# $F_2$ STUDIES ON THE MANIFESTATION OF HYBRID VIGOUR AND INHERITANCE OF QUANTITATIVE CHARACTERS IN TWO INTER VARIETAL CROSSES IN BRINJAL

(*Solanum melongena* Linn.)

by

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**THESIS**

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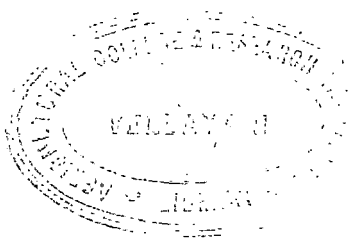

## CERTIFICATE

This is to certify that the thesis herewith submitted contains the results of bonafide research work carried out by Kumari C.S. Easwari Amma, under my supervision. No part of the work embodied in this thesis has been submitted earlier for the award of any degree.

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CONTENTS


| | Page |
|---|---|
| INTRODUCTION | 1 |
| REVIEW OF LITERATURE | 4 |
| MATERIALS AND METHODS | 27 |
| EXPERIMENTAL RESULTS | 33 |
| DISCUSSION | 48 |
| SUMMARY | 58 |
| REFERENCES | i - v |
| APPENDICES | |
| ILLUSTRATIONS | |

# INTRODUCTION

# INTRODUCTION

'Hybrid vigour' or 'heterosis' may be defined as the excess vigour of the hybrid over the average vigour of its parents.

The manifestation of increased size, greater vigour in growth and development, higher productivity and similar effects have long been observed by biologists in various hybrids of plants and animals. The term 'heterosis' which is an abbreviation of the word 'heterozygosis' was coined by Shull in 1914 to denote this phenomenon where cross bred organisms tend to surpass both their parents in vigour.

Heterosis is not confined to any group of plants and the phenomenon seems to pervade the plant kingdom as a whole. It has been recorded in diverse plants and in diverse characters. Increase has been observed in height, branching, number of leaves and flowers, yield of fruit or seed as the case may be, weight of plant, resistance to pests and diseases. These conspicuous effects produced in economic characters of crop plants attracted the attention of plant breeders from very early times. In recent years exploitation of hybrid vigour by hybridization has

been acclaimed to be a very promising line of improvement of crop plants.

The beneficial effects of crossing appear immediately in the $F_1$ and their maximum expression is in that generation. Therefore the greatest emphasis has been placed on the use of $F_1$ hybrids as they possess new vigourous superior and desirable characters. In crop plants generally, the vigour expressed in the $F_1$ hybrid is not retained in the succeeding open pollinated progenies. This reduction in vigour with inbreeding was considered to be due to the disappearance of the physiological stimulation resulting from hybridization, as the strains automatically become pure and homozygous. East and Hayes (1912) stated that the decrease in vigour due to inbreeding naturally cross fertilized species and the increase in vigour due to crossing naturally self pollinated species are manifestations of the same phenomenon. This phenomenon is heterozygosis. Crossing produces heterozygosis in all characters in which the parents differ and inbreeding tends to produce homozygosis automatically.

This genetic handicap viz. reduction in vigour, calls for the production of large quantities of hybrid seeds year after year. In several food crops hybrid seed

production has become economic because of the availability of male sterile lines. In brinjal which is the material of present study male sterile varieties have not been reported and there is no known method of efficiently inducing male sterility either. This particular factor stands as a handicap in the production of large quantities of hybrid seeds in brinjal. Thus it becomes necessary to explore the usefulness of growing open pollinated progenies of hybrid generations successively retaining the superiority of characters.

The present study is a continuation of the investigations conducted by Viswanathan (1967) on hybrids of intervarietal crosses of four varieties of Brinjal (Solanum melongena Linn.) namely Purple Long Dutta (PLD), Banaras Giant (BG), White Long (Local) (WL) and Muktakeshi (MK). Viswanathan found hybrid vigour in respect of almost all characters under study in these crosses. The present study was undertaken with a view to examine the extent of hybrid vigour transferred to the $F_2$ and the mode of inheritance of some important quantitative characters in brinjal.

# REVIEW OF LITERATURE

# REVIEW OF LITERATURE

Heterosis is the greater vigour or capacity for growth frequently displayed by cross bred animals or plants as compared with those resulting from inbreeding. This vital phenomenon has been studied by various investigators both in India and abroad.

## Early work

Hybrid vigour in crop plants was first studied by Kolreuter (1763) who was impressed by the luxuriance of hybrids in interspecific hybrids of Nicotiana. Since that time it has continued to be a problem of interest to the students of fundamental genetics and to plant and animal breeders who utilize hybrid vigour in a planned programme of plant and animal improvement. Knight (1779) described hybrid vigour as a natural sequence of crossing varieties. Gartner (1849) observed increased vigour, root development, height, number of flowers, hardiness etc. in many of the hybrids made from crosses among 700 species. Other breeders like Herbert (1825) and Nandin (1865) recorded this phenomenon. Mendel (1865) observed hybrid vigour in his pea crosses.

Darwin (1876) from his experiments in salvia, morning glory, peas, tobacco and maize, concluded that hybrid superiority resulted from the union of different germinal complexes rather than the mere act of crossing. The work of Darwin influenced greatly subsequent investigators. Beal (1880) was the first to make extensive use of controlled hybridization in increasing the yield of corn. East (1908), Shull (1908, 1911) and Jones (1918, 1945) have reported superiority of the hybrids in corn. Shull (1914) coined the term 'heterosis' for hybrid vigour.

Though this phenomenon of hybrid vigour has been of immense practical utility, the task of utilizing it in crop improvement has been difficult as many of the seed propagated plants are inbred. Very often they loose much of the vigour exhibited in the $F_1$ generation. There are cases, however, where the vigour shown in $F_1$ generation continued to persist in the advanced generations also.

A brief review of the work done in brinjal and in other crops in order to examine hybrid vigour is presented here. Literature regarding the mode of inheritance of important characters in brinjal and other important vegetable crops is also reviewed here.

Height of plants

Balya (1918) was probably the first to report the superiority of $F_1$ hybrids in height over their parents, based on his studies of a cross between a native and a foreign variety of brinjal. Nagai and Kaida (1926) and Tatesi (1927) studied the height in brinjal and among $F_1$ plants, found that the increase in height varied considerably. Kakizaki (1930-31) while studying several hybrids of japanese varieties of brinjal reported an increase in height of more than 6.4 per cent for hybrids over the average of both the parents. Pal and Singh (1946) in their studies of six crosses of brinjal found that all except two crosses showed increase in height over the taller parent. In all cases where $F_2$ progenies were also planted there was a marked decrease from the values of the parents and $F_1$s. Mishra (1961) found that the hybrids were invariably superior to both parents except in a few cases showing intermediate plant height. Frydrych (1964) found the superiority of inter varietal hybrids to their parents. Choudhury and Mishra (1966) found that eleven out of 15 $F_1$s studied showed increase in height of 15 days old seedlings. Viswanathan (1967) has reported that out of eight hybrids studied six in

comparison with mid parental value and 3 as compared to better parental mean showed significant increase in height.

Malinowski et al (1960) studied crosses between inbreds in maize and found that the $F_1$ surpassed the taller parent in mean height in all crosses. In the $F_2$ generation of each cross a number of individuals were found to be taller than the tallest $F_1$ plant. Mitra (1962) reported that hybrid vigour was found to persist in crosses of winter varieties of rice with summer varieties. Mean height of $F_2$ in every case exceeded that of the taller parent. Venkataramani (1952) in inter varietal studies of bhindi found that the height of some of the hybrids was intermediate. Joshi et al (1952) has reported that the $F_1$ hybrids were taller than their superior parents. Raman and Ramu (1962) reported a decrease in final height of hybrids than the respective parents in inter varietal hybrids of bhindi. According to Ravindra (1964) the plants which recorded the highest plant height in general, possessed longer internodes. Issac (1965) observed in bhindi that out of 12 hybrids studied only one hybrid showed significant increase (5.7 per cent) in height over the taller parent. One hybrid showed significant increase over the mean of the parents. In all the other hybrids the mean height was lesser than that of the respective

parents, the range of decrease being 3.3 to 21.3 per cent. Mathews (1966) found that with respect to plant height the different crosses behaved differently in advanced generations. In three out of six crosses the increase in height over the parental mean persisted in the $F_2$ and $F_3$ generations.

Number of branches

In their studies in brinjal, earlier workers like Nagai and Kaida (1926) and Kakizaki (1930-31) had reported hybrid superiority with respect to the number of branches. Pal and Singh (1946) found increase in number of branches in five out of eight hybrids, this increase ranging from 9 to 54 per cent over the better parent. Three out of eight hybrids were inferior to the inferior parent in number of branches. Mishra (1961) observed that hybrids of brinjal showed their superiority in average number of branches. One hybrid had decreased number of branches when compared to both the parents. Frydrych (1964) also showed that the hybrids were superior with respect to number of branches. According to Choudhury and Mishra (1966) out of 15 $F_1$ hybrids 12 hybrids showed superiority in number of main branches over the mean of the better parent but 3 failed to show their superiority statistically.

Viswanathan (1967) has recorded that 2 out of 8 combinations, in brinjal showed their superiority over the parental mean statistically. Only one hybrid has registered superiority over the better parent in respect of number of branches. Joshi et al (1958) in their studies in bhindi have recorded that the hybrids in general were significantly better than the parents regarding the number of branches produced. The range of increase in number of branches was 1.2 to 25.3 per cent. Out of the 14, combinations studied by them only one hybrid exhibited significant increase. In 8 crosses the $F_1$ were intermediate, most of them tending towards superior parent. Decrease in number of branches compared to the inferior parent was recorded in five hybrids. 2 out of 9 hybrids of bhindi studied by Raman and Ramu (1962) showed significant increase in number of branches. Issac (1965) reported that in bhindi two hybrids exceeded the better parents by 4.8 and 8.2 per cent respectively though this superiority observed was not statistically significant. Mathews (1966) in his studies in bhindi hybrids, has reported that with respect to number of branches the increase recorded in one cross in $F_1$ was not maintained in the $F_2$ and $F_3$ generations.

Number of leaves

Balya (1918) in his studies in brinjal found that the $F_1$ hybrids produced more number of leaves than the parents. The intermediate nature of $F_1$ hybrids as compared to the parents in respect of number of leaves was recorded by Venkataramani (1946). While studying the $F_1$ hybrids of brinjal, Viswanathan (1967) observed that six out of eight hybrids showed significant increase when mid parental value was considered. This was reduced to three when the hybrids were compared with better parental mean. Swarup and Pal (1966) in their studies regarding gene effect in cauliflower, observed that the $F_1$ hybrids had higher number of leaves and larger leaf size. They concluded that heterosis in leaf number was mainly due to dominance while in leaf size it was due to additive x dominance gene effects. Issac (1965) in bhindi reported that out of 12 $F_1$s studied by him none showed their superiority with respect to number of leaves. According to Mathews (1966) in bhindi, hybrid vigour observed in $F_1$ was not retained in the subsequent $F_2$ and $F_3$ generations.

Spread of plants

Belya (1918), Nagai and Kaida (1926) and Kakizaki (1930-31) have recorded hybrid superiority in respect of spread of plants. Based on their studies in the manifestation of hybrid vigour in brinjal and bitter gourd, Pal and Singh (1940, 41) reported that the average values of $F_2$ progenies were, in all out of six crosses, lower than those of the $F_1$s and parents. Venkataramani (1946) recorded a marked increase in $F_1$ hybrids as compared to parents with respect to this character. Choudhury and George (1961) and Mishra (1961) concluded that the $F_1$ hybrid had invariably greater spread than the parents. Choudhury and Mishra (1966) concluded that 13 out of 15 $F_1$ hybrids were significantly superior to their respective better parents in spread, along and across the rows, the maximum increase in spread being 33.63 per cent and 25.61 per cent, over their respective better parents. Viswanathan (1967) found that out of eight hybrids studied six in comparison with mid parental value and three as compared to better parental mean showed significant increase in spread.

Time of flowering and number of flowers

In brinjal earliness in flowering time was reported by Nagai and Kaida (1926). Kakizaki (1931) concluded that the degree of hastening in flower production of brinjal crosses was widely varying according to the different combinations. Schimidt (1935) found that earliness was dominant and even trangressive and in one cross even exceeded the earliest variety. The $F_1$ hybrids studied by Venkataramani (1946) flowered 18 days earlier than the early parent. Earliness in flowering of the hybrids was also reported by Pal and Singh (1949) and Mishra (1961). According to Rajabhandary (1966) significant difference was noted between hybrids and parents in the number of days from sowing to flowering. Choudhury and Mishra (1966) recorded intermediate nature of $F_1$ hybrids with respect to flowering duration. Out of the eight hybrids studied by Viswanathan (1967) seven registered earlier flowering than the mid parental value, and six earlier than the early parent. He obtained hybrids which produced more number of flowers as compared to the mean of the parents and this increase was found to be significant in seven out of 8 crosses studied.

Issac (1965) in his studies of 12 intervarietal crosses of bhindi found that none was earlier than the early parent. In one cross the hybrid was late in flowering than the late variety. When number of flowers is considered there was increase in eight hybrids of which only two recorded significant superiority over the better parent. Two hybrids showed decrease in the number of flowers while two equalled the mid parental value. Mathews (1966) found that vigour for earliness exhibited in the $F_1$ generation of two crosses persisted into the $F_2$ and $F_3$ generations. Out of the six crosses studied, the earliness showed by one cross over the mean of the parents was not retained in the subsequent generation. Larger number of flowers were produced by $F_1$ and $F_2$ generations of three out of eight crosses over the mid parental values. Based on their studies on gene effects and heterosis in cauliflower, Swarup and Pal (1966) reported that six hybrids showed significant heterosis in terms of earliness, of curd maturity, over the better parent where as one exhibited the same over the mid parent. There was indication of transgression in the $F_2$ generation of some crosses for earliness beyond the parental range. This varied from four to eight days in earliness. According to Erina (1963) tomatoes having a short period from germination to flowering when crossed

with forms having a short period from fruit setting to ripening, generally gave hybrids that were earlier than either. One hybrid ripened eight to nine days before the parents and another ripened four days before the earlier parent. In the $F_2$ generation most of the hybrids were also earlier. Swadick (1965) found heterosis in earliness in tomato and that this was effected by climate. This was found to persist in the $F_2$ generation also. Earliness was observed both in $F_1$ and $F_2$ of one cross.

Number of fruits

Definite increase in the number of fruits has been recorded by Nagai and Kaida (1926) and Tetsui (1927). Pal and Singh (1940, 41) based on their studies on the manifestation of hybrid vigour in brinjal and bitter gourd obtained only 50 per cent of the crosses showing increase over better parent. Six out of nine crosses showed decrease compared to the better parent though as compared to the mean of the parents all except one were superior. The $F_2$ progenies were distinctly inferior to the parents in most cases.

Venkataramani (1946) reported intermediate nature of $F_1$ hybrids, the hybrid plant producing eight fruits while the female and male parents producing ten and

seven respectively. Mishra (1961) obtained $F_1$ plants having significantly higher number of fruits than their respective parents. Rajbhandary (1966) attributed the increase in total yield of the hybrids over the parents to the increase in the number of fruits produced by the plants which was in turn brought about by the production of more number of branches. The partial expression of clustering habit also contributed to the increase in number of fruits produced per plant. Choudhury and Mishra (1966) recorded hybrid superiority in six out of 15 crosses over their better parents in number of fruits. The maximum increase in total fruit number recorded was 69.83 per cent in one hybrid while it was 62.11 per cent in another when compared with the better parent. The significant difference observed in total yield over the parental lines in brinjal was attributed to the greater number of fruits produced by hybrids by Andronicescer (1966). Viswanathan (1967) found that the different crosses produced gave increased number of fruits per plant. This increase was significant in five out of eight crosses when the comparison was made with the parental mean. Whaley (1939) and Baldoni (1949) attributed the increase in total yield in tomatoes to the increase in number of fruits produced by hybrids rather

than large sized fruits. This was confirmed by the findings of Finlay (1951).

Larson and Currance (1946) studied hybrids of some commercial varieties of tomato and several unnamed types at the Agricultural experiment Station, Minnesota to determine the early and total yields of tomato of the $F_1$ and $F_2$ generations. Their observations showed that the $F_1$s were intermediate in yield and showed a tendency towards the better parent. The increase of the $F_1$ in early yield over parental average was 47 per cent but that of the $F_2$ early yield was 8 per cent. The early yield of the $F_2$ hybrid was however, significantly greater than that of the $F_1$. When the total yield was considered the average increase of $F_1$ in total yield over the parental average was 39 per cent, while that of the $F_2$ was 23 per cent. Nine hybrids gave significantly higher $F_1$ yield than both of the parents. The majority of the $F_2$ generation produced yield midway between the parental average and the $F_2$ yields. But some $F_2$ hybrids produced yields equal to those of the $F_1$. Jonebert LAG (1950) found that certain $F_1$ hybrids of tomatoes gave considerably higher yield than others. $F_2$ yields were lower than $F_1$ yields but it was suggested that sufficient vigour may be maintained in the $F_2$ of some hybrids to make use of $F_2$ seed practicable, where tomato cultivation is generally

out of doors. Heterosis for yield in interspecific and inter varietal crosses of tomatoes was recorded by Balint (1956). Heterosis was observed in better types of hybrids, the $F_1$ generation showing an increase in yield of 25.6 to 93.3 per cent over the higher yielding parent and 36 per cent of the $F_2$ showing an increase in yield of 37.4 per cent. Vigour was most pronounced in interspecific hybrids but significant heterotic effects were also found in inter varietal hybrids.

Samarov (1965) studied 60 hybrids of tomatoes grown under a number of different conditions. In all cases the hybrids surpassed the standard in yield and a number of other characters. The greatest yield increases were often noticed in hybrids between varieties differing in origin and morphological characters. Though the yield in the $F_2$ was lower than those of the $F_1$, they were often 20 to 40 per cent above those of the parents and particularly good yields were given by two hybrids. Eventhough the plant was more resistant to bacterial and fungal diseases there was no yield improvement in many plants in $F_2$. Szawdick (1965) reported that the expression of hybrid vigour persisted in the $F_2$ generation in hybrids of tomatoes. Kime and Tilley (1947) studied three inbred lines from varieties of American upland cotton and the six possible $F_1$ and $F_2$ hybrids from the lines for a period

of three years. Significant increases in yield of advanced generations of $F_2$ over the most productive parent were recorded for only two crosses and this occured in only one year. Marked increase in yield in the $F_2$s over the parents was recorded by Ramiah and Ramaswamy (1941) in bhindi. Issac (1965) in bhindi reported that one hybrid registered a significant increase in the number of fruits over the better parent. Two hybrids also showed hybrid vigour in this character when compared to the mean of the parents. The number of fruits borne in six other hybrids was not significantly higher while one equalled the mid parental value. One hybrid was found to be inferior to the inferior parent. Mathews (1966) in his studies in six inter varietal crosses of bhindi found that the vigour obtained in three crosses with respect to number of fruits was retained in two crosses in the next generation.

Weight of fruits

Nagai and Kaida (1926) obtained 10 crosses of brinjal plants all of which showed increase over parental mean by 1 to 70 per cent in yield. Most of the hybrids yielded more than the better parent, the average increase of all the hybrids being 15 per cent.

Pal and Singh (1940, 42) in their studies in six crosses of brinjal which was spread over two seasons, found that in respect of weight of fruits during both the years all crosses except one showed increase upto 129.2 per cent (1940-41) and 62.3 per cent (1941-42) over the better parent. In one of the $F_2$ progenies of the two crosses studied during 1941-42 there was an increase over the better parent but not over the $F_1$s. But in other cases there was a decrease when compared to the mean of the parents, to the better parent and $F_1$.

