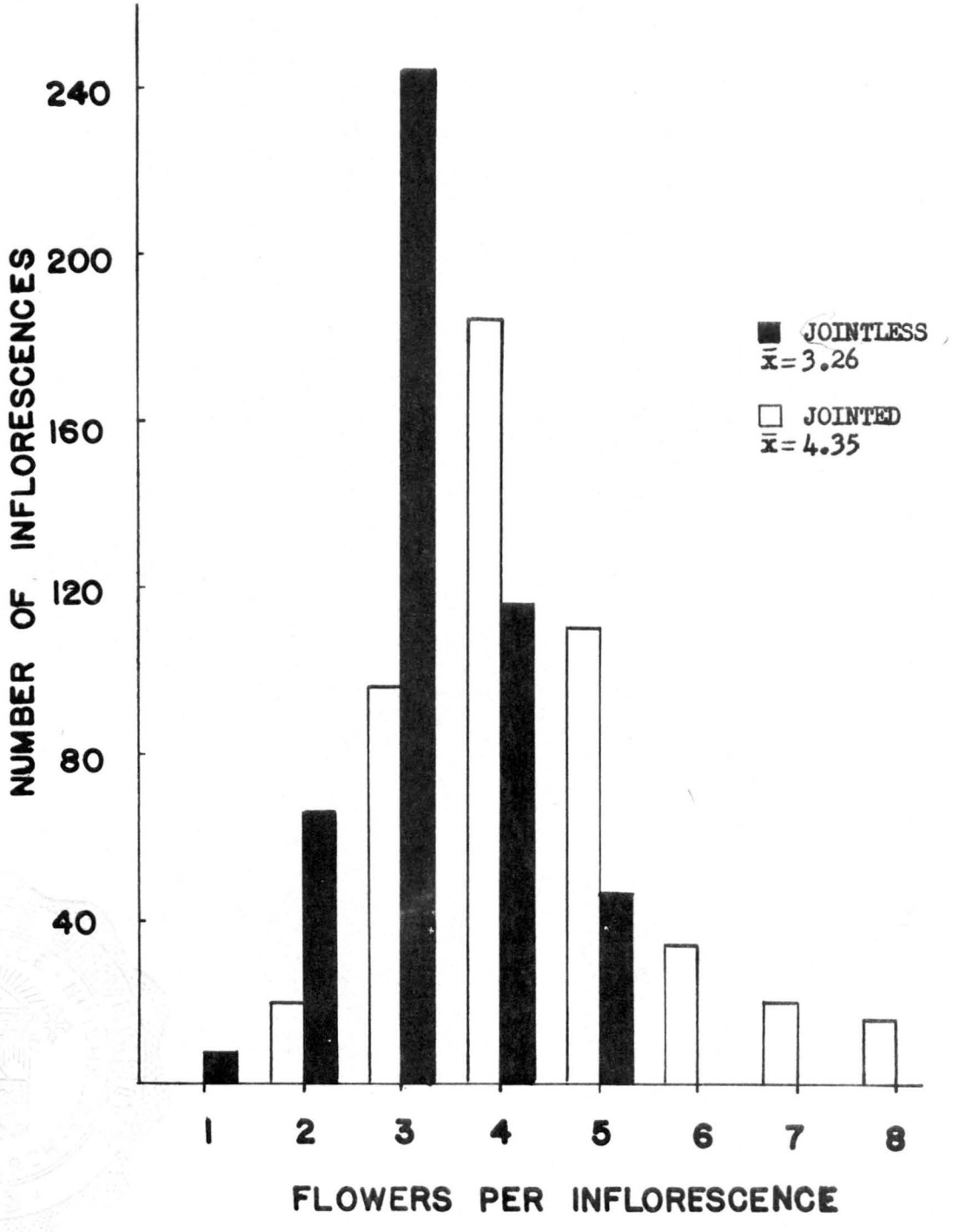
These results confirm the greenhouse results, and they emphasize the observations that the jointless gene suppresses the expression of the determinate growth character, even though the determinate gene sp is present.

