STUDY ON THE F_1 HYBRIDS

BETWEEN

CULTIVATED AND WILD BRINJAL VARIETIES

[*Solanum melongena*, Linn. (cultivars) X
Solanum melongena var. *insanum*, Prain.]

by

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THESIS

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CERTIFICATE

This is to certify that the thesis herewith submitted contains the results of bona fide research work carried out by Shri R. Gopimony, 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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C O N T E N T S

INTRODUCTION

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Hybridization between cultivated crops and their wild relatives is a potent tool in improving the cultivated varieties. It is usually observed that the wild parents compared to their related cultivars are more resistant to pests, diseases, drought and other similar unfavourable conditions. In a wide cross involving such wild plants and cultivated varieties we usually expect to incorporate the desirable genes of the wild relatives into the cultivars by genetic recombination in the segregating generations.

In many cases such hybridization works involving interspecific or similar alien crosses are not an easy task as various isolating mechanisms are in operation to keep the two groups of plants genetically apart. In this respect there is no absolute correlation between the degree of similarity in morphological characters and the effectiveness of isolation barriers between the two groups of plants. In certain inter-varietal crosses the F_1 hybrids are found to be sterile. At the same time certain interspecific crosses produced fertile F_1 hybrids, which have proved invaluable to the breeder.

The success of wide crosses depends mostly on the correct selection of the parents. In the present investigation a wild brinjal variety (*S. melongena* var. *insanum* Prain.), which usually grows as a weed on waste lands and road sides all over south India, was selected for hybridisation with brinjal varieties.

It was observed that certain economically important characters like hardiness, pest and disease resistance, increased branching, larger number of fruit production etc. are inherent in this wild plant. As a part of a long term breeding programme to transfer the above listed economic characters to the cultivated brinjal varieties the present investigation has been undertaken in the Agricultural Botany Division, Agricultural College and Research Institute, Vellayani. The aim of the work reported hereafter to raise the F_1 hybrids of all combination of crosses between the wild variety and a few commercially important cultivated brinjal varieties. Various aspects of the yielding capacity, pest and disease resistance, chemical composition and cytology of the F_1 hybrids compared to their parents are investigated in the present study.

REVIEW OF LITERATURE

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1. Taxonomic position of *Solanum melongena* Linn.

The cultivated Brinjal plant *S. melongena* Linn. belongs to Solanaceae which is an important family from the economic point of view, as it includes a large number of very useful and widely cultivated plants such as tobacco, potato and a number of popular vegetables such as tomato, brinjal and chillies.

The genus *Solanum* consists of approximately 2000 species out of which about 100 are tuberiferous and the rest non-tuberiferous. According to the classification of Wettstein (1897) the egg plant *S. melongena* and its wild relatives come under the sub genus *Leptostemonum*.

While the majority of the *Solanum* species are considered to have originated in the South and Central America, Filov (1940) and Coulter (1942) consider India as the centre of origin of *S. melongena*.

Bhaduri (1951) supported this view and pointed out the fact that a large number of cultivated and wild varieties of brinjal are found in the Indo-Burma region.

After the separation of new genus *Lycianthes* from *Solanum* by Hassler (1917), Santapau (1947) transferred 6 out of the total 28 Indian *Solanum* species to the new genus.

Bhaduri (1951) classified the remaining 22 Indian species into two natural groups or sections as (a) species which are without spines and (b) species which are armed with spines. Along with other 14 species the S. melongena Linn. comes under the group (b).

The species S. melongena Linn. has a large number of cultivated and wild forms or races recognised principally according to shape or colour of the fruits. Filov (1940) has classified these various forms on agro-ecological basis. According to Filov the different forms of S. melongena Linn. are grouped into 5 sub species. He considers that the wild form of these are found only in India. These forms which are characterised by extremely bitter and inedible fruits have been put under a separate sub species S. melongena s.sp. agrestis Fil.

2. Taxonomic position of S. melongena Var. insanum Prain.

Much confusion still exists with regard to the Taxonomic position of this wild variety of brinjal. Roxburgh as early as 1832 has described a wild variety of brinjal giving a distinct species status by naming it as S. insanum Roxb. Clarke (C.B.)(1883) has not separated this variety from the parent species S. melongena Linn. Prain (1903) made mention of a similar variety calling it S. melongena var. insana and described it as a very prickly herb with quite round fruits. He considers this form to be feral by reversion and does not represent a truly wild stock.

Gamble (1915) mentions of S. melongena var. insanum Prain. (S. insanum Willd.) and has given identical description as Prain, the fruit being a globose yellow berry under one inch in diameter. According to Bhaduri (1951) taking crossability as an index of measuring affinities between allied plants, S. melongena var. insanum is related to the cultivated type of S. melongena. He considers it as one of the nearest ancestors of the cultivated from S. melongena. The other probable ancestors listed out are S. melongena var. potangi, S. incanum L., and hybrids among these.