In their studies on different Japanese varieties of brinjal, Orland and Noll (1948) reported that in every case the hybrid exceeded the mean yield of the parents, the range of increase being 11 to 153 per cent. Mishra (1961) got significant increase in yield in many $F_1$ hybrids although in some cases differences were not significant. He observed positive correlation in the number of fruits and their weight. Hybrid vigour with regard to yield in inter varietal hybrids of brinjal was also reported by Lantican, Rajbhandary, Carangal and Deanon (1963), Raman (1964) and Frydrych (1964) also reported superiority of the hybrids in yield. Choudhury and Mishra (1966) recorded that out of 15 hybrids studied for this character 13 exhibited significant increase in total yield

over their better parent. Viswanathan (1967) found that all the eight hybrids studied produced fruits of which showed increase in weight. But only six out of the eight crosses studied, showed significant increase over the better parental value and parental mean. Balint (1952) found heterosis in yield in tomatoes in the $F_1$ hybrids which was found to be retained in the $F_2$ to about 37.4 per cent. Issac (1965) based on his studies in 12 hybrids of bhindi stated that one hybrid showed significant increase in weight of 30.6 per cent over the better parent. In weight of fruits in bhindi, Mathews (1966) has reported that the $F_1$ of two crosses out of six, showed an increase over the means of the parents and this increase was found to persist in the $F_2$ generation in one cross.

Size and shape of fruits

The $F_1$ fruits of brinjal hybrids were recorded to be having intermediate fruit shape by Nagai and Kaida (1926). Pal and Singh (1946) also recorded intermediate fruit size in hybrids. The size of the mature fruit has been calculated by multiplying length by girth. In general in only a few hybrids there are small increases either over the mean of the parents or the higher parents. Mishra (1961) reported that in general the fruits of $F_1$

hybrids were invariably longer than either both or one of the parents. The vigour was noted in fruit length in five out of eight $F_1$ hybrids. Rajbhandary (1965) suggested that the increase in yield of the hybrids over the parents was brought about by the improvement in the size of the individual fruits. Viswanathan (1967) showed that six out of eight hybrids in case of length of fruits and two in case of girth showed their superiority as compared to the parental mean. But in comparison with the better parent four out of eight hybrids showed significant increase in length and no hybrids exhibited increase in girth as compared to the better parent. Issac (1965) in bhindi recorded hybrid vigour in length in eleven out of twelve crosses when the mid parental value was considered. When higher parental value was considered none of them was significant. In girth of fruits only one hybrid showed reduction when compared to the higher parental mean. One hybrid showed significant increase in size.

Mathews (1966) studied six inter varietal crosses of bhindi and recorded that with respect to length of fruits the $F_1$ and $F_2$ generations of one cross were superior to the better parent while another cross registered an increase over the mid parental value. Three $F_1$s out of six crosses were superior to the mid parental

values. Hybrid vigour for girth of fruits was retained in the $F_2$ and $F_3$ generations of one cross.

Number and weight of seeds

Kakizaki (1931) reported that the $F_1$ seeds showed an increase in weight over the selfed seeds of the mother parent, which was due to the increase in size of the embryo by heterosis. The increase in weight varied widely averaging 11.8 per cent and the highest increase noticed was 72 per cent over the selfed seeds of the mother plant. The number of seeds per fruit was significantly less than that of the parents in the $F_1$s of brinjal crosses (Choudhury and Mishra (1966). Mean weight of 500 seeds in each of the parents and $F_1$ hybrids revealed the significance in early seven hybrids when compared with the better parent.

Increase in number of seeds was noted in three out of eight crosses studied by Viswanathan (1967). In the case of $F_1$ fruits five out of eight hybrids produced increased number of seeds as compared to the parental mean. In bhindi, Issac (1965) reported that the highest mean number of seeds was found in two out of twelve hybrids. Two other hybrids had only lesser number of seeds than the lower parent. With regard to number of seeds per fruit in bhindi Mathews (1966) observed that

$F_2$ of one cross only showed an increase over the mid parents.

Inheritance studies

Inheritance of plant height in sesamum was studied by Culp (1960). This study indicated that plant height is controlled by three to ten pairs of genes, with heritability values 40 to 50 per cent. In three crosses complete dominance of tall plants was indicated. No dominance was found in the first cross.

In a cross between tomato varieties 'Marglobe' and 'Louisiana Slicer' the normal height of Marglobe was dominant over the extreme tallness (long internode) of Louisiana Slicer.

According to Gotoh (Goto) in brinjal heritability values for flowering period was 67 to 78 per cent. Sikka and Gupta (1947) reported that solitary flowered condition in sesamum was dominant over 3 flowered condition, the difference being monogenic.

Linkage relationships between arrangement of leaves on the main stem, number of flowers in each leaf axil, flower colour and seed colour have been studied by Sikka and Gupta (1947). The genes controlling these characters

have been found to assort independently and no linkage exist between them.

Nagai et al (1926) reported that larger number of genes may be responsible for the production of anthocyanin pigmentation in brinjal. Noll (1934) found that coloured anther tips were monogenically dominant over colourless anther tip. He further found that purple stem was monogenically dominant over green stem and purple colour of corolla over non-pigmented corolla. According to Nagai et al (1926) the mode of inheritance of fruit colour in brinjal was complex. Sinha (1965) obtained monogenic inheritance of anthocyanin pigmentation of anther tip, leaf vein, stem, petiole, corolla and leaf margin and digenic inheritance of fruit colour.

While conducting studies in Sesamum orientale Sikka and Gupta (1947) found purple colour of corolla to be dominant over purplish white colour and these differ from each other by two genes. A segregation of nine purple : seven purplish white involving parents with these two colours occurred. Studies on inheritance of characters in Dolichos lablab by Meenakshi and Sundaresan (1964) showed that in a cross between Tenkasi and DL-224, a single dominant gene controlled the pigmentation of vegetative plant parts and purple flower colour.

Independent genes governed the inheritance of seed colour and pod colour.

The heritability values for fruit shape and fruit weight were estimated to be 60 to 75 per cent and 40 to 60 per cent respectively by Gotoh (1943).

Culp (1960) observed that the inheritance of capsule length in sesamum to be conditioned by two to five pairs of factors. Heritability values of 50 to 70 per cent were estimated for this character. In one cross complete dominance of long capsule was found while in the other crosses the long capsuled nature was partially dominant.

In tomato, Powers (1941) reported that the small size of fruit was found to be dominant over large size and small number of locules per fruit was partially dominant to large number of locules. The results for the character number of fruits per centimeter of branch showed that both dominance and heterosis for this character depend upon both the cross and environmental conditions as represented by the year in which the cross was grown.

Genetic studies on fruit characters in Capsicum annuum by Sakai (1937) revealed as follows:

1. Fruit weight per plant is heterotic in some crosses but not in others.

2. The smaller the number of fruits per plant in a cross is usually completely dominant and

3. Small size of fruit is partially dominant.

In Capsicum, Miyazawa (1957) reported that the minimum number of genes controlling fruit weight is 52.24, fruit length 0.79 and fruit width 9.52.

Synder (1957) obtained the following results regarding the inheritance of seed weight in tomato.

1. Seed weight is quantitatively inherited.

2. Large number of factors are involved in the expression of seed weight.

3. The effect of these factors is additive, the only expression of heterosis being in early yield of the hybrid and not in total yield. Small seeds of normally large seeded inbreds exhibited low percentage of germination.

# MATERIALS AND METHODS

# MATERIALS AND METHODS

The present study was conducted in the Division of Agricultural Botany, Agricultural College and Research Institute, Vellayani, during the year 1967-68 (October 1967 to February 1968).

## A. MATERIAL

out of the eight crosses studied by the previous worker, Viswanathan (1967) two crosses viz. Purple Long Dutta (PLD) x Banaras Giant (BG), White Long (WL) x Mukta Keshi (MK) were selected for the $F_2$ studies reported here. 500 selfed seeds from each of the four parents viz. PLD, BG, WL, MK and of the two crosses viz. PLD x BG and WL x MK formed the material for the present investigation. The distinguishing features of the parental varieties are summarised in Table 1.

## B. METHODS

The seeds were sown in pots. Thirty days after sowing, the seedlings were transplanted to the main field in well prepared pits of 25 cm x 25 cm x 25 cm at a spacing 80 cm either way.

Layout

The hybrids were planted in the middle and the respective male and female parents flanked them on either side. The number of parents and $F_2$ are as given below.

| | Number of plants | | |
|---|---|---|---|
| | Originally planted | Germinated | Finally existed |
| Cross I | | | |
| Parent PLD | 16 | 12 | 7 |
| ,, BG | 19 | 19 | 18 |
| Cross PLD x BG | 240 | 176 | 172 |
| Cross II | | | |
| Parent WL | 13 | 13 | 13 |
| ,, MK | 17 | 17 | 17 |
| Cross WL x MK | 64 | 53 | 51 |

Standard vegetable mixture (12-24-12) was applied twice as top-dressing, one, 25 days after transplanting and the second after 90 days at the rate of 200 kg/ha. The crop was regularly irrigated twice a day in the morning and in the evening.

Observations on the following characters were recorded for both parents and $F_2$ progenies.

1. Height of plants
2. Number of branches
3. Number of leaves
4. Spread of plants
5. Time of flowering and number of flowers
6. Number of fruits
7. Weight of fruits
8. Size and shape of fruits
9. Number and weight of seeds
10. Germination capacity
11. Pollen sterility

The first observation on height of plants, number of leaves and number of branches was taken on the 20th day and continued up to the 70th day after transplanting and each observation falling at 10 days intervals.

Height of plants

The length of the main stem from the ground level to the topmost bud leaf was reckoned as the height of the plant. Measurements of all the plants were recorded in cm and the data analysed.

Number of branches

The total number including primary, secondary and

Table 1

The distinguishing features of the varieties

| Characters | PLD | BG | WL | MK |
|---|---|---|---|---|
| 1. Height in cm | 92.57 | 74.58 | 84.13 | 70.16 |
| 2. Growth habit | Erect and open | Spreading and bushy | Erect and bushy | Spreading and bushy |
| 3. Spines | Absent | Absent | Well developed | Absent |
| 4. Leaf size | Broad and long | Large | Medium to large | Medium |
| 5. Leaf colour | Dark green with purple veins | Green | Light green | Dark green with purple veins |
| 6. Flower colour | Violet | Light purple | Pure white | Violet |
| 7. Fruit length in cm | 23.44 | 18.56 | 18.48 | 18.44 |
| 8. Fruit colour | Greenish purple | White to greenish white | White | Dark purple |
| 9. Fruit diameter in cm | 12.95 | 30.48 | 18.67 | 24.37 |
| 10. Bearing habit | Solitary | Solitary | Both solitary and clusters | Solitary |
| 11. Duration of crop | Medium | Medium | Medium to long | Medium |

tirtiary branches were counted on individual plants. Five observations were recorded.

Number of leaves

Total number of leaves on all plants was counted on each observation and analysed.

Spread of plants

Observations were recorded on the 55th day after transplanting, ie., when the plants attained full growth. Measurement was taken in the direction where there was maximum spread.

Time of flowering and number of flowers

The time when the first flower opened in each plant was noted. Three types of flowers, viz. long, medium and short styled were found produced by each plant. Total number of each of these flowers that opened in plants was recorded daily for a period of one month from the commencement of flowering and the data were analysed.

Number of fruits

The total number of fruits set from long and medium styled flowers was recorded separately and analysed.

Weight of fruits

Mature fruits suitable for vegetable purpose were harvested periodically and the total weight of fruits from individual plants was recorded separately and the mean worked out.

Size and shape of fruits

Three fruits selected at random from each plant at each time of harvest were measured for their length and girth and the mean worked out for statistical analyses.

Number and weight of seeds

One well ripened fruit from each plant was selected at random and seeds were extracted and counted. A random sample of 5 plants each from the four parents and 25 plants each from the two crosses was included for this observation.

Five hundred well developed seeds of both parents and hybrids were counted and the weight recorded.

Germination capacity

Fifty well developed seeds were counted and placed in a petri dish over moistened blotting paper. The

number of seeds germinated was counted after 48 hours and the percentage marked out.

Pollen sterility

Acetocarmine staining method was used for assessing the pollen sterility. Mature flower buds which would open next day were covered with paper bags. Anthers were collected from such buds and dusted on a slide containing a drop of acetocarmine stain and covered with a cover glass. After half an hour the slides were examined under the microscope. The deeply stained pollen grains were scored as fertile while those which took little or no stain were scored as sterile ones. Sterile and fertile pollen grains were counted from 30 microscopic fields and the percentage of sterility calculated.

# EXPERIMENTAL RESULTS

# EXPERIMENTAL RESULTS

## PART A. Hybrid vigour

The results of the investigation are presented hereafter.

The data for various characters are statistically analysed. The means with respect to each of the characters studied are presented in tables. The mean of the $F_2$ was compared with that of the better parent and also with the mean of the parents. The data are presented in Tables I (A) to XVI after testing their significance by critical difference.

### 1. Height of plants.

The data are presented in Tables I (A) and I (B) and Fig. (1).

From Table I (A) it can be seen that the F ratio is not significant. The data presented in Table I (B) shows that the cross PLD x BG records a decrease of 14.12% in its mean height than that of the better parent and 4.82% than the mid parental values. Decrease in height is also noticed in the cross WL x MK, to the extent of 12% from the better parental value and 7.81% from the mid parental value.

TABLE I (B)

Mean height of plants (in cm) of parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD+ | 83.86 | | | | | |
| BG | 65.38 | | | | | |
| WL+ | 81.05 | | | | | |
| MK | 69.58 | | | | | |
| PLD x BG | 71.02 | 83.86 | 74.62 | 65.38 | -14.12 | -4.82 |
| WL x MK | 69.43 | 81.05 | 75.315 | 69.58 | -12.01 | -5.885 |

+ Better parents

PLD = Purple Long Dutta

BG = Banaras Giant

WL = White Long

MK = Mukta Keshi

## TABLE II (B)

Mean number of branches of parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD+ | 21.86 | | | | | |
| BG | 17.11 | | | | | |
| WL+ | 28.08 | | | | | |
| MK | 17.94 | | | | | |
| PLD x BG | 19.92 | 21.86 | 19.485 | 17.11 | -8.87 | - 2.23 |
| WL x MK | 26.18 | 28.08 | 23.010 | 17.94 | -7.22 | -13.82 |

+ Better parents

PLD = Purple Long Dutta

BG = Banaras Giant

WL = White Long

MK = Mukta Keshi

## TABLE III (B)

Mean number of leaves of parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD+ | 172.14 | | | | | |
| BG | 116.83 | | | | | |
| WL+ | 176.38 | | | | | |
| MK | 112.06 | | | | | |
| PLD x BG | 118.52 | 172.14 | 144.485 | 116.83 | -31.15 | -16.57 |
| WL x MK | 138.27 | 176.38 | 157.325 | 112.06 | -21.03 | -12.11 |

+ Better parents

PLD = Purple Long Dutta

BG = Banaras Giant

WL = White Long

MK = Mukta Keshi

2. Number of branches.

Data are presented in Tables II (A) and II (B).

The means of the parents and $F_2$ differed significantly in the number of branches produced by them. There is a decrease in vigour with respect to the number of branches. In the cross PLD x BG the decrease ranges from 8.87% to 2.23% when the mean of the better parent and the mean of parents are considered. However this decrease is not statistically significant. Cross WL x MK exhibited decrease in number of branches by 7.22% compared to the better parental mean and 13.82% compared to the mid parental value, both of which are not statistically significant.

3. Number of leaves.

Data are furnished in Tables III (A) and III (B).

From Table III (B) it can be seen that decrease in vigour in respect of number of leaves is exhibited by both the crosses. When the $F_2$ means are compared with the means of better parents this decrease ranged from 31.15% in PLD x BG to 21.03% in WL x MK and against the mid parental values the decrease is 16.57% in the case of cross PLD x BG and 12.11% in the case of cross WL x MK.

## TABLE IV (B)

Mean spread of plants of parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD+ | 86.60 | | | | | |
| BG+ | 94.14 | | | | | |
| WL | 96.85 | | | | | |
| MK+ | 98.27 | | | | | |
| PLD x BG | 98.67 | 94.14 | 90.37 | 86.60 | +4.59 | +8.41 |
| WL x MK | 102.26 | 98.27 | 97.56 | 96.85 | +4.30 | +4.61 |

+ Better parents

PLD = Purple Long Dutta

BG = Banaras Giant

WL = White Long

MK = Mukta Keshi

## TABLE V (B)

Mean number of days from sowing to flowering of parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD | 83.86 | | | | | |
| BG+ | 80.58 | | | | | |
| WL+ | 81.31 | | | | | |
| MK | 83.53 | | | | | |
| PLD x BG | 85.95 | 80.58 | 82.21 | 83.58 | +6.65* | +4.54* |
| WL x MK | 76.65 | 81.31 | 82.42 | 83.53 | -5.72* | -7.00* |

+ Better parents

* Significant at 5% level

PLD = Purple Long Dutta

BG = Banaras Giant

WL = White Long

MK = Mukta Keshi

Eventhough there is clear evidence of decrease in hybrid vigour in the $F_2$, this is not significant statistically.

4. Spread of plants.

Data are presented in Tables IV (A) and IV (B).

The $F_2$s show their superiority in respect of spread of plants when they are compared with the means of better parents eventhough this is not statistically significant. This increase ranges from 4.59% to 4.30% (in PLD x BG it is 4.59% and in WL x MK is 4.30%.) This increase in vigour exhibited by the two crosses, when comparison is made with the parental mean varies from 8.41% in the case of PLD x BG to 4.61% in the case of WL x MK. The increase is not found statistically significant.

5. Time of flowering.

The data are presented in Tables V (A) and V (B).

The cross PLD x BG is later in flowering than the late parent PLD. This lateness in time for flowering of this cross is seen when compared with the better parental value as well as with the mean of the parents. It is later in flowering by 2.09 days than the late parent, and 5.37 days than the early parent. When compared with the parental mean the increase is by 3.74 days. The cross

## TABLE VI (B)

Mean number (total) of flowers produced by parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD+ | 59.71 | | | | | |
| BG | 18.05 | | | | | |
| WL+ | 52.15 | | | | | |
| MK | 18.82 | | | | | |
| PLD x BG | 25.87 | 59.71 | 38.88 | 18.05 | -56.67* | -33.97* |
| WL x MK | 48.20 | 52.15 | 35.435 | 18.82 | - 7.57 | +33.20* |

+ Better parents

PLD = Purple Long Dutta

BG = Banaras Giant

* Significant at 5% level

WL = White Long

MK = Mukta Keshi

## TABLE VII (B)

Mean number of long styled flowers produced by parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD+ | 22.86 | | | | | |
| BG | 13.17 | | | | | |
| WL+ | 23.00 | | | | | |
| MK | 12.71 | | | | | |
| PLD x BG | 18.06 | 22.86 | 18.015 | 13.17 | -20.99 | + 0.24 |
| WL x MK | 23.13 | 23.00 | 17.855 | 12.71 | + 0.57 | +29.32* |

\+ Better parent

PLD = Purple Long Dutta

BG = Banaras Giant

* Significant at 5% level

WL = White Long

MK = Mukta Keshi

WL x MK is earlier than the early parent by 4.66 days and 6.88 days earlier than the later parent. This cross shows 7 days earliness when the comparison is made with the mean of the parents.

6. Total number of flowers produced.

Data are presented in Tables VI (A) and VI (B) and Fig. (1).

It is observed that the $F_2$, PLD x BG produced less number of flowers than the parents. This statistically significant decrease in flower production amounts to 56.67% when compared to the mean of the better parent. Also against the mean of the parents, there is significant decrease in flower production scaling to 33.97%. The hybrid WL x MK shows significant vigour in flower production reaching to 33.2% over the mean of the parents. However, it shows 7.57% reduction when compared with the better parent.

(a) Number of long styled flowers.

The data are presented in Tables VII (A) and VII (B).