A comparison of the distributions of numbers of flowers per inflorescence among jointless plants and jointed plants is shown in Fig. 6. The populations used were 480 jointless inflorescences and 480 jointed inflorescences, obtained by observing four inflorescences from each of the 120 jointless plants and 120 randomly selected jointed plants in the field trial.

The range of flowers per inflorescence among jointless inflorescences was from one to five, while the range among jointed inflorescences was from two to eight flowers. Differences in distribution, however, are more striking. Examination of Fig. 6 shows a great abundance of jointless inflorescences falling into one class. Of the 480 jointless inflorescences, 244 had three flowers. Thus, 50.83 per cent of all jointless inflorescences had three flowers.

The distribution of jointed inflorescences, on the other hand, more nearly approached a normal distribution. The modal number of flowers in the jointed inflorescences was four, and there was 184

Fig. 6.—Number of inflorescences having different numbers of flowers. Notations are based on four inflorescences from each plant. The two populations are the 120 jointless plants in the field trial and 120 randomly selected jointed plants.



or 38.33 per cent of the jointed population, in this group. Besides the effect on distribution, these data indicate that the jointless gene j may have a suppressing effect on the number of flowers. There was a significant difference between the mean number of flowers of jointless inflorescences and of jointed.

One of the interesting results is that the jointless plants had a higher per cent of fruit set than jointed plants. Fig. 7 shows the fruit set for the same inflorescences shown in Fig. 6. Fig. 7 shows that the number of fruits per inflorescence is ranged from 0 to 5 for jointless plants and from 0 to 8 for jointed plants. The mean number of fruits per inflorescence was 2.99 for jointless plants and 3.16 for jointed ones. While there were slightly more fruits per inflorescences among jointed inflorescences than among jointless, the percentage of flowers that set fruit was higher among jointless plants than among jointed (Fig. 8). The 480 jointless inflorescences produced 1,566 flowers, of which 1,436 (91.7 per cent) set fruits. On 480 jointed inflorescences, 2,086 flowers were produced and 1,519 of these (72.8 per cent) set fruits. Fig. 8 shows also that although there was a significant difference between jointless and jointed plants in number of flowers, this difference became less apparent in number of fruits set by the plants. For percentage of flowers setting fruit, the situation is reversed and jointless plants set a higher percentage of fruits. It was hoped that the influence of the jointless gene on fruit size could also be determined, but the spring hail and an unusually

Figure 7.--Distribution of inflorescences having different numbers of fruits. Notations are based on four inflorescences from each plant. The two populations are the 120 jointless plants in the field trial and 120 randomly selected jointed plants.