When the better parental mean is taken as a criterian for comparison the cross PLD x BG shows a decrease of 20.99% in the number of long styled flowers

## TABLE VIII (B)

Mean number of short styled flowers produced by parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD+ | 36.85 | | | | | |
| BG | 4.89 | | | | | |
| WL+ | 27.62 | | | | | |
| MK | 6.12 | | | | | |
| PLD x BG | 9.96 | 36.85 | 20.87 | 4.89 | -81.11* | -51.22* |
| WL x MK | 25.24 | 27.62 | 21.87 | 6.12 | -12.24 | +15.41* |

\+ Better parent

PLD = Purple Long Dutta

BG = Banaras Giant

* Significant at 5% level

WL = White Long

MK = Mukta Keshi

TABLE IX (B)

Mean number of fruits produced by parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD+ | 7.43 | | | | | |
| BG | 3.56 | | | | | |
| WL+ | 10.15 | | | | | |
| MK | 4.53 | | | | | |
| PLD x BG | 5.39 | 7.43 | 5.495 | 3.56 | -26.87 | - 1.72 |
| WL x MK | 8.61 | 10.15 | 7.340 | 4.53 | -15.16 | +17.16* |

\+ Better parent

PLD = Purple Long Dutta

BG = Benaras Giant

* Significant at 5% level

WL = White Long

MK = Mukta Keshi

produced. But the same cross shows an increase of 0.24% in the production of long styled flowers, when this $F_2$ mean is compared with the mean of the parents. WL x MK manifests hybrid vigour for this character when comparison is made with the better parent and also the mid parental value. But only the increase over parental mean (29.32%) is statistically significant.

(b) Number of short styled flowers.

The data are presented in Tables VIII (A) and (B) and Fig. (2).

Both the hybrids PLD x BG and WL x MK show decrease in number of short styled flowers when the $F_2$ means are compared with the better parental mean. The decrease in number of short styled flowers produced ranges from 31.11% in PLD x BG and 12.24% in WL x MK. The cross WL x MK, in comparison with the mean of the parents, shows significant increase in vigour for this character (15.41%).

7. Number of fruits produced.

The data are presented in Tables IX (A) and IX (B) and Fig. (3).

The mean table shows that the hybrid PLD x BG produced less number of fruits when compared with the

TABLE X (B)

Mean weight of fruits (in kg) produced by parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD | 0.892 | | | | | |
| BG+ | 1.232 | | | | | |
| WL+ | 1.554 | | | | | |
| MK | 1.349 | | | | | |
| PLD x BG | 1.352 | 1.232 | 1.062 | 0.892 | +9.74* | +27.30* |
| WL x MK | 1.707 | 1.554 | 1.474 | 1.394 | +9.86* | +15.81* |

+ Better parents

PLD = Purple Long Datta

BG = Benares Giant

* Significant at 5% level

WL = White Long

MK = Mukta Kesni

TABLE XI (B)

Mean length of fruits (in cm) produced by parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD+ | 20.58 | | | | | |
| BG | 15.65 | | | | | |
| WL+ | 18.67 | | | | | |
| MK | 17.38 | | | | | |
| PLD x BG | 21.78 | 20.58 | 18.115 | 15.65 | +5.83 | +20.02 |
| WL x MK | 19.60 | 18.67 | 18.025 | 17.38 | +4.97 | + 8.73 |

+ Better parents

PLD = Purple Long Dutta

BG = Banaras Giant

WL = White Long

MK = Mukta Keshi

mean of better parent as well as with the mean of the parents, the percentage of decrease being 27.45% and 1.72% respectively. It is observed that eventhough WL x MK shows 15.16% decrease in the number of fruits produced as against the mean of better parent, it exhibits hybrid vigour to the extent of 17.16% over the mean of the parents. This increase is statistically significant.

8. Weight of fruits.

The data are given in Tables X (A) and X (B) and Fig. (3).

Significant hybrid vigour for weight of fruits is manifested by both the crosses. When the mean of better parent is taken for comparison the crosses PLD x BG and WL x MK show increased weight to the extent of 9.74% and 9.86% respectively. When the $F_2$s are compared with the mid parental values, they exhibit a significant increase in weight of fruits which accounts for 27.30% in PLD x BG and 15.81% in WL x MK.

9. Length of fruits.

Data are presented in Tables XI (A) and XI (B) and Fig. (4).

## TABLE XII (B)

Mean girth of fruits (in cm) produced by parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD | 13.47 | | | | | |
| BG+ | 31.37 | | | | | |
| WL | 18.22 | | | | | |
| MK+ | 24.17 | | | | | |
| PLD x BG | 21.09 | 31.37 | 22.42 | 13.47 | -32.10* | - 5.93 |
| WL x MK | 17.71 | 24.17 | 21.18 | 18.22 | -26.72* | -16.38 |

+ Better parents

PLD = Purple Long Dutta

BG = Banaras Giant

* Significant at 5% level

WL = White Long

MK = Mukta Keshi

It is observed that there is no significant difference between the parents and $F_2$ in respect of length of fruits. However a comparison of the means given in the mean table indicates that the cross PLD x BG shows an increase in length of fruits to the extent of 5.83% and 20.02% over mean of the better parent and the parental mean respectively. The cross WL x MK also exhibits increased vigour (4.97% and 8.73%) over the mean of better parent and mid parental value. But the hybrid vigour obtained in these two crosses is found to be statistically not significant.

10. Girth of fruits.

Data are presented in Tables XII (A) and XII (B) and Fig. (4).

When the better parental mean is considered the girth of fruits of hybrid PLD x BG shows a reduction of 32.10%. It shows a decrease in girth of fruits to the extent of 5.93% against the mid parental value. The mean table indicates decrease in vigour for WL x MK also. This decrease varies from 26.72% to 16.38% when compared with the mean of the better parent and mean of both the parents respectively.

## TABLE XIII

Mean number of seeds from parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD | 2656 | | | | | |
| BG+ | 3112 | | | | | |
| WL | 894 | | | | | |
| MK+ | 2318 | | | | | |
| PLD x BG | 2837 | 3112 | 2884 | 2656 | -8.84 | - 1.63 |
| WL x MK | 2484 | 2318 | 1606 | 894 | +7.15 | +54.04 |

+ Better parents

PLD = Purple Long Dutta

BG = Banaras Giant

WL = White Long

MK = Mukta Keshi

## TABLE XIV

Mean weight of 500 seeds (in g) from fruits of parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD | 2.20 | | | | | |
| BG+ | 2.58 | | | | | |
| WL+ | 2.36 | | | | | |
| MK | 2.21 | | | | | |
| PLD x BG | 2.29 | 2.58 | 2.39 | 2.20 | -11.24 | - 4.14 |
| WL x MK | 1.95 | 2.36 | 2.285 | 2.21 | -17.37 | -10.24 |

+ Better parents

PLD = Purple Long Dutta

BG = Banaras Giant

WL = White Long

MK = Mukta Keshi

11. Number and weight of seeds.

(a) Number of seeds.

Data are presented in Table XIII.

The cross PLD x BG shows a decrease in the number of seeds produced by the $F_2$ when compared with the mean of the better parent as well as with the parental mean. Nevertheless the cross WL x MK produces more number of seeds than the parents, the range of increase being 7.15% when compared to the better parent and 54.04% when compared with the mean of the parents.

(b) Weight of 500 seeds from $F_2$ fruits and fruits from parents.

Data are presented in Table XIV.

A general tendency of decrease in the weight of seeds is seen in both the crosses. In PLD x BG it is 11.24% in comparison with the mean of better parent and 4.41% in comparison with the mid parental values. This in WL x MK is 17.37 and 10.24 respectively.

12. Germination percentage.

Data are presented in Table XV.

## TABLE XV

Mean germination percentage of seeds of parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD+ | 10.50 | | | | | |
| BG | 8.50 | | | | | |
| WL+ | 2.58 | | | | | |
| MK | 14.13 | | | | | |
| PLD x BG | 12.60 | 10.50 | 11.55 | 8.50 | +20.00 | +9.09 |
| WL x MK | 13.50 | 14.13 | 13.815 | 12.58 | - 4.45 | -2.21 |

+ Better parents

PLD = Purple Long Dutta

BG = Banaras Giant

WL = White Long

MK = Mukta Keshi

## TABLE XVI

Mean pollen sterility (in %) of parents and $F_2$

| Varieties | Mean of | | | | Mean increase or decrease in % over | |
|---|---|---|---|---|---|---|
| | Varieties | Better parent | Parents | Inferior parent | Better parent | Parents |
| PLD+ | 10.210 | | | | | |
| BG | 12.615 | | | | | |
| WL+ | 8.450 | | | | | |
| MK | 14.420 | | | | | |
| PLD x BG | 12.829 | 10.21 | 11.412 | 12.615 | +25.60 | 13.15 |
| WL x MK | 10.890 | 8.45 | 11.435 | 14.420 | +28.87 | - 4.72 |

+ Better parents

PLD = Purple Long Dutta

BG = Banaras Giant

WL = White Long

MK = Mukta Keshi

When the better parental mean is considered PLD x BG shows an increase in germination percentage amounting to 20%. The same cross exhibits an increase of 9.09% in germination capacity of seeds over the mean of the parents. But the $F_2$ WL x MK is low in germination capacity. The percentage of germination of seeds in this cross decreases to 4.45% when compared with the mean of the parent and 2.21% when compared with the mid parental value.

13. Pollen sterility

Data are presented in Table XVI.

Both the crosses show increase in sterility of pollen than the respective better parents. The cross PLD x BG exhibits an increase in pollen sterility to the extent of 25.60% and 13.15% over the better parental and parental means respectively. The increase in pollen sterility in the cross WL x MK is 28.87% over the better parental mean, while it records a decrease in pollen sterility (4.72%) from the mid parental value.

## TABLE XVII (A)

Frequency distribution of parents and $F_2$ for height of plants

Cross 1 - PLD x BG

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | PLD ($P_1$) | PLD x BG ($F_2$) | BG ($P_2$) |
| 1 | 16.25 - 22.25 | 0 | 1 | 0 |
| 2 | 22.25 - 28.25 | 0 | 0 | 0 |
| 3 | 28.25 - 34.25 | 0 | 1 | 0 |
| 4 | 34.25 - 40.25 | 0 | 2 | 1 |
| 5 | 40.25 - 46.25 | 0 | 3 | 2 |
| 6 | 46.25 - 52.25 | 0 | 8 | 0 |
| 7 | 52.25 - 58.25 | 0 | 6 | 1 |
| 8 | 58.25 - 64.25 | 0 | 23 | 5 |
| 9 | 64.25 - 70.25 | 0 | 27 | 2 |
| 10 | 70.25 - 76.25 | 1 | 44 | 0 |
| 11 | 76.25 - 82.25 | 1 | 28 | 2 |
| 12 | 82.25 - 88.25 | 3 | 24 | 3 |
| 13 | 88.25 - 94.25 | 2 | 4 | 2 |
| 14 | 94.25 -100.25 | 0 | 1 | 0 |
| | Total | 7 | 172 | 18 |
| | A.M. | 83.86 | 65.67 | 70.67 |
| | S.E. | 3.057 | 4.90 | 3.27 |
| | C.V. | 21.37 | 27.32 | 23.30 |

($P_1$) PLD = Purple Long Dutta
($P_2$) BG = Banaras Giant
} Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

## TABLE XVII (B)

Frequency distribution of parents and $F_2$ for height of plants

Cross 2 - WL x MK

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | WL ($P_1$) | WL x MK ($F_2$) | MK ($P_2$) |
| 1 | 46.5 - 50.5 | 0 | 2 | 0 |
| 2 | 50.5 - 54.5 | 0 | 6 | 0 |
| 3 | 54.5 - 58.5 | 0 | 4 | 2 |
| 4 | 58.5 - 62.5 | 0 | 7 | 4 |
| 5 | 62.5 - 66.5 | 0 | 3 | 1 |
| 6 | 66.5 - 70.5 | 1 | 4 | 1 |
| 7 | 70.5 - 74.5 | 2 | 8 | 4 |
| 8 | 74.5 - 78.5 | 2 | 4 | 2 |
| 9 | 78.5 - 82.5 | 2 | 6 | 3 |
| 10 | 82.5 - 86.5 | 3 | 2 | 0 |
| 11 | 86.5 - 90.5 | 0 | 2 | 0 |
| 12 | 90.5 - 94.5 | 3 | 1 | 0 |
| 13 | 94.5 - 98.5 | 0 | 0 | 0 |
| 14 | 98.5 -102.5 | 0 | 1 | 0 |
| 15 | 102.5 -106.5 | 0 | 1 | 0 |
| | Total | 13 | 51 | 17 |
| | A.M. | 81.42 | 93.44 | 68.97 |
| | S.E. | 1.99 | 3.95 | 2.14 |
| | C.V. | 9.47 | 14.07 | 12.00 |

($P_1$) WL = White Long
($P_2$) MK = Mukta Keshi
} Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

## TABLE XVIII (A)

Frequency distribution of parents and $F_2$ for number of branches

Cross 1 - PLD x BG

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | PLD ($P_1$) | PLD x BG ($F_2$) | BG ($P_2$) |
| 1 | 6.5 - 8.5 | 0 | 2 | 0 |
| 2 | 8.5 - 10.5 | 0 | 6 | 1 |
| 3 | 10.5 - 12.5 | 0 | 12 | 3 |
| 4 | 12.5 - 14.5 | 1 | 10 | 3 |
| 5 | 14.5 - 16.5 | 1 | 22 | 2 |
| 6 | 16.5 - 18.5 | 1 | 18 | 2 |
| 7 | 18.5 - 20.5 | 1 | 20 | 2 |
| 8 | 20.5 - 22.5 | 0 | 24 | 2 |
| 9 | 22.5 - 24.5 | 1 | 23 | 2 |
| 10 | 24.5 - 26.5 | 0 | 14 | 1 |
| 11 | 26.5 - 28.5 | 0 | 8 | 0 |
| 12 | 28.5 - 30.5 | 1 | 6 | 0 |
| 13 | 30.5 - 32.5 | 0 | 7 | 0 |
| 14 | 32.5 - 34.5 | 0 | 0 | 0 |
| 15 | 34.5 - 36.5 | 1 | 0 | 0 |
| | Total | 7 | 172 | 18 |
| | A.M. | 20.93 | 19.9 | 16.94 |
| | S.E. | 2.13 | 2.41 | 1.21 |
| | C.V. | 29.46 | 37.52 | 2.78 |

($P_1$) PLD = Purple Long Dutta
($P_2$) BG = Banaras Giant
} Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

## TABLE XVIII (B)

Frequency distribution of parents and $F_2$ for number of branches

Cross 2 - WL x MK

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | WL ($P_1$) | WL x MK ($F_2$) | MK ($P_2$) |
| 1 | 12.25 - 14.75 | 0 | 1 | 3 |
| 2 | 14.75 - 17.25 | 0 | 3 | 7 |
| 3 | 17.25 - 19.75 | 0 | 1 | 2 |
| 4 | 19.75 - 22.25 | 0 | 6 | 3 |
| 5 | 22.25 - 24.75 | 1 | 7 | 1 |
| 6 | 24.75 - 27.25 | 5 | 17 | 1 |
| 7 | 27.25 - 29.75 | 4 | 7 | 0 |
| 8 | 29.75 - 32.25 | 2 | 6 | 0 |
| 9 | 32.25 - 34.75 | 1 | 2 | 0 |
| 10 | 34.75 - 37.25 | 0 | 0 | 0 |
| 11 | 37.25 - 39.75 | 0 | 0 | 0 |
| 12 | 39.75 - 42.25 | 0 | 2 | 0 |
| 13 | 42.25 - 44.75 | 0 | 0 | 0 |
| 14 | 44.75 - 47.25 | 0 | 1 | 0 |
| | Total | 13 | 53 | 17 |
| | A.M. | 27.92 | 26.28 | 17.77 |
| | S.E. | 0.70 | 1.53 | 0.87 |
| | C.V. | 9.39 | 22.54 | 18.23 |

($P_1$) WL = White Long } Parents
($P_2$) MK = Mukta Keshi }

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

## PART B. Segregation studies

### 1. Height of plants.

Data are presented in Tables XVII (A) and XVII (B) and Fig. (5).

As can be seen from Table XVII (A) the coefficient of variation indicates that there is a wide range of variation in height of plants in the cross PLD x BG with more number of individuals in the intermediate classes. The distribution tends to be approximately normal with the mean of $F_2$ being intermediate to that of the parents. There is a one sided transgressive segregation in the $F_2$ which indicates polygenic nature of interaction. The second cross, WL x MK, as is clear from Table XVII (B), also shows a one sided transgressive segregation. The approximate normal distribution of the $F_2$ progenies in both the crosses shows the quantitative nature of segregation of the character 'height of plants'.

### 2. Number of branches.

Data are presented in Tables XVIII (A) and XVIII (B).

The means of $F_2$ in both the crosses are intermediate to the parental means. In PLD x BG there is one sided

## TABLE XIX (A)

Frequency distribution of parents and $F_2$ for number of leaves

Cross 1 - PLD x BG

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | PLD ($P_1$) | PLD x BG ($F_2$) | BG ($P_2$) |
| 1 | 36.5 - 48.5 | 0 | 3 | 1 |
| 2 | 48.5 - 60.5 | 0 | 4 | 1 |
| 3 | 60.5 - 72.5 | 0 | 8 | 0 |
| 4 | 72.5 - 84.5 | 0 | 4 | 0 |
| 5 | 84.5 - 96.5 | 0 | 11 | 2 |
| 6 | 96.5 - 108.5 | 0 | 21 | 2 |
| 7 | 108.5 - 120.5 | 0 | 33 | 5 |
| 8 | 120.5 - 132.5 | 0 | 28 | 2 |
| 9 | 132.5 - 144.5 | 1 | 30 | 1 |
| 10 | 144.5 - 156.5 | 0 | 11 | 0 |
| 11 | 156.5 - 168.5 | 2 | 6 | 3 |
| 12 | 168.5 - 180.5 | 1 | 2 | 1 |
| 13 | 180.5 - 192.5 | 2 | 4 | 0 |
| 14 | 192.5 - 204.5 | 1 | 2 | 0 |
| 15 | 204.5 - 216.5 | 0 | 5 | 0 |
| | Total | 7 | 172 | 18 |
| | A.M. | 172.79 | 122.03 | 114.50 |
| | S.E. | 4.8 | 8.53 | 8.96 |
| | C.V. | 10.77 | 26.27 | 16.09 |

($P_1$) PLD = Purple Long Dutta
($P_2$) BG = Banaras Giant
} Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

## TABLE XIX (B)

### Frequency distribution of parents and $F_2$ for number of leaves

Cross 2 - WL x MK

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | WL ($P_1$) | WL x MK ($F_2$) | MK ($P_2$) |
| 1 | 50.5 - 60.5 | 0 | 0 | 1 |
| 2 | 60.5 - 70.5 | 0 | 0 | 0 |
| 3 | 70.5 - 80.5 | 0 | 1 | 1 |
| 4 | 80.5 - 90.5 | 0 | 0 | 1 |
| 5 | 90.5 - 100.5 | 0 | 0 | 3 |
| 6 | 100.5 - 110.5 | 0 | 8 | 3 |
| 7 | 110.5 - 120.5 | 0 | 4 | 3 |
| 8 | 120.5 - 130.5 | 0 | 11 | 0 |
| 9 | 130.5 - 140.5 | 2 | 8 | 2 |
| 10 | 140.5 - 150.5 | 1 | 5 | 1 |
| 11 | 150.5 - 160.5 | 2 | 5 | 1 |
| 12 | 160.5 - 170.5 | 1 | 2 | 1 |
| 13 | 170.5 - 180.5 | 1 | 1 | 0 |
| 14 | 180.5 - 190.5 | 1 | 2 | 0 |
| 15 | 190.5 - 200.5 | 1 | 2 | 0 |
| 16 | 200.5 - 210.5 | 2 | 6 | 0 |
| 17 | 210.5 - 220.5 | 2 | 1 | 0 |
| | Total | 13 | 51 | 17 |
| | A.M. | 176.27 | 147.85 | 111.97 |
| | S.E. | 6.89 | 7.97 | 6.75 |
| | C.V. | 16.12 | 32.23 | 24.87 |

($P_1$) WL = White Long
($P_2$) MK = Mukta Keshi
Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

transgressive segregation ie., towards the lower limit of the parents, while in the cross WL x MK there is no transgression. There is appreciable amount of variation among the individuals of both the crosses within the limits of error, with the maximum number of individuals being in the intermediate classes. The approximate normal distribution of the $F_2$ is indicative of quantitative nature of inheritance of the character.

3. Number of leaves.

Data are presented in Tables XIX (A) and XIX (B).

In both the crosses ie., PLD x BG and WL x MK, the coefficient of variations are larger than those of the parents, which in turn indicates that the $F_2$s have more range of variation (within the limits of error) than the parents. The distribution tends to be approximately normal. The means of the $F_2$ in PLD x BG is 122.03 which is intermediate to the means of parents, ie., 172.79 in PLD and 114.50 in BG respectively. This in WL x MK is 147.85 which is in between 176.27 and 111.97 of the parents. There is clear evidence of the quantitative nature of inheritance for this character. No transgressive segregation is exhibited by either of the crosses.

TABLE XX (A)

Frequency distribution of parents and $F_2$ for the number of days from sowing to flowering

Cross 1 - PLD x BG

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | PLD ($P_1$) | PLD x BG ($F_2$) | BG ($P_2$) |
| 1 | 66.5 - 69.5 | 0 | 0 | 1 |
| 2 | 69.5 - 72.5 | 0 | 0 | 0 |
| 3 | 72.5 - 75.5 | 0 | 2 | 4 |
| 4 | 75.5 - 78.5 | 0 | 5 | 1 |
| 5 | 78.5 - 81.5 | 2 | 12 | 0 |
| 6 | 81.5 - 84.5 | 3 | 50 | 3 |
| 7 | 84.5 - 87.5 | 0 | 35 | 2 |
| 8 | 87.5 - 90.5 | 1 | 64 | 6 |
| 9 | 90.5 - 93.5 | 1 | 13 | 1 |
| 10 | 93.5 - 96.5 | 0 | 1 | 0 |
| | Total | 7 | 182 | 18 |
| | A.M. | 84.24 | 85.93 | 82.67 |
| | S.E. | 1.33 | 1.21 | 1.305 |
| | C.V. | 0.046 | 0.048 | 0.049 |

($P_1$) PLD = Purple Long Dutta
($P_2$) BG = Banaras Giant
} Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

## TABLE XX (B)

Frequency distribution of parents and $F_2$ for the number of days from sowing to flowering

Cross 2 - WL x MK

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | WL ($P_1$) | WL x MK ($F_2$) | MK ($P_2$) |
| 1 | 54.5 - 57.5 | 0 | 1 | 0 |
| 2 | 57.5 - 60.5 | 0 | 0 | 0 |
| 3 | 60.5 - 63.5 | 0 | 3 | 0 |
| 4 | 63.5 - 66.5 | 0 | 5 | 0 |
| 5 | 66.5 - 69.5 | 0 | 5 | 0 |
| 6 | 69.5 - 72.5 | 0 | 4 | 0 |
| 7 | 72.5 - 75.5 | 4 | 4 | 1 |
| 8 | 75.5 - 78.5 | 0 | 4 | 0 |
| 9 | 78.5 - 81.5 | 0 | 11 | 4 |
| 10 | 81.5 - 84.5 | 5 | 8 | 7 |
| 11 | 84.5 - 87.5 | 4 | 4 | 1 |
| 12 | 87.5 - 90.5 | 0 | 5 | 4 |
| | Total | 13 | 54 | 17 |
| | A.M. | 81.15 | 76.45 | 83.35 |
| | S.E. | 1.42 | 2.44 | 0.35 |
| | C.V. | 0.061 | 0.111 | 0.016 |

($P_1$) WL = White Long
($P_2$) MK = Mukta Keshi
} Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

## TABLE XXI (A)

Frequency distribution of parents and $F_2$ for number of flowers

Cross 1 - PLD x BG

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | PLD ($P_1$) | PLD x BG ($F_2$) | BG ($P_2$) |
| 1 | 4.5 - 8.5 | 0 | 6 | 3 |
| 2 | 8.5 - 12.5 | 0 | 20 | 1 |
| 3 | 12.5 - 16.5 | 0 | 15 | 5 |
| 4 | 16.5 - 20.5 | 0 | 18 | 8 |
| 5 | 20.5 - 24.5 | 0 | 20 | 1 |
| 6 | 24.5 - 28.5 | 0 | 27 | 0 |
| 7 | 28.5 - 32.5 | 0 | 24 | 0 |
| 8 | 32.5 - 36.5 | 1 | 23 | 0 |
| 9 | 36.5 - 40.5 | 0 | 8 | 0 |
| 10 | 40.5-- 44.5 | 0 | 9 | 0 |
| 11 | 44.5 - 48.5 | 1 | 6 | 0 |
| 12 | 48.5 - 52.5 | 0 | 2 | 0 |
| 13 | 52.5 - 56.5 | 1 | 1 | 0 |
| 14 | 56.5 - 60.5 | 0 | 1 | 0 |
| 15 | 60.5 - 64.5 | 1 | 0 | 0 |
| 16 | 64.5 - 68.5 | 1 | 0 | 0 |
| 17 | 68.5 - 72.5 | 0 | 0 | 0 |
| 18 | 72.5 - 76.5 | 1 | 0 | 0 |
| 19 | 76.5 - 80.5 | 1 | 0 | 0 |
| | Total | 7 | 180 | 18 |
| | A.M. | 59.640 | 25.970 | 21.833 |
| | S.E. | 3.315 | 2.517 | 1.0713 |
| | C.V. | 24.229 | 42.250 | 21.385 |

($P_1$) PLD = Purple Long Dutta
($P_2$) BG = Banaras Giant
} Parents

TABLE XXI (B)

Frequency distribution of parents and $F_2$ for number of flowers

Cross 2 - WL x MK

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | WL ($P_1$) | WL x MK ($F_2$) | MK ($P_2$) |
| 1 | 7.5 - 13.5 | 0 | 0 | 4 |
| 2 | 13.5 - 19.5 | 0 | 0 | 5 |
| 3 | 19.5 - 25.5 | 0 | 3 | 6 |
| 4 | 25.5 - 31.5 | 0 | 4 | 2 |
| 5 | 31.5 - 37.5 | 1 | 7 | 0 |
| 6 | 37.5 - 43.5 | 3 | 7 | 0 |
| 7 | 43.5 - 49.5 | 0 | 14 | 0 |
| 8 | 49.5 - 55.5 | 4 | 5 | 0 |
| 9 | 55.5 - 61.5 | 3 | 5 | 0 |
| 10 | 61.5 - 67.5 | 2 | 3 | 0 |
| 11 | 67.5 - 73.5 | 0 | 2 | 0 |
| 12 | 73.5 - 79.5 | 0 | 2 | 0 |
| 13 | 79.5 - 85.5 | 0 | 1 | 0 |
| 14 | 85.5 - 91.5 | 0 | 0 | 0 |
| 15 | 91.5 - 97.5 | 0 | 0 | 0 |
| 16 | 97.5 - 103.5 | 0 | 0 | 0 |
| 17 | 103.5 - 109.5 | 0 | 1 | 0 |
| | Total | 13 | 54 | 17 |
| | A.M. | 51.78 | 47.94 | 18.62 |
| | S.E. | 2.27 | 3.89 | 1.40 |
| | C.V. | 18.16 | 33.45 | 32.09 |

($P_1$) WL = White Long

($P_2$) MK = Mukta Keshi

} Parents

4. Time of flowering.

Data are presented in Tables XX (A) and XX (B).

The mean of PLD x BG is higher than those of the parents. But it is intermediate in the cross WL x MK. The frequencies show that the distribution of the $F_2$ values tends to an approximate normal distribution. The coefficient of variation is slightly more in the $F_2$s than those of the parents, indicating that there is a little more variation in the $F_2$ than in the parents. The cross WL x MK manifests transgressive segregation towards the negative side. But in PLD x BG the transgression is towards the positive values of the parents. These tendencies go to confirm the quantitative nature of inheritance of the character.

5. Number of flowers.

Data are presented in Tables XXI (A) and XXI (B).

The frequencies of the individuals in the $F_2$ generation of both the crosses PLD x BG and WL x MK fall into approximate normal distribution as can be seen from Tables XXI (A) and XXI (B). The increase in variability of the $F_2$ is clearly evidenced by the increase in the

## TABLE XXII (A)

Frequency distribution of parents and $F_2$ for number of fruits

Cross 1 - PLD x BG

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | PLD ($P_1$) | PLD x BG ($F_2$) | BG ($P_2$) |
| 1 | 0.5 - 1.5 | 0 | 5 | 2 |
| 2 | 1.5 - 2.5 | 1 | 16 | 3 |
| 3 | 2.5 - 3.5 | 0 | 13 | 5 |
| 4 | 3.5 - 4.5 | 0 | 30 | 2 |
| 5 | 4.5 - 5.5 | 0 | 33 | 4 |
| 6 | 5.5 - 6.5 | 1 | 25 | 1 |
| 7 | 6.5 - 7.5 | 2 | 16 | 1 |
| 8 | 7.5 - 8.5 | 1 | 13 | 0 |
| 9 | 8.5 - 9.5 | 1 | 10 | 0 |
| 10 | 9.5 - 10.5 | 0 | 2 | 0 |
| 11 | 10.5 - 11.5 | 0 | 5 | 0 |
| 12 | 11.5 - 12.5 | 0 | 2 | 0 |
| 13 | 12.5 - 13.5 | 1 | 0 | 0 |
| | Total | 7 | 170 | 18 |
| | A.M. | 8.14 | 5.39 | 3.56 |
| | S.E. | 0.66 | 0.69 | 0.45 |
| | C.V. | 29.23 | 44.52 | 40.07 |

($P_1$) PLD = Purple Long Dutta } Parents
($P_2$) BG = Banaras Giant }

A.M. = Arithmetic Mean
S.E. = Standerd Error
C.V. = Coefficient of variation

TABLE XXII (B)

Frequency distribution of parents and $F_2$ for number of fruits

Cross 2 - WL x MK

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | WL ($P_1$) | WL x MK ($F_2$) | MK ($P_2$) |
| 1 | 1.75 - 3.25 | 0 | 2 | 7 |
| 2 | 3.25 - 4.75 | 2 | 3 | 2 |
| 3 | 4.75 - 6.25 | 3 | 5 | 3 |
| 4 | 6.25 - 7.75 | 0 | 4 | 1 |
| 5 | 7.75 - 9.25 | 1 | 7 | 3 |
| 6 | 9.25 - 10.75 | 0 | 4 | 1 |
| 7 | 10.75 - 12.25 | 1 | 12 | 0 |
| 8 | 12.25 - 13.75 | 2 | 2 | 0 |
| 9 | 13.75 - 15.25 | 3 | 4 | 0 |
| 10 | 15.25 - 16.75 | 0 | 2 | 0 |
| 11 | 16.75 - 18.25 | 0 | 4 | 0 |
| 12 | 18.25 - 19.75 | 0 | 0 | 0 |
| 13 | 19.75 - 21.25 | 1 | 2 | 0 |
| | Total | 13 | 51 | 17 |
| | A.M. | 14.85 | 10.53 | 4.33 |
| | S.E. | 0.38 | 0.62 | 0.68 |
| | C.V. | 33.53 | 41.01 | 36.58 |

($P_1$) WL = White Long
($P_2$) MK = Mukta Keshi
} Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

coefficient of variations of the crosses when compared with those of the parents. More over the means of the $F_2$s are intermediate to those of the parents. In the case of WL x MK there is slight transgressive segregation towards the positive side. All these facts show clearly that the inheritance of the character 'number of flowers' is quantitative in nature.

6. Number of fruits.

Data are presented in Tables XXII (A), XXI (B) and Fig. (6).

The cross PLD x BG shows considerable variability for this character, as is evidenced through a comparison of the coefficient of variations of the parents and hybrids. The coefficient of variation of PLD x BG is 44.52 while those of the parents are 29.23 and 40.07 respectively. This ranges from 33.53 to 36.58 in the parents and 41.01 in WL x MK. The intermediate position of the means of the crosses when compared with those of the parents is also a clear indication of the polygenic nature of inheritance of this character. Both the crosses also manifest transgressive segregation towards positive side.

## TABLE XXIII (B)

Frequency distribution of parents and $F_2$ for length of fruits

Cross 2 - WL x MK

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | WL ($P_1$) | WL x MK ($F_2$) | MK ($P_2$) |
| 1 | 12.25 - 13.25 | 0 | 3 | 0 |
| 2 | 13.25 - 14.25 | 0 | 1 | 1 |
| 3 | 14.25 - 15.25 | 0 | 2 | 2 |
| 4 | 15.25 - 16.25 | 1 | 4 | 2 |
| 5 | 16.25 - 17.25 | 3 | 2 | 1 |
| 6 | 17.25 - 18.25 | 3 | 5 | 5 |
| 7 | 18.25 - 19.25 | 1 | 4 | 4 |
| 8 | 19.25 - 20.25 | 2 | 9 | 1 |
| 9 | 20.25 - 21.25 | 1 | 6 | 1 |
| 10 | 21.25 - 22.25 | 1 | 2 | 0 |
| 11 | 22.25 - 23.25 | 0 | 4 | 0 |
| 12 | 23.25 - 24.25 | 1 | 3 | 0 |
| 13 | 24.25 - 25.25 | 0 | 3 | 0 |
| 14 | 25.25 - 26.25 | 0 | 2 | 0 |
| | Total | 13 | 51 | 17 |
| | A.M. | 18.75 | 19.48 | 17.40 |
| | S.E. | 0.59 | 0.81 | 0.50 |
| | C.V. | 11.70 | 11.90 | 10.62 |

($P_1$) WL = White Long
($P_2$) MK = Mukta Keshi
} Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

## TABLE XXIII (A)

Frequency distribution of parents and $F_2$ for length of fruits

Cross 1 - PLD x BG

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | PLD ($P_1$) | PLD x BG ($F_2$) | BG ($P_2$) |
| 1 | 7.675 - 9.675 | 0 | 1 | 0 |
| 2 | 9.675 - 11.675 | 0 | 0 | 0 |
| 3 | 11.675 - 13.675 | 0 | 2 | 3 |
| 4 | 13.675 - 15.675 | 0 | 8 | 6 |
| 5 | 15.675 - 17.675 | 2 | 24 | 5 |
| 6 | 17.675 - 19.675 | 2 | 34 | 4 |
| 7 | 19.675 - 21.675 | 1 | 41 | 0 |
| 8 | 21.675 - 23.675 | 1 | 35 | 0 |
| 9 | 23.675 - 25.675 | 0 | 12 | 0 |
| 10 | 25.675 - 27.675 | 0 | 9 | 0 |
| 11 | 27.675 - 29.675 | 0 | 2 | 0 |
| 12 | 29.675 - 31.675 | 1 | 1 | 0 |
| 13 | 31.675 - 33.675 | 0 | 0 | 0 |
| 14 | 33.675 - 35.675 | 0 | 1 | 0 |
| | Total | 13 | 170 | 18 |
| | A.M. | 19.008 | 20.51 | 15.78 |
| | S.E. | 1.22 | 1.91 | 1.22 |
| | C.V. | 14.10 | 17.50 | 12.66 |

($P_1$) PLD = Purple Long Dutta
($P_2$) BG = Banaras Giant
} Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

## TABLE XXIV (A)

Frequency distribution of parents and $F_2$ for girth of fruits

Cross 1 - PLD x BG

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | PLD ($P_1$) | PLD x BG ($F_2$) | BG ($P_2$) |
| 1 | 11.025 - 12.525 | 1 | 1 | 0 |
| 2 | 12.525 - 14.025 | 4 | 2 | 0 |
| 3 | 14.025 - 15.525 | 2 | 1 | 0 |
| 4 | 15.525 - 17.025 | 0 | 6 | 0 |
| 5 | 17.025 - 18.525 | 0 | 18 | 0 |
| 6 | 18.525 - 20.025 | 0 | 35 | 0 |
| 7 | 20.025 - 21.525 | 0 | 34 | 0 |
| 8 | 21.525 - 23.025 | 0 | 33 | 0 |
| 9 | 23.025 - 24.525 | 0 | 27 | 0 |
| 10 | 24.525 - 26.025 | 0 | 11 | 2 |
| 11 | 26.025 - 27.525 | 0 | 2 | 1 |
| 12 | 27.525 - 29.025 | 0 | 0 | 4 |
| 13 | 29.025 - 30.525 | 0 | 0 | 2 |
| 14 | 30.525 - 32.025 | 0 | 0 | 1 |
| 15 | 32.025 - 33.525 | 0 | 0 | 1 |
| 16 | 33.525 - 35.025 | 0 | 0 | 3 |
| 17 | 35.025 - 36.525 | 0 | 0 | 2 |
| 18 | 36.525 - 38.025 | 0 | 0 | 1 |
| 19 | 38.025 - 39.525 | 0 | 0 | 1 |
| | Total | 7 | 170 | 18 |
| | A.M. | 13.29 | 20.89 | 32.35 |
| | S.E. | 0.71 | 0.79 | 0.93 |
| | C.V. | 7.29 | 12.69 | 12.48 |

($P_1$) PLD = Purple Long Dutta
($P_2$) BG = Benaras Giant

} Parents

## TABLE XXIV (B)

### Frequency distribution of parents and $F_2$ for girth of fruits

Cross 2 - WL x MK

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | WL ($P_1$) | WL x MK ($F_2$) | MK ($P_2$) |
| 1 | 10.33 - 11.90 | 0 | 5 | 0 |
| 2 | 11.90 - 13.47 | 0 | 5 | 0 |
| 3 | 13.47 - 15.04 | 1 | 5 | 0 |
| 4 | 15.04 - 16.61 | 1 | 1 | 0 |
| 5 | 16.61 - 18.18 | 6 | 7 | 0 |
| 6 | 18.18 - 19.75 | 4 | 10 | 0 |
| 7 | 19.75 - 21.32 | 0 | 10 | 0 |
| 8 | 21.32 - 22.89 | 0 | 5 | 4 |
| 9 | 22.89 - 24.46 | 1 | 2 | 3 |
| 10 | 24.46 - 26.03 | 0 | 0 | 7 |
| 11 | 26.03 - 27.60 | 0 | 0 | 2 |
| 12 | 27.60 - 29.17 | 0 | 1 | 1 |
| | Total | 13 | 51 | 17 |
| | A.M. | 17.99 | 16.74 | 24.60 |
| | S.E. | 0.60 | 0.36 | 0.517 |
| | C.V. | 11.00 | 23.10 | 7.23 |

($P_1$) WL = White Long
($P_2$) MK = Mukta Keshi
} Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

7. Length of fruits.

Data are presented in Tables XXIII (A), XXIII (B) and Fig. (8).

The coefficient of variations in the crosses PLD x BG and WL x MK exceed those of the parents. This shows that the $F_2$ is having a higher range of variability, within the limits of error, than those of the parents. More number of individuals are seen in the intermediate classes. The mean of $F_2$ is intermediate to those of the parents. There is clear transgressive segregation in both the crosses.

8. Girth of fruits.

Data are presented in Tables XXIV (A), XXIV (B) and Fig. (7).