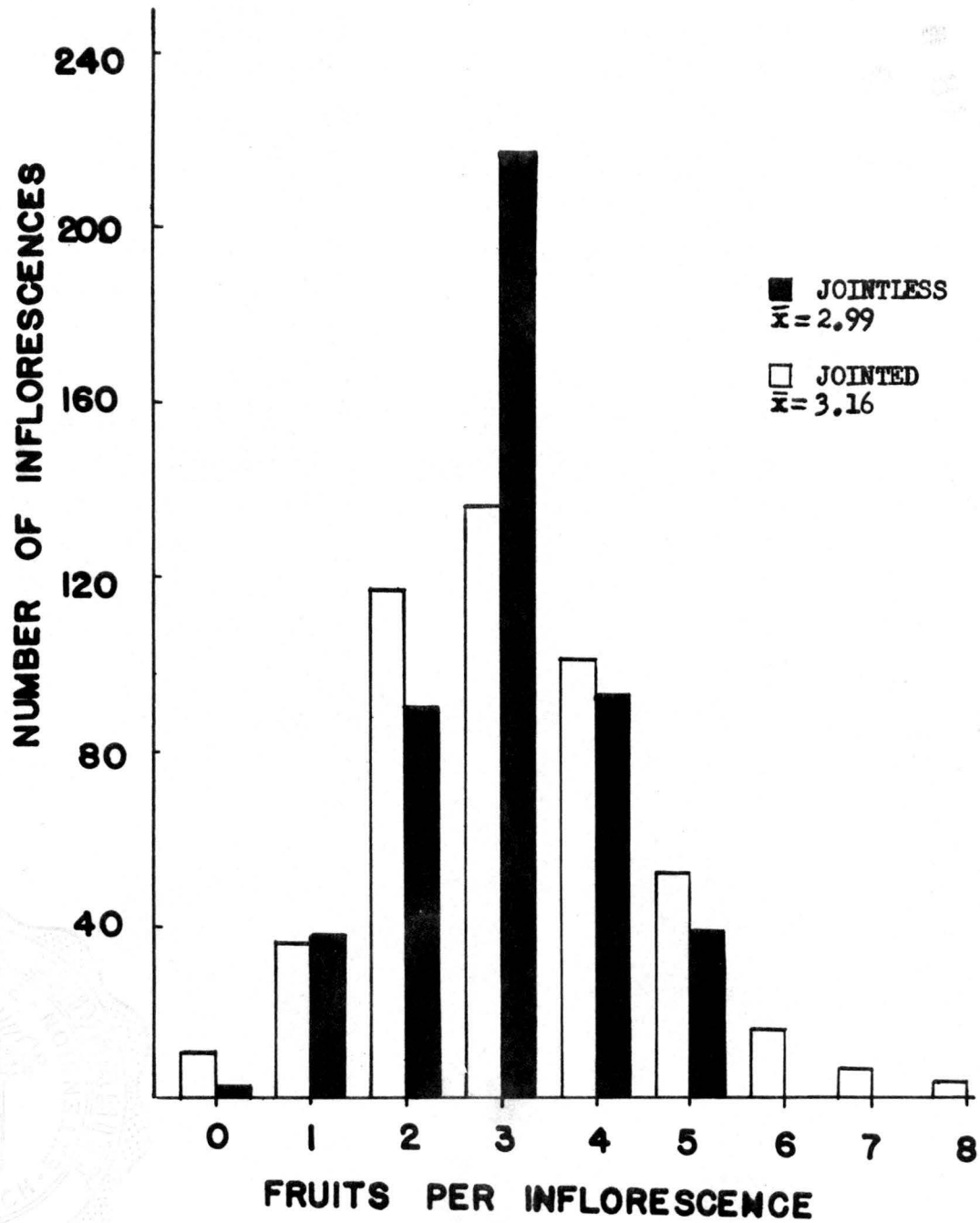
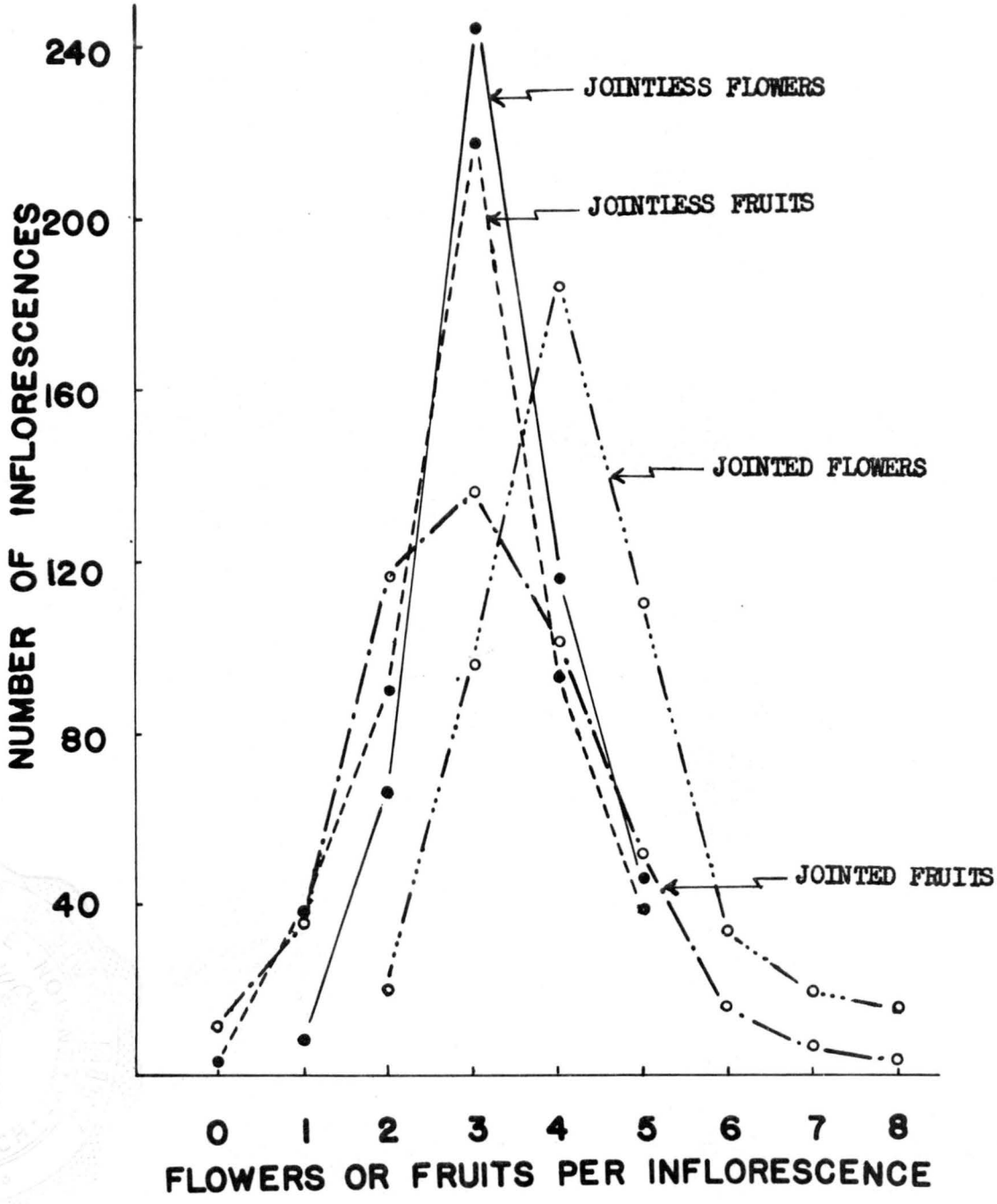