The tables indicate that the distribution of the $F_2$ values in PLD x BG and WL x MK is continuous and that it tends to approximate normality. The $F_2$s are having a wide range of variation within the limits of error as is indicated by the coefficient of variation. The mean values of $F_2$ are intermediate to those of parents. In the cross WL x MK there is distinct transgressice segregation. In PLD x BG the $F_2$ values are not uniformly

## TABLE XXV (A)

Frequency distribution of parents and $F_2$ for weight of fruits

Cross 1 - PLD x BG

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | PLD ($P_1$) | PLD x BG ($F_2$) | BG ($P_2$) |
| 1 | 0.000 - 0.275 | 1 | 7 | 3 |
| 2 | 0.275 - 0.550 | 0 | 12 | 5 |
| 3 | 0.550 - 0.825 | 4 | 19 | 1 |
| 4 | 0.825 - 1.100 | 0 | 27 | 2 |
| 5 | 1.100 - 1.375 | 1 | 28 | 1 |
| 6 | 1.375 - 1.650 | 0 | 25 | 1 |
| 7 | 1.650 - 1.925 | 0 | 23 | 1 |
| 8 | 1.925 - 2.200 | 1 | 11 | 1 |
| 9 | 2.200 - 2.475 | 0 | 10 | 0 |
| 10 | 2.475 - 2.750 | 0 | 2 | 0 |
| 11 | 2.750 - 3.025 | 0 | 2 | 1 |
| 12 | 3.025 - 3.300 | 0 | 2 | 0 |
| 13 | 3.300 - 3.575 | 0 | 2 | 1 |
| 14 | 3.575 - 3.800 | 0 | 0 | 1 |
| | Total | 7 | 170 | 18 |
| | A.M. | 0.88 | 1.34 | 1.23 |
| | S.E. | 0.167 | 0.95 | 0.29 |
| | C.V. | 63.80 | 97.50 | 45.00 |

($P_1$) PLD = Purple Long Dutta
($P_2$) BG = Banarus Giant
} Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

## TABLE XXV (B)

Frequency distribution of parents and $F_2$ for weight of fruits

Cross 2 - WL x MK

| Sl. No. | Classes | Frequency | | |
|---|---|---|---|---|
| | | WL ($P_1$) | WL x MK ($F_2$) | MK ($P_2$) |
| 1 | 0.0 - 0.3 | 0 | 1 | 0 |
| 2 | 0.3 - 0.6 | 1 | 0 | 2 |
| 3 | 0.6 - 0.9 | 1 | 7 | 3 |
| 4 | 0.9 - 1.2 | 3 | 5 | 2 |
| 5 | 1.2 - 1.5 | 2 | 9 | 4 |
| 6 | 1.5 - 1.8 | 1 | 11 | 2 |
| 7 | 1.8 - 2.1 | 3 | 5 | 2 |
| 8 | 2.1 - 2.4 | 1 | 3 | 1 |
| 9 | 2.4 - 2.7 | 0 | 5 | 0 |
| 10 | 2.7 - 3.0 | 0 | 2 | 1 |
| 11 | 3.0 - 3.3 | 1 | 1 | 0 |
| 12 | 3.3 - 3.6 | 0 | 0 | 0 |
| 13 | 3.6 - 3.9 | 0 | 1 | 0 |
| 14 | 3.9 - 4.2 | 0 | 1 | 0 |
| | Total | 13 | 51 | 17 |
| | A.M. | 1.53 | 1.71 | 1.32 |
| | S.E. | 0.183 | 0.21 | 0.17 |
| | C.V. | 44.44 | 49.61 | 47.88 |

($P_1$) WL = White Long
($P_2$) MK = Mukta Keshi
} Parents

A.M. = Arithmetic Mean
S.E. = Standard error
C.V. = Coefficient of variation

spread but are confined to a narrow range. This may be due to the fact that this character is governed by a very large number of genes.

9. Weight of fruits.

Data are presented in Tables XXV (A), XXV (B) and Fig. (6).

For this character the means of the hybrids in both crosses are slightly higher than those of the parents. In WL x MK there is transgressive segregation. The coefficient of variation in both the crosses is more than those in the parents and which indicate that the $F_2$s have more variation than in the parents. The frequencies of the crosses fall into an approximate normal distribution which in turn indicate the quantitative nature of inheritance of this character.

# DISCUSSION

# DISCUSSION

In the following pages are discussed the results of investigation presented in the earlier part of this thesis. The object of study was to examine the extent of hybrid vigour transmitted to the $F_2$ generation and the study of the pattern of inheritance of some of the important quantitative characters in two inter varietal crosses in brinjal.

## PART A. Hybrid vigour

From the results of the present investigation it is observed that the $F_2$ generations of the two crosses tend to exhibit a general decline in hybrid vigour for most of the characters studied and that the two crosses show marked variation in the measure of hybrid vigour in such characters.

The height of plants in $F_2$ in both the hybrids under study was less when compared to the better parental and also mid parental values. The hybrid PLD x BG studied by Viswanathan (1967) also did not show significant increase in vigour over the parents with respect to this character. But in the $F_1$ of the cross WL x MK, the same

author found significant increase in height of plants over the mid parental value. The $F_2$ of this cross exhibited hybrid vigour to the extent of 12% than the better parent and 7.81% than the mean of parents. Similar findings in the decline of hybrid vigour for height of plants in $F_2$ generation when compared to the parents and $F_1$ was registered in Bhindi (Mathews, 1966). Hybrid vigour for plant height degraded in the $F_2$ and $F_3$ generations in three out of six crosses studied by him.

The number of branches in a plant is positively correlated with its production of fruits. In brinjal where the fruit is the economic part or factor for yield, this character therefore happens to be a strong component of yield. A point of observation in the $F_2$ progenies of the two crosses studied has been the invariably reduced number of branches in the progenies when compared to the parents. The reduction of vigour in respect of this character was more pronounced in the cross WL x MK than in PLD x BG. According to Viswanathan (1967) the $F_1$ of these two crosses were also not profusely branching in comparison with their parents. Such reduction in vigour for this character in the $F_2$ has been reported in other

crops. Mathews (1966) has recorded similar results in a cross between Pusa Red x Kilichundan in Bhindi.

Data on number of leaves produced by the plants showed that the $F_2$ was far inferior to the parents for this character. Even though the hybrid vigour for this character exhibited by the $F_1$ WL x MK in the previous work was not considerable, this vigour was not retained in the $F_2$. The $F_2$s in both the crosses were inferior to the parents. Mathews (1966) observed that hybrid vigour for number of leaves manifested in the $F_1$ was not retained in $F_2$ in bhindi.

The $F_2$s under present study showed a slight increase in spread than the parents even though this increase was not statistically significant. With regard to the cross WL x MK, the $F_2$ showed less vigour when compared with the $F_1$ of this cross studied by Viswanathan (1967). This is in conformity with the results obtained by Pal and Singh (1940-41) in brinjal, that the average values of the $F_2$ progenies were, in all the six crosses studied, lower than those of the $F_1$s and parents.

There was considerable amount of variation in the degree of earliness in flower production in the two crosses under study. Kakizaki (1931) concluded that

the degree of hastening in flower production of brinjal crosses was widely varying according to the difference in combination. The significant lateness in flowering exhibited by the $F_2$ PLD x BG in the present study, has resulted in a steep fall of hybrid vigour, for this character when compared with the $F_1$ of the same cross (Viswanathan, 1967). This result agrees with that of Mathews (1966), wherein he found that out of 6 crosses studied, the earliness showed by one cross was not retained in the subsequent generations. In the present study the cross WL x MK had recorded earliness in flowering over the better parent and also the mid parental value. Hybrid vigour for this character in $F_1$ of this particular cross is seen to have persisted in the $F_2$ also. This is in agreement with the findings of Erina (1963) and Swadick (1965) in tomato and Swarup and Pal (1966) in cauliflower.

Yield in brinjal depends upon the number of fertile flowers produced per plant, number of fruit set, weight of individual fruit and its size contributed by length and girth.

Under the present study three different types of flowers viz., long styled, medium styled and short styled

were produced. The number of long styled flowers contributed more towards the increase in yield because the fruit set of these flowers were more than that of the other two categories of flowers. The results of the investigation showed that both the hybrids exhibited vigour in the production of long styled flowers. The cross PLD x BG was superior, for this character compared to the mean of the parents, while WL x MK showed its superiority over the mean of the parents, better parent and also the $F_1$ (Viswanathan, 1967) respectively. Mathews (1966) reporting on hybrid vigour for flower production in $F_1$ of bhindi recorded vigour for this character in the subsequent generation also. As far as the present study is concerned, the increase in the production of large number of long styled flowers in $F_2$ is the most important character, as this has contributed the increase in yield, inspite of the decline in vigour of most of the morphological characters.

The present investigation revealed that the cross PLD x BG showed a decline in the number of fruits produced. The hybrid vigour recorded for this character in the $F_1$ according to Viswanathan (1967) also was not retained in the $F_2$. Neverthless hybrid vigour by way of increase in number of fruits produced was exhibited by the $F_2$ WL x MK,

when compared to the mean of the parents. The particular character of this cross viz. the production of large number of long styled flowers, had consequently been reflected in the production of fruits also. This was clear from the fact that WL x MK ($F_2$) exceeded the $F_1$ studied by Viswanathan (1967) in its capacity for the production of more number of fruits. Eventhough the results obtained in the two crosses PLD x BG and WL x MK for this character were not consistent, they are supported by the findings of previous workers. According to Pal and Singh (1940-41) the $F_2$ progenies of brinjal and bitter gourd were distinctly inferior to the parents in most cases. Larson and Currance (1946) reported that the majority of $F_2$ generations produced yields midway between the parental verage and the $F_2$ yields, but some $F_2$ hybrids produced yields equal to those of the $F_1$. Pal and Singh (1946) also obtained certain $F_2$ plants in brinjal which produced larger number of fruits.

In the case of weight of fruits both the hybrids exceeded the better parental as well as mid parental limits. This vigour shown in weight of fruits of $F_2$ was found to be gradually declining, when this was compared with the vigour obtained in the $F_1$ studied by the previous worker. Jonebert (1950) found that eventhough the $F_2$

yields were lower than $F_1$ yields in tomatoes, it was suggested that sufficient vigour may be retained in the $F_2$ of some hybrids to make use of $F_2$ seed also practicable. According to Samarov (1965) though the yield in $F_2$ was lower than those of $F_1$, they were often 20-40% above those of the parents. The results of the present findings also agrees with those of Pal and Singh (1941-42) in that the $F_2$ plants showed increase in weight over the better parent but not over $F_1$s.

In the length of fruits, a gradual decline was noticed in the vigour retained in the $F_2$s but they showed a small increase over the better parental as well as mid parental values, though this increase was not statistically significant. No hybrid vigour for girth of fruits was retained in the $F_2$s and the decrease in vigour in comparison with the $F_1$s was much steep.

From the results of the present study it was found that the number of fruits, weight of fruits and length of fruits have played an important role in increasing the total yield of $F_2$, eventhough the increase was not to the same extent as was found in the $F_1$. This result is in agreement with a large volume of reports dealing with the performance of $F_2$ generation of various crop plants.

## PART B. Segregation studies

The behaviour of the $F_2$ hybrids of two crosses of brinjal regarding the mode the inheritance of some quantitative characters as shown in the part B of the chapter "Experimental Results" is briefly discussed here.

Results obtained in the present study indicated that characters determining the size of the vegetative parts of the plants viz., height, number of branches, number of leaves etc. were quantitative in nature of inheritance and that these characters must be assumed to be governed by a number of genes. This conclusion was possible due to the fact that the means of the $F_2$ in all these cases were intermediate and very close to the parental values. Transgressive segregation either to one side or towards both the extremes which is a typical character of quantitative attributes was distinctly seen in the distribution of the above characters. The wide variability of the $F_2$ plants as clearly shown by the coefficient of variation, in comparison with that of the parents was also apparent. The approximate normal distribution of the $F_2$ individuals was in support of the view that the plant height, number of branches, number of leaves etc. in brinjal were quantitative in nature and

that they are governed by a number of factors. Similar results have been obtained by Thomas W. Culp (1960) in Sesamum. He found that plant height in this crop was controlled by 3 to 10 pairs of genes with heritability values 40 to 50%.

According to Gotoh (1955) in brinjal the heritability values for flowering period was 67-78%. In the present study the $F_2$ WB x MK showed transgression towards earliness. Both the crosses were intermediate and the parental values were frequently found to occur in the $F_2$ classes. A segregation pattern typical of normal distribution was obtained in both the cases. These facts show that time of flowering in brinjal was polygenic in nature.

In the case of number of flowers produced by the plants data reveal that the cross WB x MK showed transgressive segregation. The means were intermediate between those of the parents. The higher coefficient of variation shown by the $F_2$, also suggested the larger variability of $F_2$ when compared with those of the parents. In PLD x BG there was an accumulation of the frequencies towards one extreme of the parents. According to Chandrasekharan and Parthasarathi (1960) this was not due to blending of characters but due to its being governed by a very large number of genes.

The important characters contributing to increase in yield in brinjal viz., number of fruits produced, weight of fruits and size of fruits as determined by their length and girth, were all found to be quantitatiye as clearly revealed in the present studies. Gotoh (1955) reported that in brinjal heritability values for fruit shape and fruit weight were estimated to be 60-75% and 40-60% respectively. Thomas W. Culp (1960) in sesamum also found that the capsule length in this crop was determined by 2 to 5 pairs of factors and had heritability values of 50 to 70%. The studies of Miyazawa (1957) showed that the minimum number of genes controlling fruit weight in capsicum was 52.24, fruit length 0.79 and fruit width 9.52. The yield characters in brinjal as seen by the present studies was in agreement with the above findings and indicated that these were also polygenic in nature. This was clearly shown by the high coefficient of variation, the intermediate position of the means of the $F_2$, transgressive segregation exhibited by the $F_2$s the approximate normal distribution of the $F_2$ values etc. as evidenced by the data.

The present investigation reveals that the characters height of plants, number of branches, number of leaves, time of flowering, number of fruits, weight of fruits, length and girth of fruit in brinjal are all quantitative and polygenic in their nature of inheritance.

# SUMMARY

## SUMMARY

The present investigation was carried out in the Division of Botany, Agricultural College and Research Institute, Vellayani during the year 1967-68.

The present study was undertaken with a view to examine the extent of hybrid vigour transmitted to the $F_2$ generation and also the pattern of inheritance of some of the important quantitative characters in brinjal. The parents involved were Purple Long Dutta, Banaras Giant, White Long and Muktakeshi. The important results obtained are summarised below.

Decline in hybrid vigour was exhibited by both of the $F_2$s under study for the chafacters viz., height of plants, number of branches, number of leaves, number of short styled flowers, girth of fruits and weight of seeds. The cross PLD x BG manifested hybrid vigour for germination percentage of seeds. WL x MK recorded hybrid vigour in $F_2$ for total number of flowers, number of long styled flowers, number of seeds and pollen sterility. Hybrid vigour was transmitted to the $F_2$ of both PLD x BG and WL x MK only in the case of weight of fruits.

A wide range of variations in characters was manifested in the $F_2$ generation of the hybrids under study and this is in general conformity with the observations reported by eminent authorities in the field. Inspite of the fact that there was loss of hybrid vigour in relation to most of the morphological characters, it is worth mentioning that in both the hybrids of brinjal studied here, there was an increase in yield of fruits by weight. This is further based on an increase in the number of long styled fertile flowers compared to their respective parents. The yield being the ultimate criterian for determining the practical utility of a crop variety, there is sufficient justification for the claim of superiority in this respect for both these $F_2$ generations and particularly so for the cross WL x MK.

As far as the nature of inheritance of characters is concerned, plant height, number of branches, number of leaves, time of flowering, number of flowers, number of fruits, length of fruits, girth of fruits and weight of fruits were found to be quantitative.

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# APPENDICES

## APPENDIX

### TABLE I (A)

Analysis of variance table for mean height of parents and $F_2$

| Source | S.S. | DF | Variance | F ratio |
|---|---|---|---|---|
| Total | 141233712.34 | 277 | | |
| Treatments | 4107.05 | 5 | 821.41 | < 1 |
| Error | 141229605.29 | 272 | 519226.49 | |

F ratio is not significant

## TABLE II (A)

Analysis of variance table for mean number of branches of parents and $F_2$

| Source | S.S. | DF | Variance | F ratio |
|---|---|---|---|---|
| Total | 21132.38 | 279 | | |
| Treatment | 3479.98 | 5 | 695.99 | 10.80* |
| Error | 17652.40 | 274 | 64.42 | |

* Significant at 5% level

C.D. for comparison between better parental mean and $F_2$

1. PLD x BG = 6.64
2. WL x MK = 4.82

C.D. for comparison between parental mean and $F_2$

1. PLD x BG = 3.68
2. WL x MK = 3.66

## TABLE III (A)

Analysis of variance table for mean number of leaves of parents and $F_2$

| Source | S.S. | DF | Variance | F ratio |
|---|---|---|---|---|
| Total | 573143.620 | 277 | | |
| Treatments | 71187.537 | 5 | 14237.51 | 7.71* |
| Error | 501956.083 | 272 | 1845.43 | |

* Significant at 5% level

C.D. for comparison between better parental mean and $F_2$

1. PLD x BG = 32.38
2. WL x MK = 26.15

C.D. for comparison between parental mean and $F_2$

1. PLD x BG = 19.63
2. WL x MK = 19.56

## TABLE IV (A)

Analysis of variance table for mean spread of parents and $F_2$

| Source | S.S. | DF | Variance | F ratio |
|---|---|---|---|---|
| Total | 87920.73 | 278 | | |
| Treatments | 2031.20 | 5 | 406.24 | 1.29 |
| Error | 85889.53 | 273 | 314.61 | |

F ratio is not significant

TABLE V (A)

Analysis of variance table for mean number of days from sowing to flowering of parents and $F_2$

| Source | S.S. | DF | Variance | F ratio |
|---|---|---|---|---|
| Total | 6263.574 | 290 | | |
| Treatments | 3713.898 | 5 | 742.78 | 83.027* |
| Error | 2549.676 | 285 | 8.95 | |

* Significant at 5% level

C.D. for comparison between better parental mean and $F_2$

1. PLD x BG = 2.26
2. WL x MK = 1.81

C.D. for comparison between parental mean and $F_2$

1. PLD x BG = 1.37
2. WL x MK = 1.33

## TABLE VI (A)

Analysis of variance table for total number of flowers produced by parents and $F_2$

| Source | S.S. | DF | Variance | F ratio |
|---|---|---|---|---|
| Total | 76727.18 | 288 | | |
| Treatments | 37845.08 | 5 | 7569.016 | 55.09* |
| Error | 38882.10 | 283 | 137.393 | |

* Significant at 5% level

C.D. for comparison between better parental mean and $F_2$

1. PLD x BG = 8.84
2. WL x MK = 7.15

C.D. for comparison between parental mean and $F_2$

1. PLD x BG = 5.37
2. WL x MK = 5.23

## TABLE VII (A)

Analysis of variance table for number of long styled flowers produced by parents and $F_2$

| Source | S.S. | DF | Variance | F ratio |
|---|---|---|---|---|
| Total | 27413.15 | 288 | | |
| Treatments | 5258.69 | 5 | 1051.738 | 13.4349* |
| Error | 22154.46 | 283 | 78.284 | |

* Significant at 5% level

C.D for comparison between better parental mean and $F_2$

1. PLD x BG = 6.60
2. WL x MK = 5.35

C.D. for comparison between parental mean and $F_2$

1. PLD x BG = 4.06
2. WL x MK = 3.94

## TABLE VIII (A)

Analysis of variance table for number of short styled flowers produced by parents and $F_2$

| Source | S.S. | DF | Variance | F ratio |
|---|---|---|---|---|
| Total | 34052.63 | 288 | | |
| Treatments | 18361.64 | 5 | 3672.328 | 66.234* |
| Error | 15690.99 | 283 | 55.445 | |

* Significant at 5% level

C.D. for comparison between better parental mean and $F_2$

1. PLD x BG = 5.61
2. WL x MK = 4.51

C.D. for comparison between parental mean and $F_2$

1. PLD x BG = 3.44
2. WL x MK = 3.33

TABLE IX (A)

Analysis of variance table for mean number of fruits produced by parents and $F_2$

| Source | S.S. | DF | Variance | F ratio |
|---|---|---|---|---|
| Total | 3863.91 | 275 | | |
| Treatments | 791.29 | 5 | 158.26 | 13.91* |
| Error | 3072.62 | 270 | 11.38 | |

* Significant at 5% level

C.D. for comparison between better parental mean and $F_2$

1. PLD x BG = 2.54
2. WL x MK = 2.05

C.D. for comparison between parental mean and $F_2$

1. PLD x BG = 1.25
2. WL x MK = 1.57

TABLE X (A)

Analysis of variance table for mean weight of fruits produced by parents and $F_2$

| Source | S.S. | DF | Variance | F ratio |
|---|---|---|---|---|
| Total | 151.970 | 275 | | |
| Treatments | 42.123 | 5 | 8.425 | 20.70* |
| Error | 109.847 | 270 | 0.407 | |