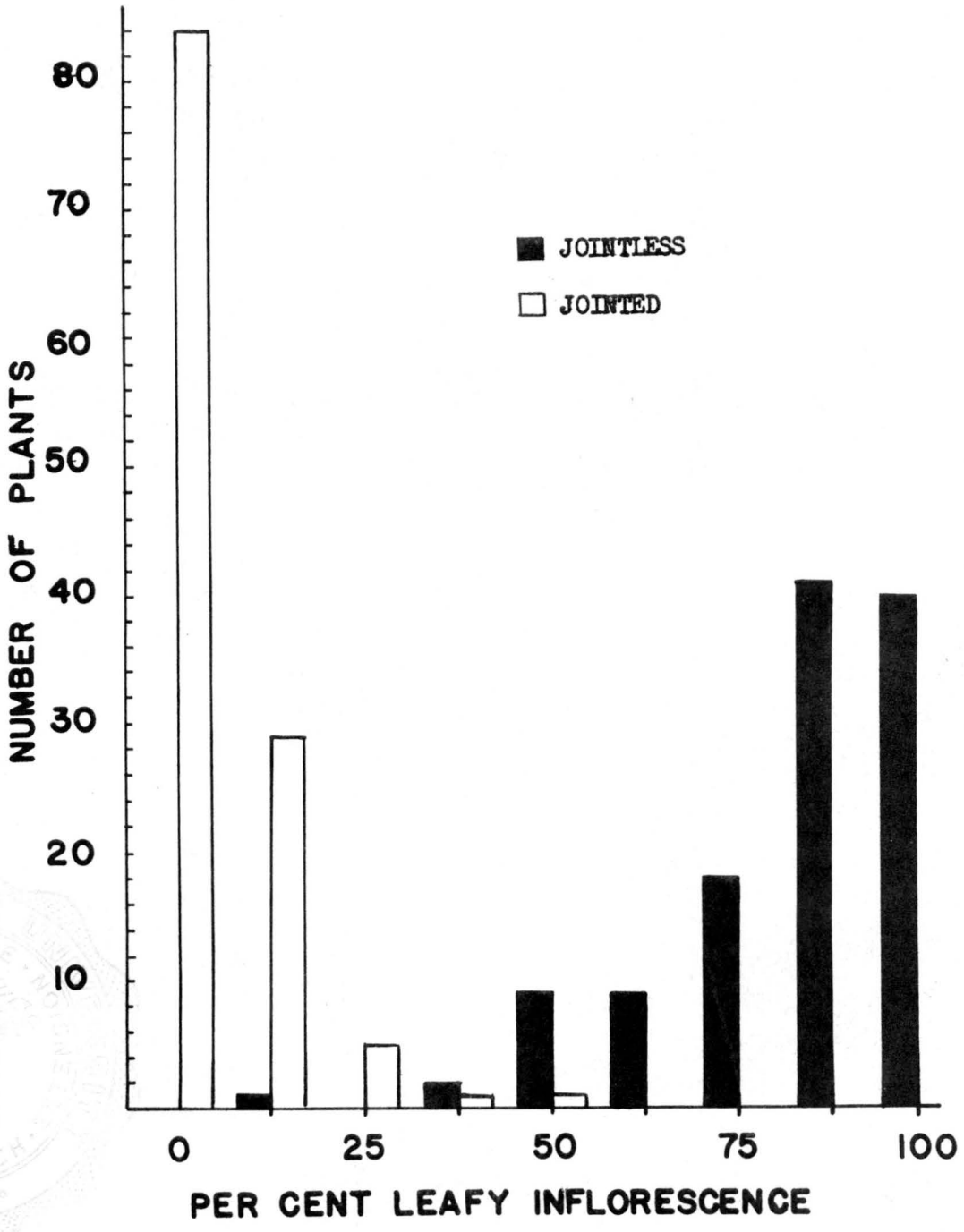
Figure 8.—Distribution of inflorescences having different numbers of flowers and fruits. notations are based on four inflorescences from each plant. The two populations are the 120 jointless plants in the field trial and 120 randomly selected jointed plants.