* Significant at 5% level

C.D. for comparison between better parental mean and $F_2$

1. PLD x BG = 0.04
2. WL x MK = 0.02

C.D. for comparison between parental mean and $F_2$

1. PLD x BG = 0.60
2. WL x MK = 1.57

TABLE XI (A)

Analysis of variance table for mean length of fruits produced by parents and $F_2$

| Source | S.S. | DF | Variance | F ratio |
|---|---|---|---|---|
| Total | 13813218.28 | 275 | | |
| Treatments | 949.53 | 5 | 189.91 | 0.0037 |
| Error | 13812268.75 | 270 | 51156.55 | |

F ratio is not significant

C.D. for comparison between better parental mean and $F_2$

1. PLD x BG = 54.05
2. WL x MK = 33.15

C.D. for comparison between parental mean and $F_2$

1. PLD x BG = 103.95
2. WL x MK = 102.05

TABLE XII (A)

Analysis of variance table for mean girth of fruits produced by parents and $F_2$

| Source | S.S. | DF | Variance | F ratio |
|---|---|---|---|---|
| Total | 24409.16 | 275 | | |
| Treatments | 2036.21 | 5 | 407.21 | 4.91* |
| Error | 22372.95 | 270 | 82.86 | |

* Significant at 5% level

C.D. for comparison between better parental mean and $F_2$

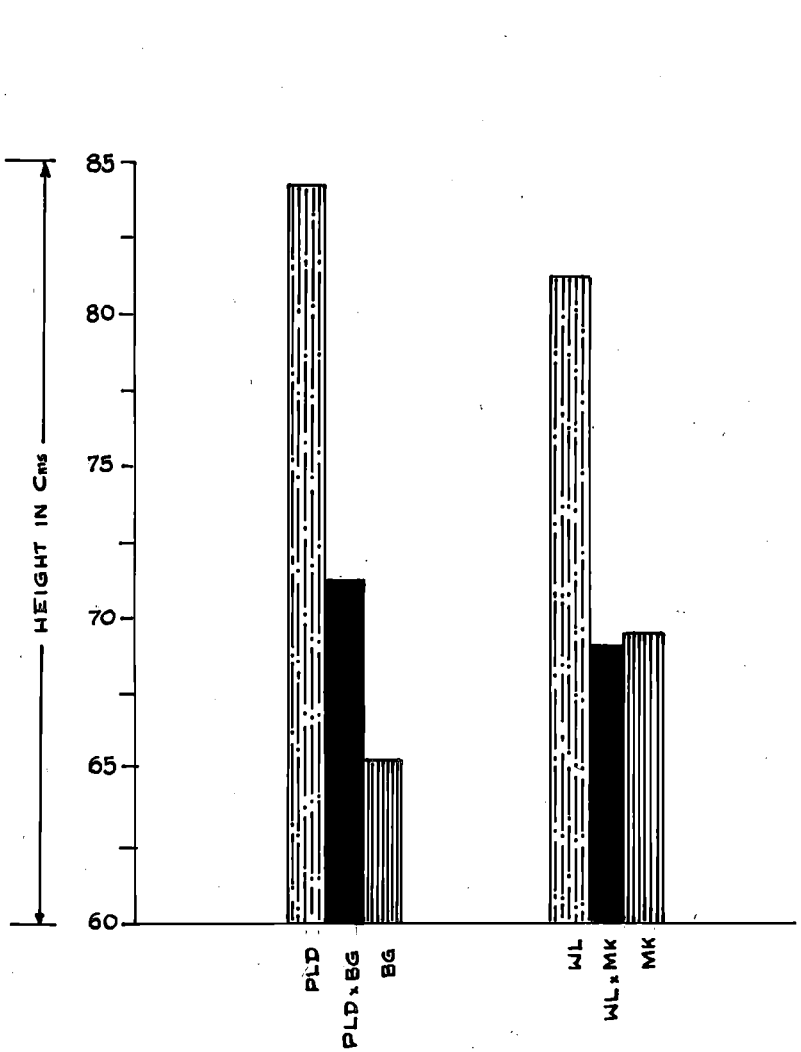
1. PLD x BG = 4.35
2. WL x MK = 4.86

C.D. for comparison between parental mean and $F_2$

1. PLD x BG = 4.17
2. WL x MK = 4.09

# ILLUSTRATIONS

## MEAN HEIGHT OF PLANTS




## TOTAL NUMBER OF FLOWERS

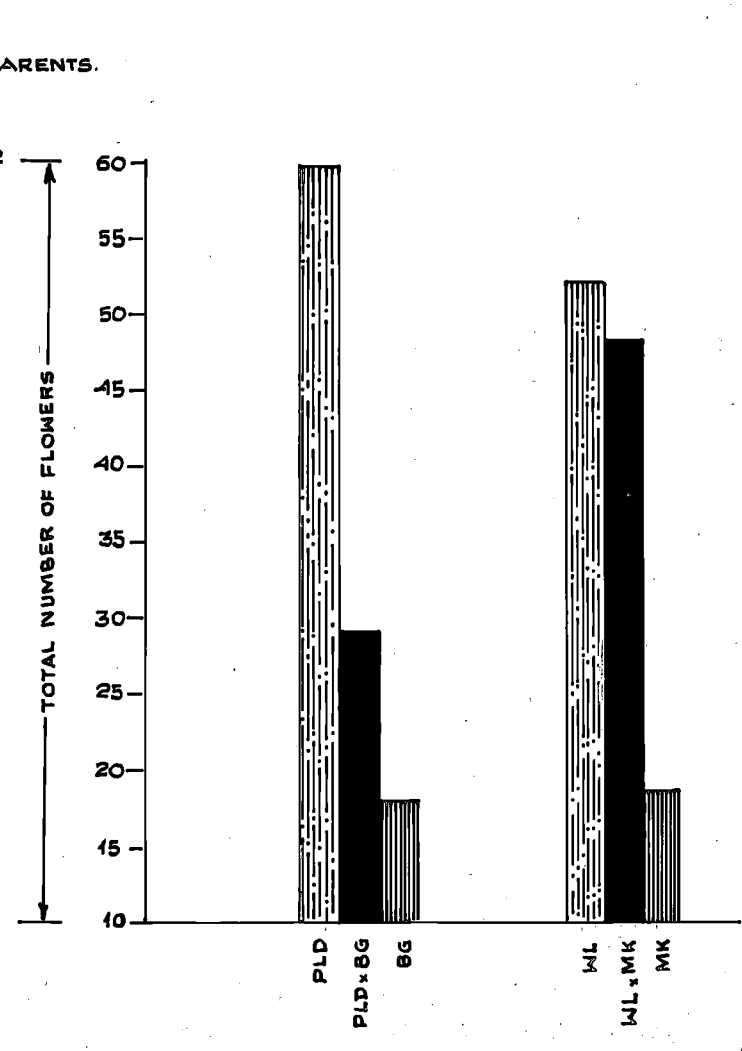
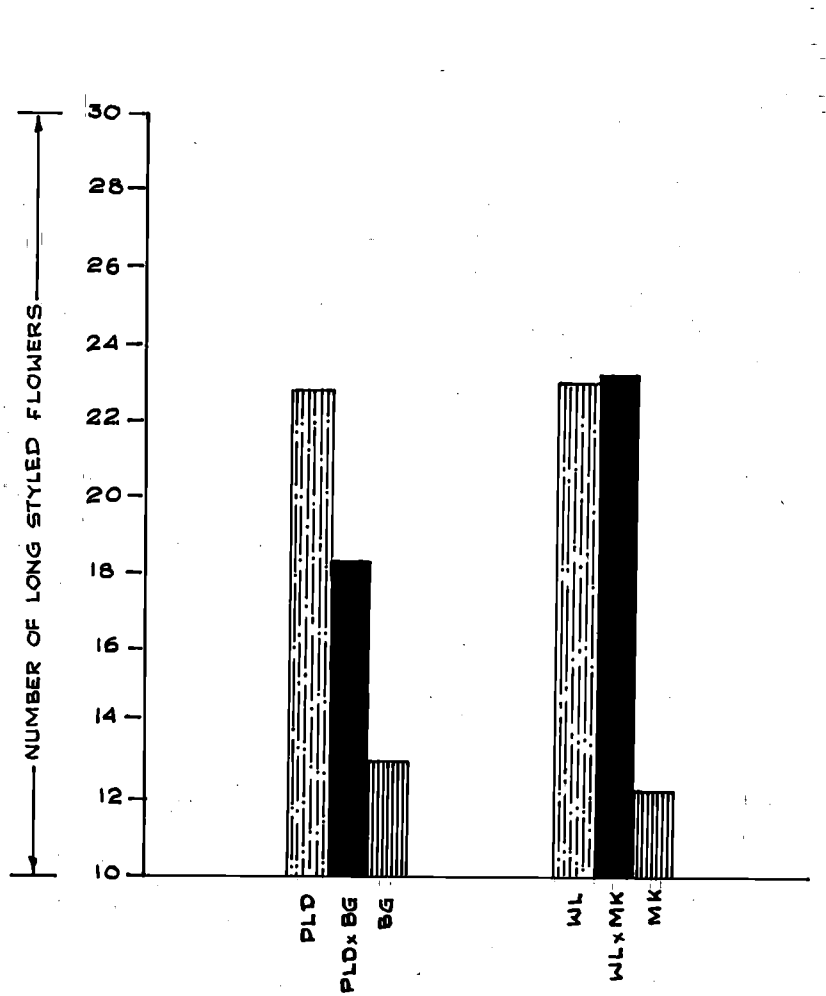



Fig. 1

MEAN NUMBER OF LONG STYLED FLOWERS PRODUCED BY PARENTS AND $F_2$




MEAN NUMBER OF SHORT STYLED FLOWERS PRODUCED BY PARENTS AND $F_2$

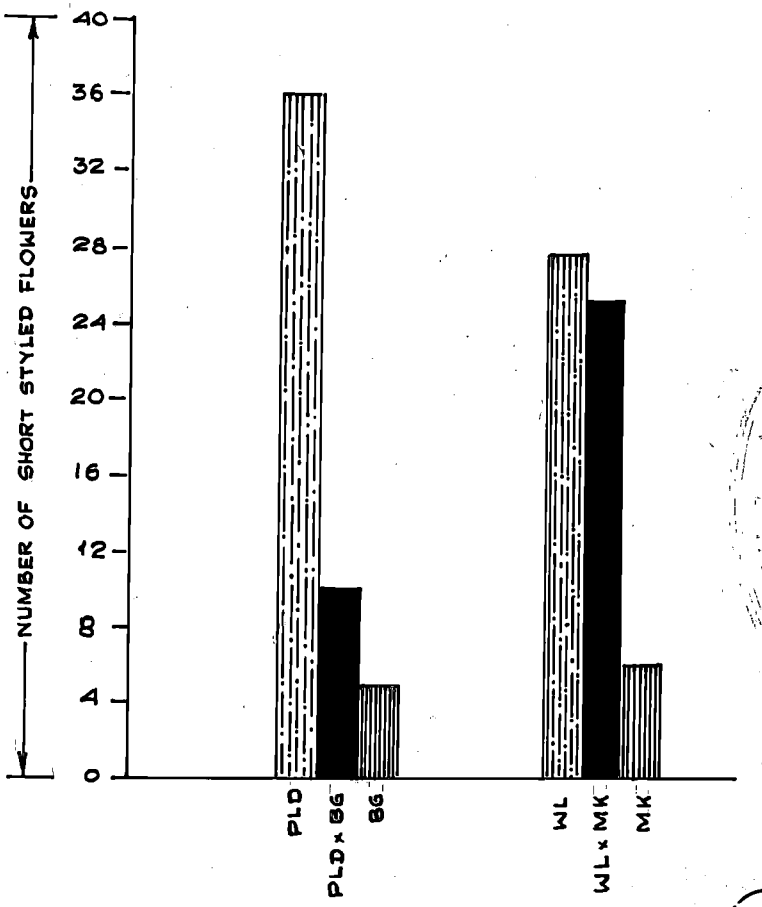
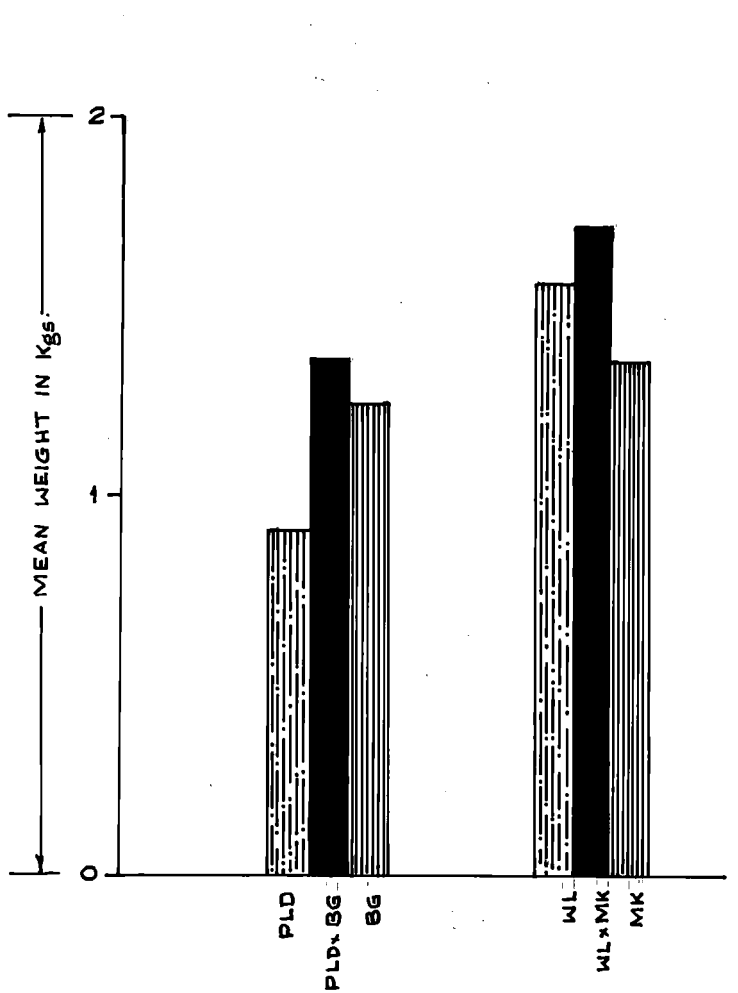





Fig. 2

## MEAN WEIGHT OF FRUITS




## MEAN NUMBER OF FRUITS

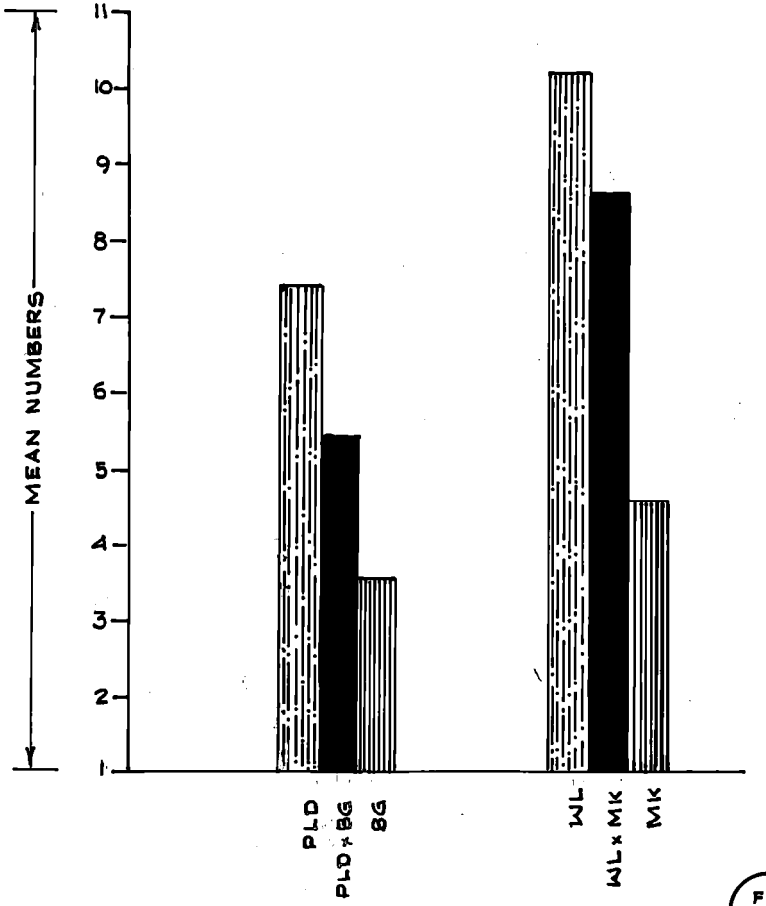
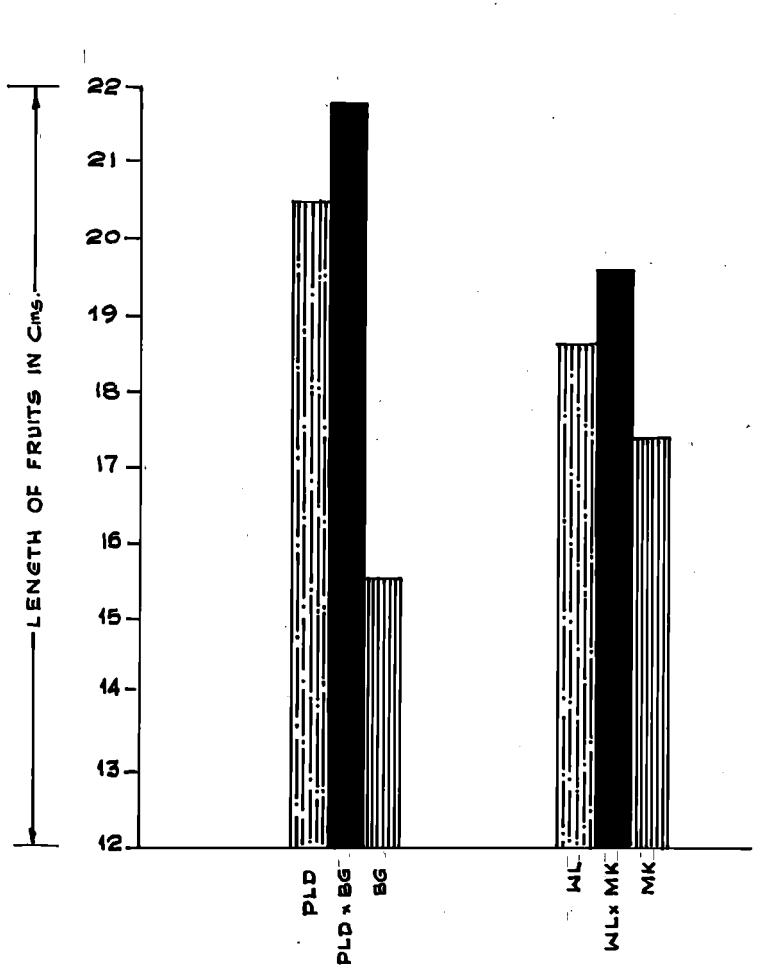



Fig. 3

MEAN LENGTH OF FRUITS OF PARENTS AND $F_2$.




MEAN GIRTH OF FRUITS OF PARENTS AND $F_2$

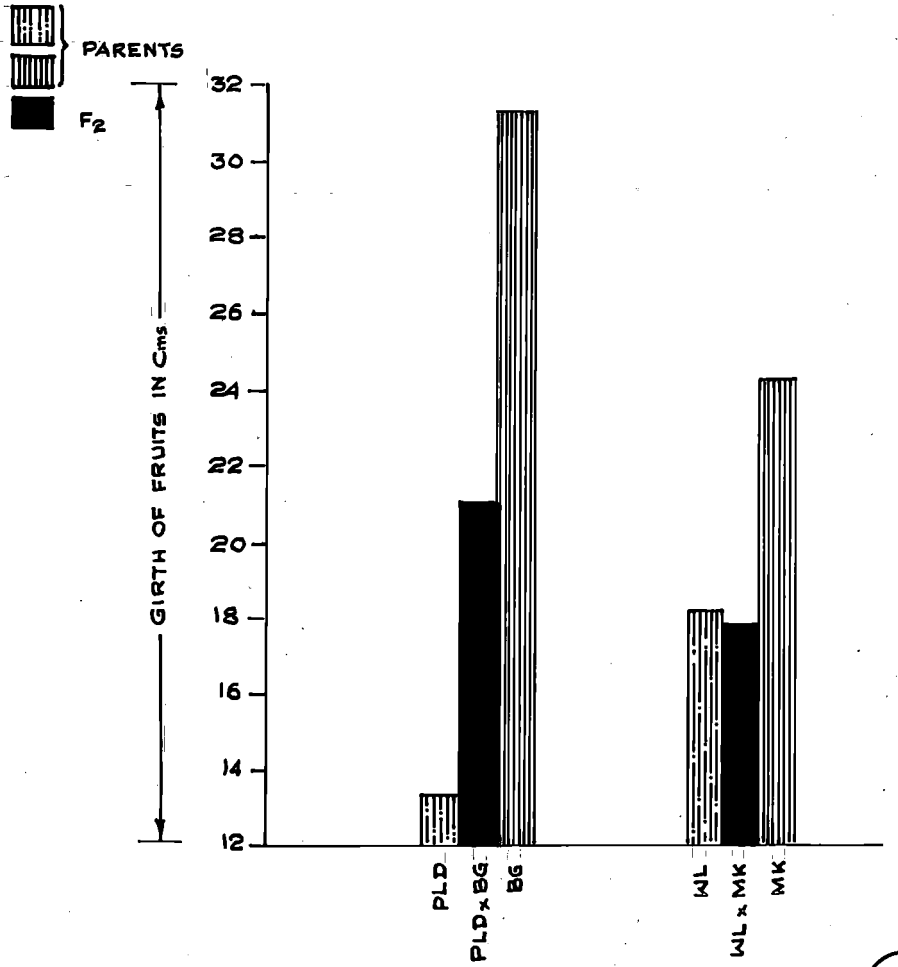
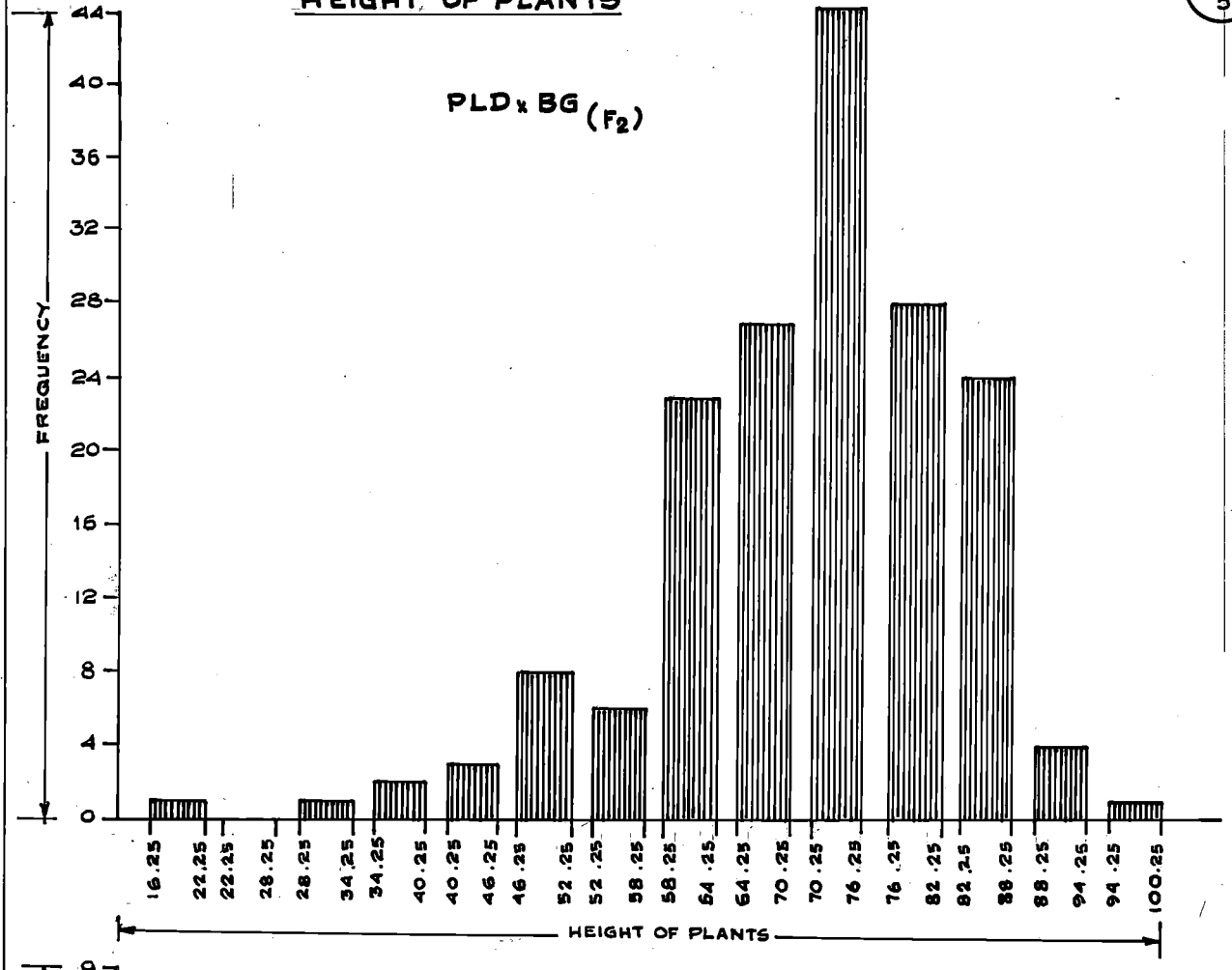



Fig. 4

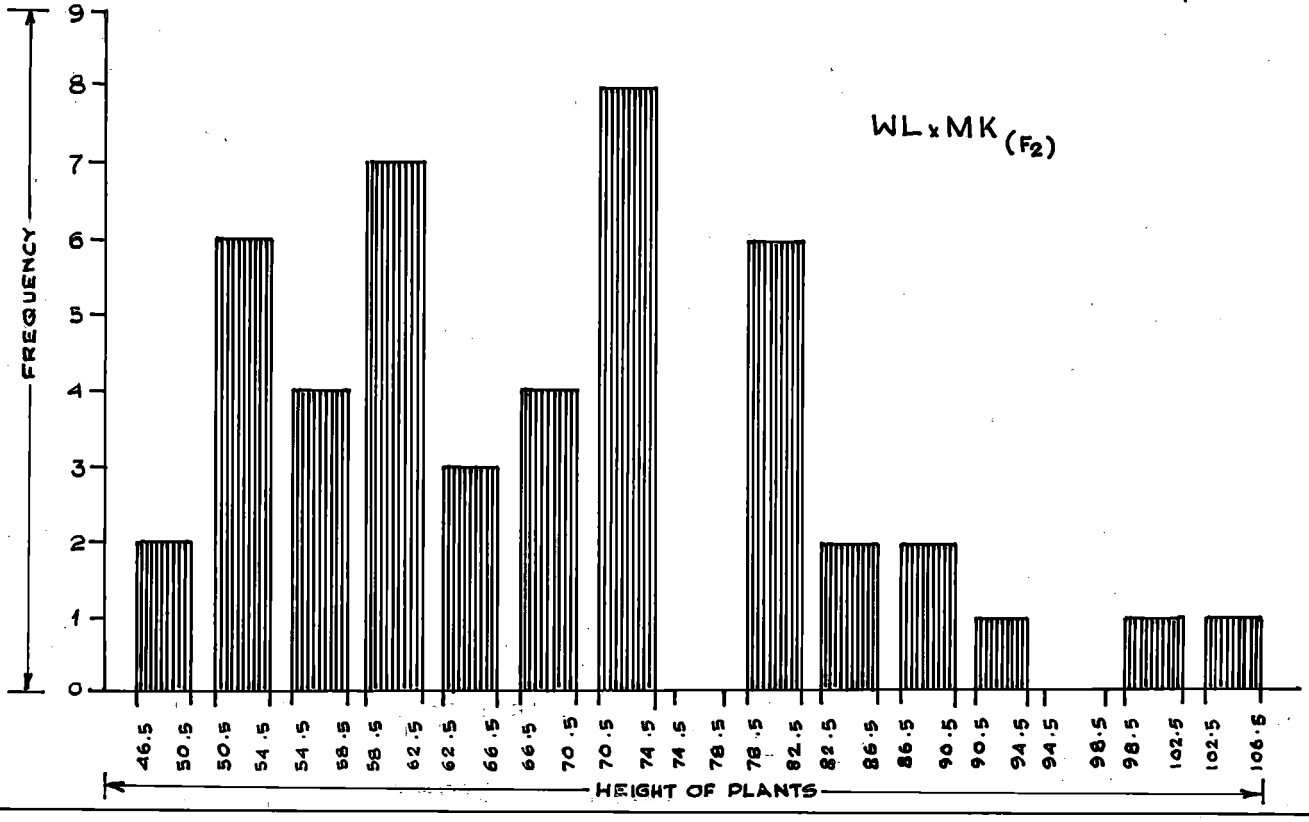
Fig 5

## HEIGHT OF PLANTS

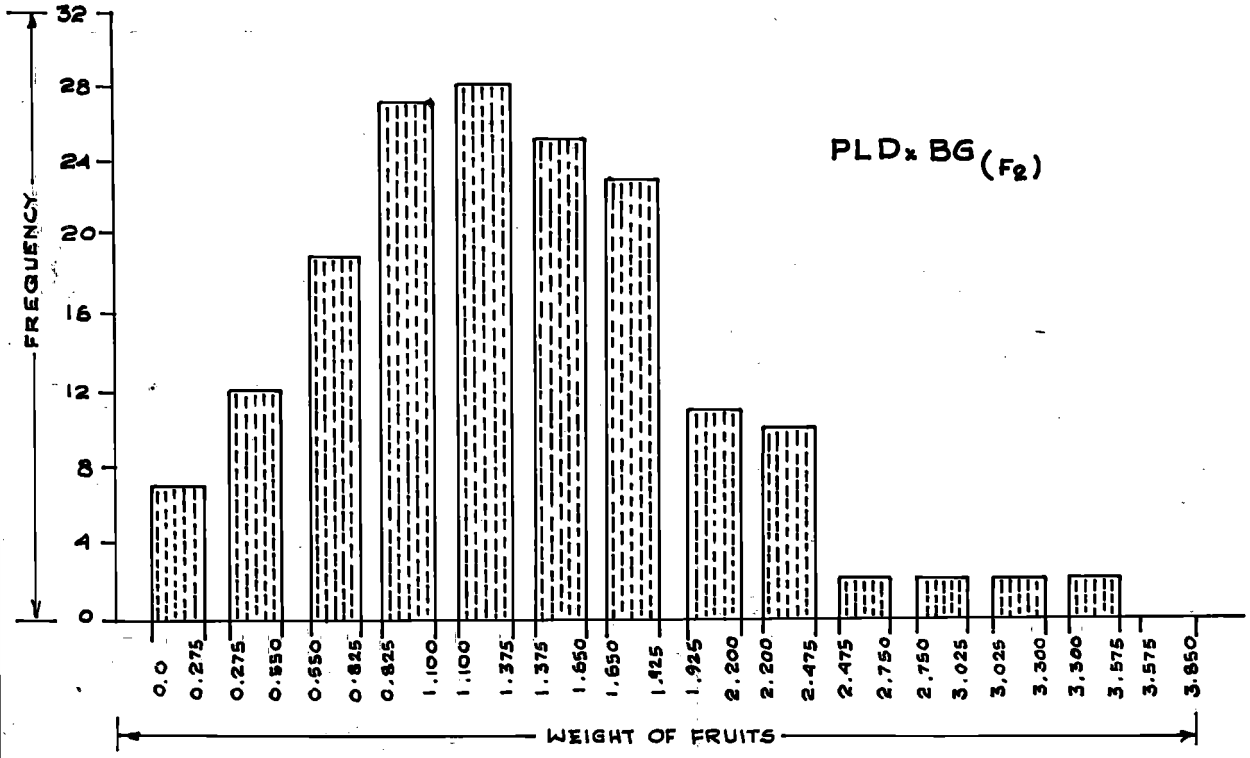
PLD x BG $(F_2)$




WL x MK $(F_2)$



## WEIGHT OF FRUITS



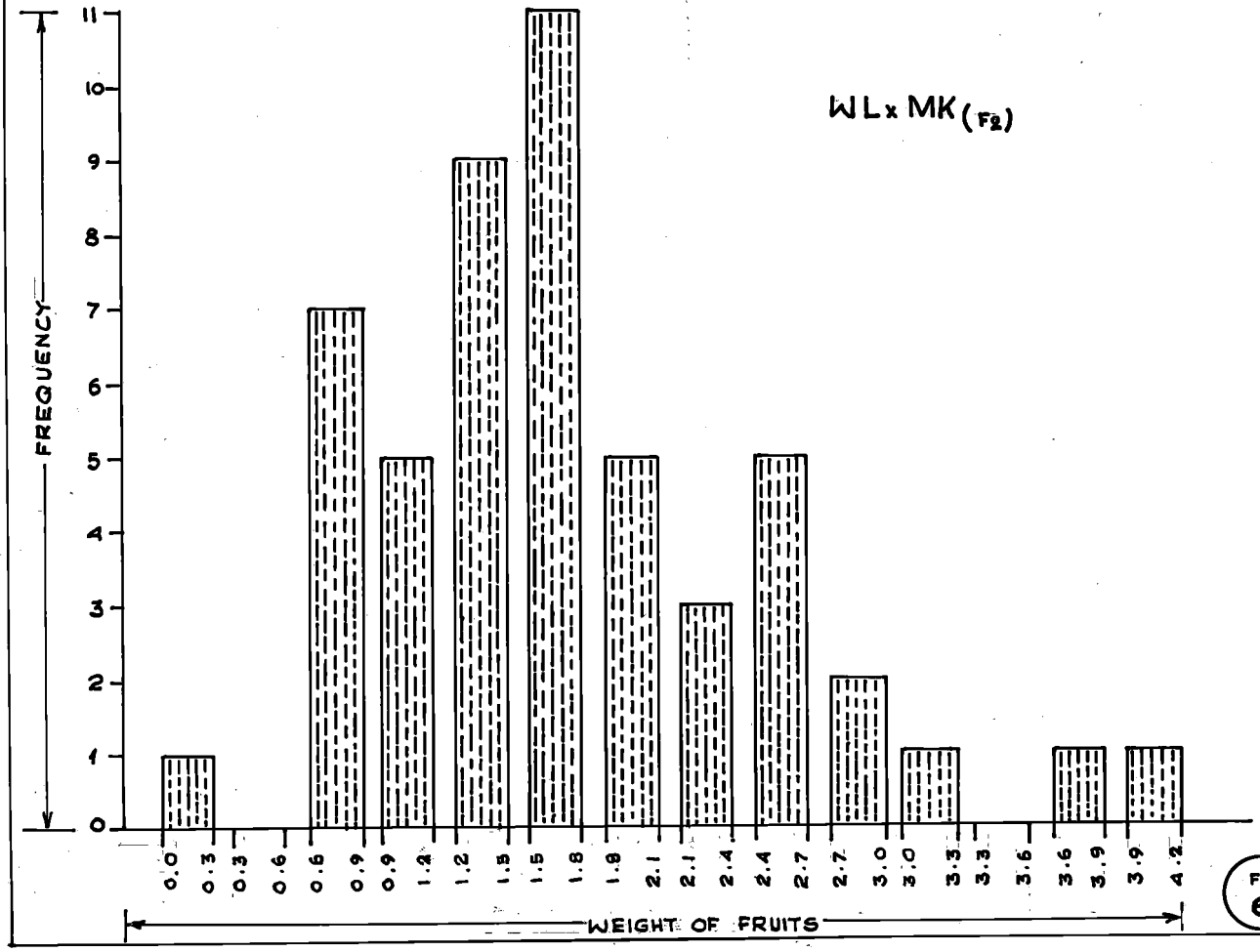
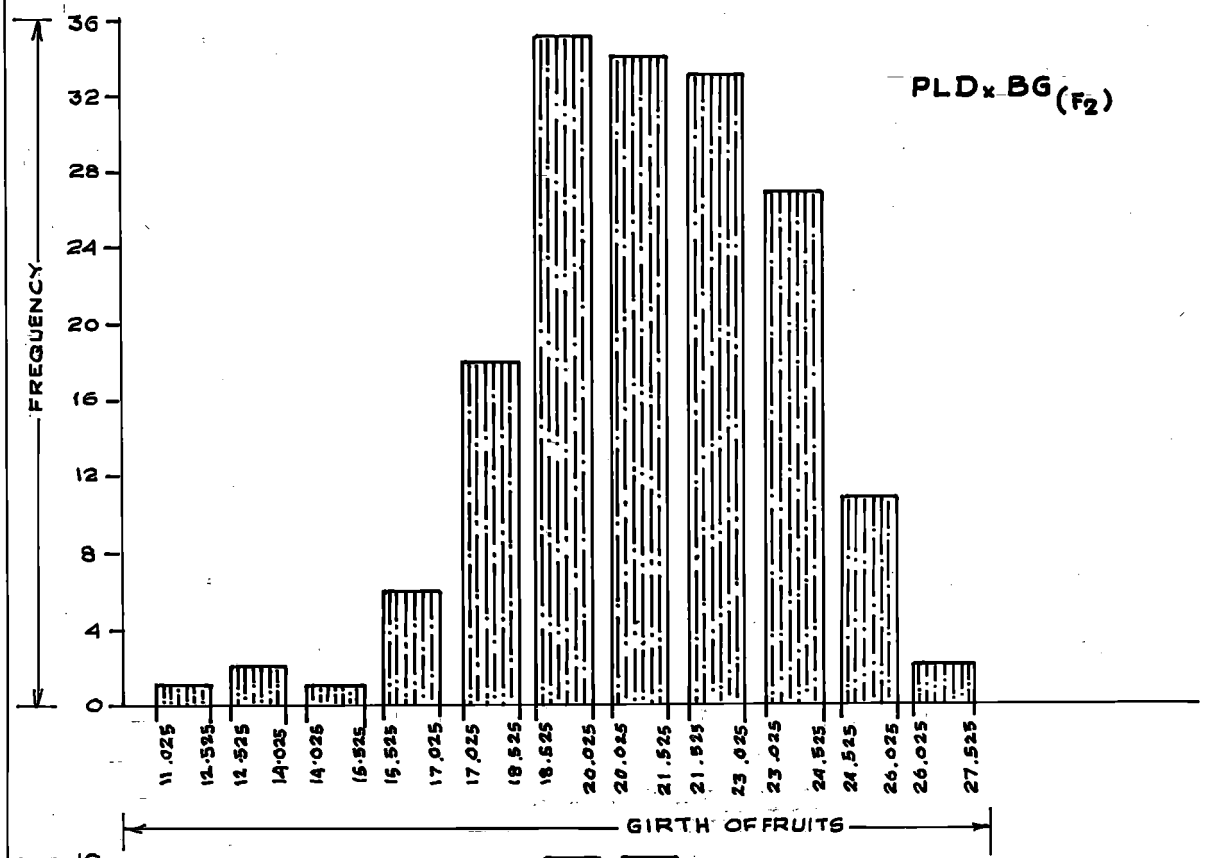