and wet summer reduced yields below the level necessary for such a study. These results indicate clearly, however, that jointless gene j limits the number of flowers per inflorescence and increases fruit set percentage.

Leafy inflorescence character was very clearly associated with jointless pedicel character. Data were recorded for eight inflorescences from each plant. From a population of 120 jointless plants one plant had leaves on one inflorescence, two plants had three leafy inflorescences, nine had four, nine had five, 18 had six, 41 had seven, and 40 plants had leaves on all the inflorescences. No jointless-non-leafy plants were obtained. Within a population of 120 jointed plants 84 plants were non-leafy, 29 had only one leafy inflorescence, five had two, one plant had three, and one had four. These results are shown as a per cent leafy inflorescences in Fig. 9. These results coincide with greenhouse results, previously mentioned, and both confirm the results obtained by Rick and Sawant (21).

Figure 9.--Number of jointless and jointed plants in field trial containing varying percentages of leafy inflorescences. Eight inflorescences on each plant were counted. The two populations are the 120 jointless plants in the field trial and 120 randomly selected jointed plants.



Chapter V

SUMMARY

The phenotypic effects of the tomato mutant jointless _j_, obtained from the variety Dwarf Champion, were studied. Although Dwarf Champion was phenotypically indeterminate, it was found by crossing with both determinate and indeterminate jointed varieties that this jointless variety actually contained the genes for determinate growth. The effects of the determinate gene were found to be masked by the presence of the jointless character.

There were fewer flowers per inflorescence on jointless plants than on jointed plants in all progenies and treatments in the study. It was also noted that the modal number of all jointless populations was three. This number remained constant in F_2 populations regardless of jointed parent. It was also not increased by removing leaves after the fourth node, a treatment which increased the number of flowers in jointed inflorescences.

Although the jointless character decreased number of flowers per inflorescence, the percentage of flowers setting fruits was higher among jointless plants than among jointed. This resulted in almost as many fruits per inflorescence among jointless plants as among jointed.

Number of days until the opening of first flower and number of nodes before the first inflorescence were in all cases greater among

jointless plants than among jointed. Leafy inflorescence was also associated with jointless plants. Eight inflorescences were observed from each plant in the field study. In this study all jointless plants had some leafy inflorescences and all the observed inflorescences were leafy in 33 per cent of the jointless plants. On the other hand, 70 per cent of the jointed plants had no leafy inflorescences and no jointed plants were found with more than four of the eight inflorescences leafy.