Fig. 6

# GIRTH OF FRUITS



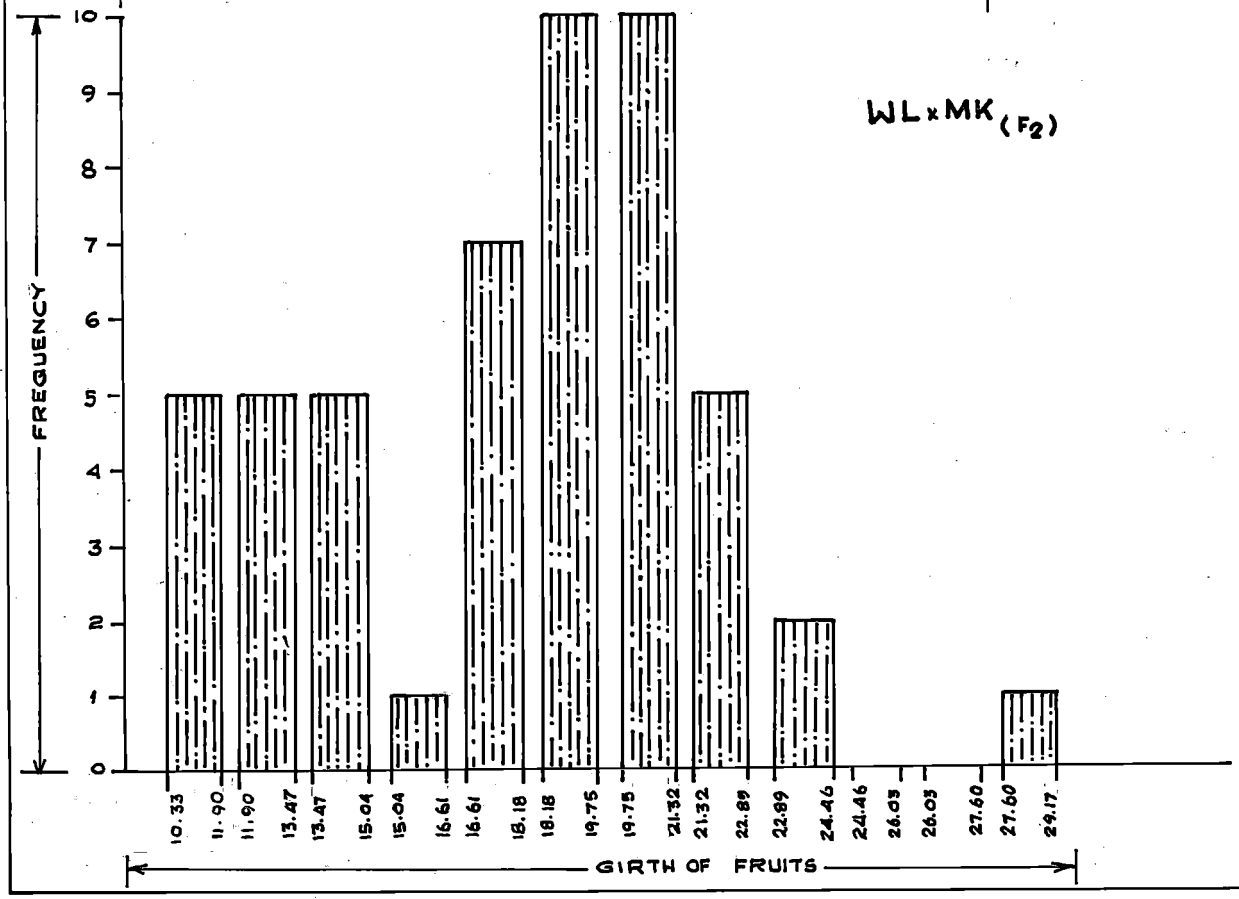
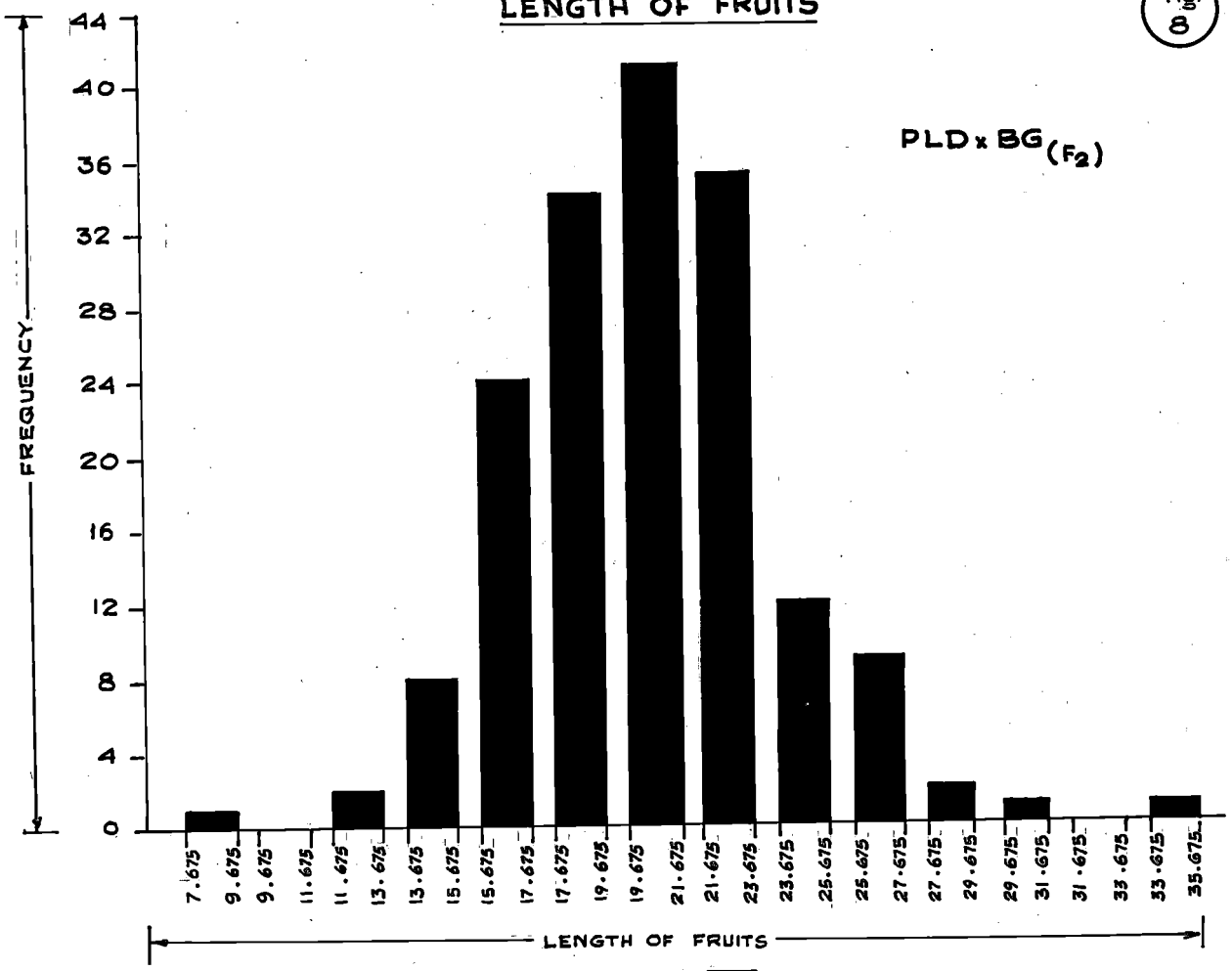




Fig. 7

## LENGTH OF FRUITS

Fig: 8



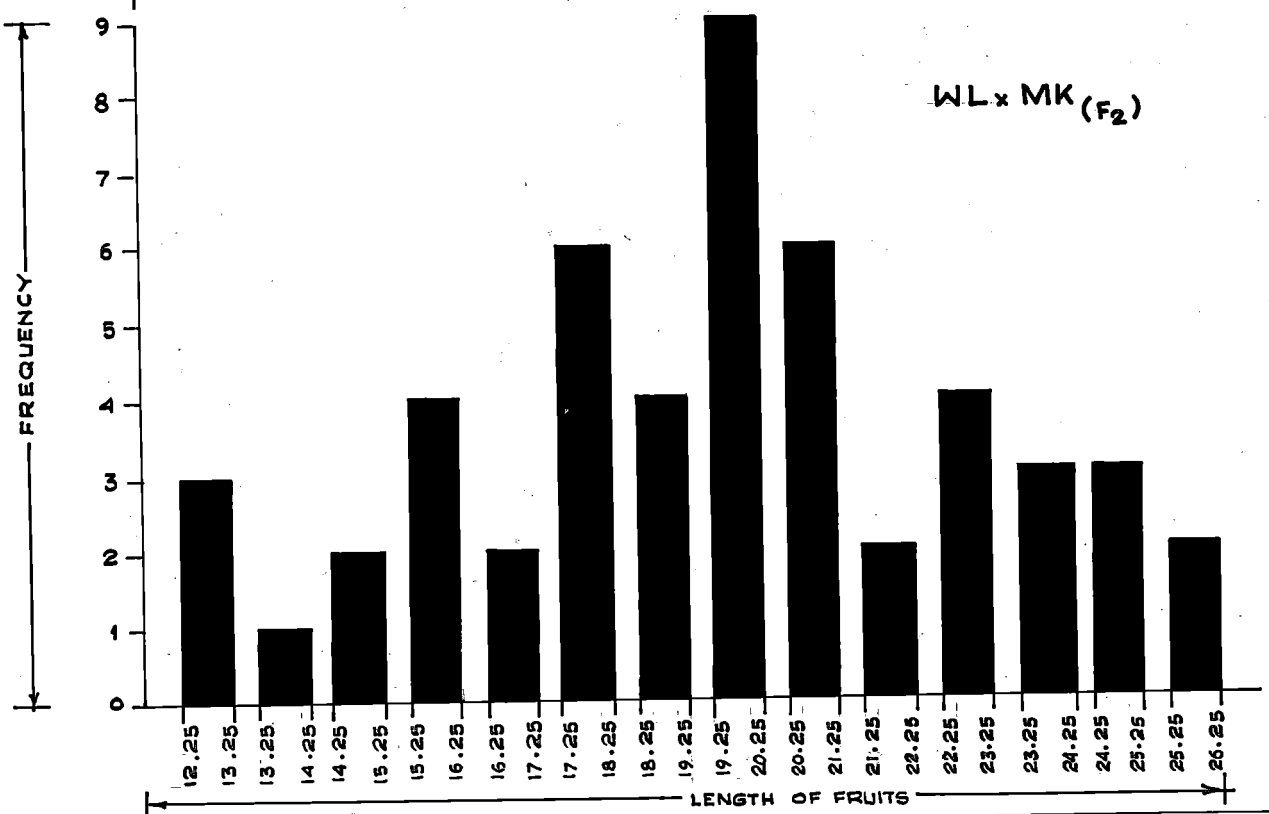



Plate 1.

Photograph showing height of parents and $F_2$

Cross 1 - PLD x BG

PLD = Purple Long Dutta - Female parent

BG = Banaras Giant - Male parent

Plate 2.

Photograph showing height of parents and $F_2$

Cross 2 - WL x MK

WL = White Long - Female parent

MK = Muktakeshi - Male parent


F
F
BC


F
F
F

Plate 3.

Photograph showing spread of parents and $F_2$

Cross 1 - PLD x BG

PLD = Purple Long Dutta - Female parent

BG = Banaras Giant - Male parent

Plate 4:

Photograph showing spread of parents and $F_2$

Cross 2 - WL x MK

WL = White Long - Female parent

MK = Muktakeshi - Male parent


E
E


WL
E
E
MK

Plate 5.

Photograph showing spread of $F_2$ plants

Cross 1 - PLD x BG

PLD x BG = Purple Long Dutta x Banaras Giant

Plate 6.

Photograph showing spread of $F_2$ plants

Cross 2 - WL x MK

WL x MK = White Long x Muktakeshi


P.L.D x B.G.

Plate 7.

Photograph showing length of fruits of parents and $F_2$

Cross 1 - PLD x BG

PLD = Purple Long Dutta - Female parent

BG = Banaras Giant - Male parent

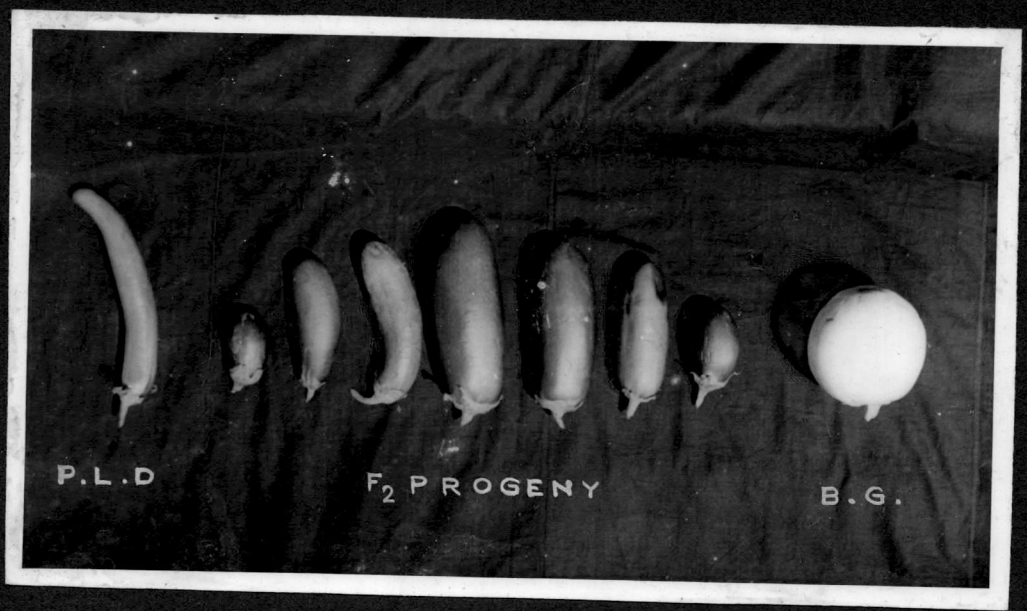
Plate 8.

Photograph showing length of fruits of parents and $F_2$

Cross 2 - WL x MK

WL = White Long - Female parent

MK = Muktakeshi - Male parent


P.L.D
F2 PROGENY
B.G.

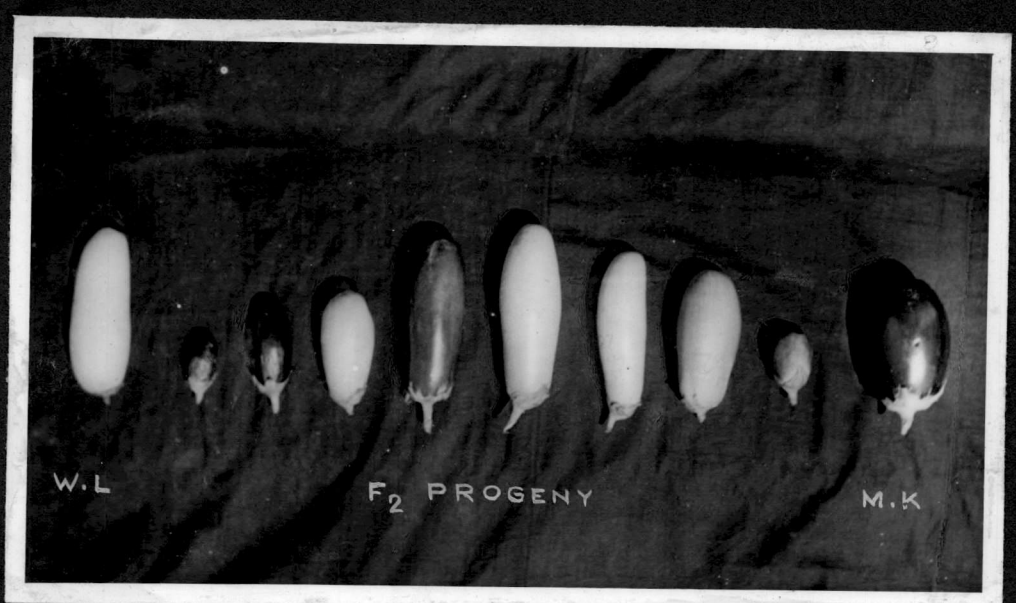

W.L
F2 PROGENY
M.K

Plate 9

Photograph showing girth of fruits of parents and $F_2$

Cross 1 - PLD x BG

PLD = Purple Long Dutta - Female parent

BG = Banaras Giant - Male parent

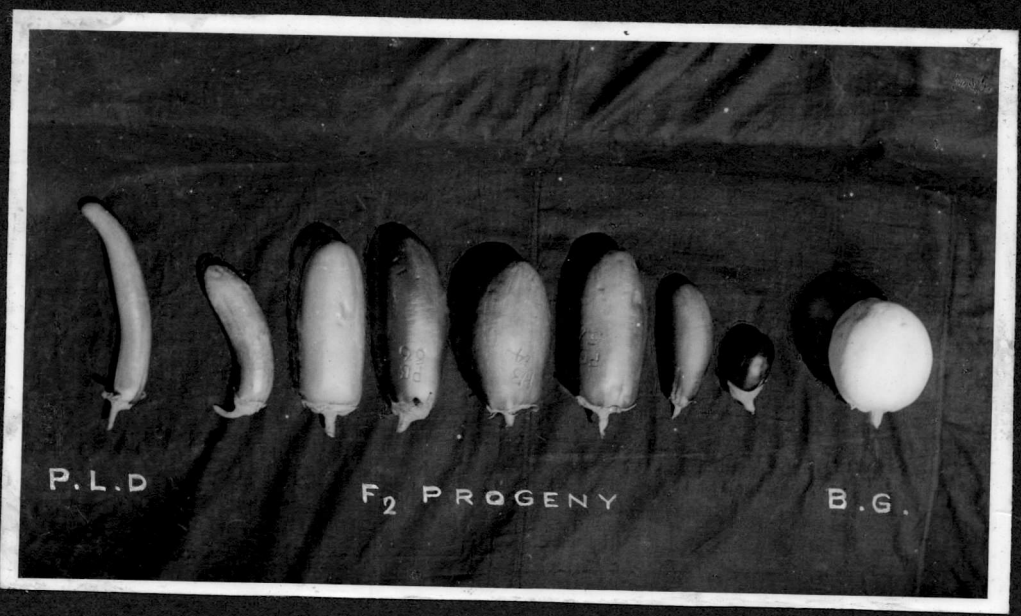
Plate 10

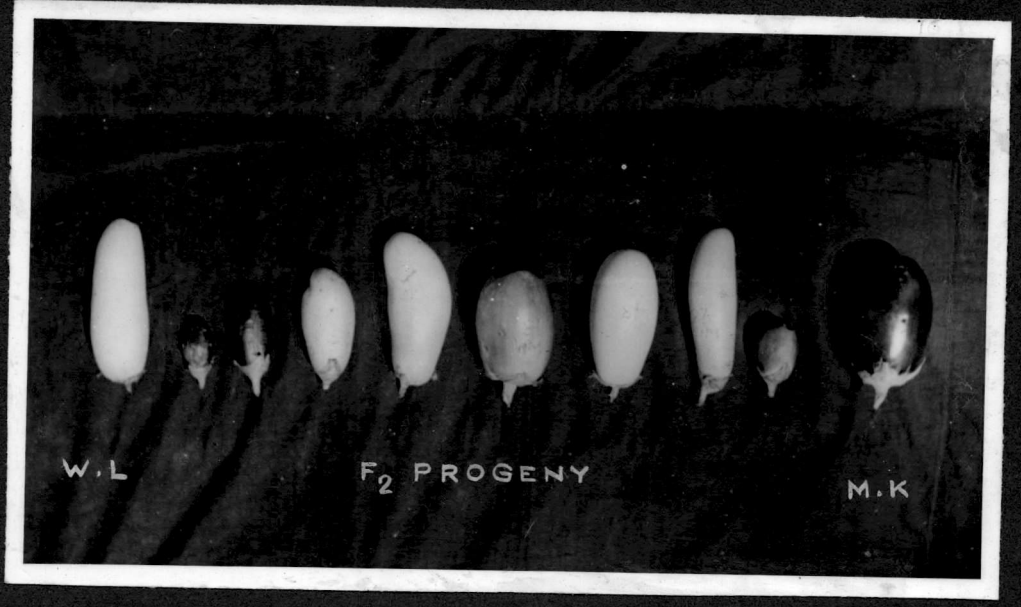
Photograph showing girth of fruits of parents and $F_2$

Cross 2 - WL x MK

WL = White Long - Female parent

MK = Muktakeshi - Male parent


P.L.D
F2 PROGENY
B.G.


W.L
F2 PROGENY
M.K