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APPENDIX - NUMBER OF INFLORESCENCES PRODUCING VARIOUS NUMBERS OF FLOWERS PER INFLORESCENCE. NOTATIONS ARE BASED ON FOUR INFLORESCENCES FROM EACH PLANT. TOTAL POPULATION IS THE 120 JOINTLESS PLANTS IN THE FIELD TRIAL.

Lot number	Number of plants	Number of flowers per inflorescence 1	2	3	4	5	Total inflorescences
27	21	1	12	36	19	16	84
60	17	1	7	39	17	4	68
37	23	3	12	54	18	5	92
49	11	1	4	18	14	7	44
69	3		3	6	3		12
52	1			3	1		4
24	3		1	6	3	2	12
59	3	1		4	4	3	12
61	2		1	5	2		8
66	4		1	7	6	2	16
46	2		1	5	1	1	8
31	4	1		7	6	2	16
67	12		10	23	12	3	48
26	6		4	16	4		24
43	6		8	12	4		24
34	2		2	3	2	1	8
Total	120	8	66	244	116	46	480

APPENDIX - NUMBER OF INFLORESCENCES PRODUCING VARIOUS NUMBER OF FLOWERS PER INFLORESCENCE. NOTATIONS ARE BASED ON FOUR INFLORESCENCES FROM EACH PLANT. TOTAL POPULATION 120 RANDOMLY SELECTED JOINTED PLANTS FROM THE FIELD TRIAL.

Lot no.	No. of plants	Number of flowers per inflorescence								Total inflorescences
		1	2	3	4	5	6	7	8	
59	11			12	19	8	1	3	1	44
61	9			1	4	15	7	5	4	36
66	15		3	21	25	10			1	60
40	2			1	7					8
51	9			4	20	7	3	2		36
55	27		4	17	48	28	8	1	2	108
12	5			7	10	3				20
24	4		2		1	5	5	2	1	16
45	6			1	9	6	4	1	3	24
46	5			1	9	6	1	3		20
48	1				2	1	1			4
58	6		1	9	9	3		1	1	24
26	10		7	11	10	11		1		40
38	1				1		1		2	4
43	6		3	11	9				1	24
52	3				1	7	3	1		12
Total	120		20	96	184	110	34	20	16	480

APPENDIX - NUMBER OF INFLORESCENCES PRODUCING VARIOUS NUMBERS OF FRUITS PER INFLORESCENCE. NOTATIONS ARE BASED ON FOUR INFLORESCENCES FROM EACH PLANT. TOTAL POPULATION IS THE 120 JOINTLESS PLANTS IN THE FIELD TRIAL

Lot number	Number of plants	Number of fruits per inflorescence						Total inflorescences
		0	1	2	3	4	5	
27	21	2	4	16	35	15	12	84
60	17	1	3	11	36	13	4	68
37	23		5	16	50	17	4	92
49	11		2	8	16	12	6	44
69	3		2	2	5	3		12
52	1				3	1		4
24	3		2	2	4	2	2	12
59	3		1	1	3	4	3	12
61	2		1	2	4	1		8
66	4		1	4	5	4	2	16
46	2			1	6		1	8
31	4		1		7	6	2	16
67	12		5	12	21	8	2	48
26	6		4	8	10	2		24
43	6		6	6	9	3		24
34	2		1	1	3	2	1	8
Total	120	3	38	90	217	93	39	480

APPENDIX - NUMBER OF INFLORESCENCES PRODUCING VARIOUS NUMBERS OF FRUITS PER INFLORESCENCE. NOTATIONS ARE BASED ON FOUR INFLORESCENCES FROM EACH PLANT. TOTAL POPULATION 120 RANDOMLY SELECTED JOINTED PLANTS FROM THE FIELD TRIAL.

Lot no.	No. of plants	Number of fruits per inflorescence									Total inflorescences
		0	1	2	3	4	5	6	7	8	
59	11	1		15	18	8	2				44
61	9				3	12	11	5	4	1	36
66	15		3	21	22	10	4				60
40	2		4	2	2						8
51	9		5	7	11	13					36
55	27	2	7	22	36	27	11	2		1	108
12	5	6	4	8	2						20
24	4		1	1	1	1	5	5	1	1	16
45	6		2	1	8	7	3	2		1	24
46	5			1	5	8	6				20
48	1	1		1	1		1				4
58	6		2	11	6	3	1		1		24
26	10		4	15	12	5	4				40
38	1					1		2	1		4
43	6		4	11	6	3					24
52	3	1		1	3	3	4				12
Total	120	11	36	117	136	101	52	16	7	4	480

APPENDIX - NUMBER OF PLANTS IN FIELD TRIAL CONTAINING VARYING PERCENTAGES OF LEAFY INFLORESCENCES. NOTATIONS ARE BASED ON EIGHT INFLORESCENCES FROM EACH PLANT. THE POPULATION IS THE 120 JOINTLESS PLANTS IN THE TRIAL.

Lot number	Number of plants	Per cent leafy inflorescences								
		0	12.5	25	37.5	50	67.5	75	87.5	100
27	21							1	9	11
60	17							3	9	5
37	23							2	9	12
49	11					3	3	1	3	1
69	3								2	1
52	1							1		
24	3								1	2
59	3					1				2
61	2							1		1
66	4						1	2	1	
46	2								1	1
31	4					1		2		1
67	12		1		2	3	2	3		1
26	6					1	3		2	
43	6							1	3	2
34	2							1	1	
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Total	120		1		2	9	9	18	41	40

APPENDIX - NUMBER OF PLANTS IN FIELD TRIAL CONTAINING VARYING PERCENTAGES OF LEAFY INFLORESCENCES. NOTATIONS ARE BASED ON EIGHT INFLORESCENCES FROM EACH PLANT. THE POPULATION IS 120 RANDOMLY SELECTED JOINTED PLANTS.

Lot number	Number of plants	Per cent leafy inflorescences						
		0	12.5	25	37.5	50	67.5	75
59	11	9	2					
61	9	7	1	1				
66	15	13	2					
40	2	2						
51	9	9						
55	27	18	7	2				
12	5	2	3					
24	4	1	2			1		
45	6	5		1				
46	5	3	1	1				
48	1	1						
58	6	4	2					
26	10	6	4					
38	1		1					
43	6	3	3					
52	3	1	1		1			
Total	120	84	29	5	1	1	-	-

ABSTRACT OF THESIS

PHENOTYPIC EFFECTS OF JOINTLESS GENE IN TOMATO

Submitted by

Mohamed N. K. El Sayed

In partial fulfillment of the requirements

for the Degree of Master of Science

Colorado State University

Fort Collins, Colorado

March, 1962

A study of the pleiotropic effects of the jointless gene in tomato (j_1) was conducted in both the greenhouse and the field. This gene was found to mask the determinate character, controlled by a single recessive gene (sp). This effect was found by crossing the phenotypically indeterminate and jointless variety Dwarf Champion with known indeterminate and determinate jointed varieties. The F_1 of the cross with an indeterminate variety was indeterminate, but there were determinate segregates in the F_2 progeny. Furthermore, the F_1 of the cross with a known determinate and no indeterminate-jointed plants were observed in the F_2 generation. All jointless plants in this study were phenotypically indeterminate.

There were fewer flowers per inflorescence on jointless plants than on jointed plants in all progenies and treatments in the study. It was also noted that the modul number off all jointless populations was three. This number remained constant in F_2 populations regardless of jointed parent. It was also not increased by removing leaves after the fourth node, a treatment which increased the number of flowers in jointed inflorescences.

Although the jointless character decreased number of flowers per inflorescence, the percentage of flowers setting fruits was higher among jointless plants than among jointed. This resulted in almost as many fruits per inflorescence among jointless plants as among jointed.

Number of days until the opening of first flower and number of nodes before the first inflorescence were in all cases greater among jointless plants than among jointed. Eight inflorescences were observed from each plant in the field study. In this study all jointless plants had some leafy inflorescences and all the observed inflorescences were leafy in 33 per cent of the jointless plants. On the other hand, 70 per cent of the jointed plants had no leafy inflorescences and no jointed plants were found with more than four of the eight inflorescences leafy.