3. Crossability studies

Comparatively few reports have been known with regard to breeding behaviour of non-tuber bearing species. Eventhough some hybridization works at specific and sub specific level have been undertaken in the non-tuberiferous group of Solanum by different investigators, none of them was on an extensive scale as in tuberiferous group. The following will give an account of the various crosses attempted at inter generic, inter specific and intra specific levels and their results.

A. Inter generic

Only very few crosses have been done at intergeneric level involving Solanum and none of them has been successful.
Miwa et al. (1958) have done the following 5 intergeneric crosses involving Solanum.

(1) S. integrifolium x Petunia violacea.

(2) S. esculentum x L. esculentum.

(3) L. esculentum x S. melongena.

(4) Capsicum annuum x S. melongena.

(5) Capsicum annuum x S. integrifolium.

These crosses were possible only by hormonal treatments and in all the cases the F_1's were sterile.

A cross between S. pseudo capsicum and Capsicum annuum was attempted by Krishnappa and Channa Veeriah (1964) but found unsuccessful.

B. Interspecific

Jorgensen (1928) attempted a cross between S. nigrum ($n = 36$) and S. luteum ($n = 24$) and found the hybrids sterile. Sarvayya (1936) crossed S. xanthocarpum with S. melongena treating S. melongena as the pollen parent and the hybrids obtained were found to be partially sterile. Ellison (1936) attempted a cross between S. nigrum ($2n = 72$) and S. nitidibaccatum ($2n = 24$) and resulted in failure. Hagiwara and Iida (1938) and Tatebe (1939) effected successful cross between S. integrifolium and S.melongena using the latter as male parent, but the hybrid was reported as partially sterile by the former workers and completely sterile by the latter.

Paddock (1942 and 1943) crossed S. donglasii with S. nodiflorum and obtained male sterile hybrids. Tatebe (1944) effected crosses between S. melongena and S. tamago and also between S. integrifolium and S. tamago and found the hybrids were partially sterile. Westergaard (1948) effected two inter specific crosses, one using the mono basic and dibasic species of S. nigrum complexes and the other between S. adventitium and S. nitidibaccatum and the result in the former case was triploid sterile hybrids and in the latter the cross was unsuccessful. Swaminathan (1949), Mittal (1950) and Bhaduri (1957) effected all combination of crosses between the species S. incanum, S. xanthocarpum, and S. melongena (cultivar) and found the hybrids ranging from completely sterile to completely fertile ones. Miwa et.al. (1958) and Rai (1959) crossed S. integrifolium with S. melongena and obtained the same results as that by Hagiwara and Iida (1938). Rzhavitin (1958) effected a cross between S. guinense and S.luteum using S. luteum as male parent and obtained viable seeds and the F_2 plants were normal and well developed mostly resembling the female parent. Ramirez (1959) effected a cross between S.melongena and S. grandiflorum and obtained partially sterile hybrids.

Magoon et.al. (1962) have done the following crosses using 4 different solanum species and obtained the results as showed against each.

Cross	Results
1. S. incanum x S. melongena (cultivar)	Obtained fertile hybrids.
2. S. xanthocarpum x S. melongena (cultivar)	Obtained partially sterile hybrids.
3. S. xanthocarpum x S. indicum	Sterile hybrids.
4. S. indicum x S. melongena	Unsuccessful.

Nasrallah and Hopp (1963) tried the following crosses and obtained results as shown against each.

1. S. melongena x S. gilo	hybrids semi-sterile.
2. S. melongena x S. indicum	do.
3. S. melongena x S. mamosum	Unsuccessful cross.
4. S. mamosum x S. ciliatum	do.
5. S. melongena x S. ciliatum	do.
6. S. indicum x S. mamosum	do.
7. S. indicum x S. ciliatum	do.
8. S. gilo x S. mamosum	do.
9. S. gilo x S. ciliatum	do.

Capinpin, Lunde and Pancho (1963) obtained highly fertile F_1 and F_2 hybrids from the cross between S. melongena Linn. and S. cumingii Dunal each of which has 2n = 24 chromosomes.

Krishnappa and Chenne Veeriah (1964) attempted a large number of inter specific crosses using 6 different solanum species and obtained results as follows:-

Crosses	Results
1. S. indicum x S. melongena	Successful cross obtained in one variety of S. melongena. F_1 was intermediate for height fruit and calyx. F_1 was semi sterile and reciprocal cross unsuccessful.
2. S. aculeatissimum x S. khasianum	Got healthy seeds but F_1 plants could not survive.
3. S. khasianum x S. melongena	Partly successful. Reciprocal unsuccessful.
4. S. xanthocarpum x S. melongena	Weak F_1 plants which did not live long. Reciprocal unsuccessful.
5. S. torvum x S. indicum	Cross unsuccessful in both ways.
6. S. torvum x S. melongena	Not successful
7. S. khasianum x S. torvum	Resulted in immature fruits fall off after cross.
8. S. khasianum x S. indicum	Fruits developed with aborted seeds. In reciprocal not even fruit set.
9. S. indicum x S.aculeatissimum	Shrivelled seeds. No cross in reciprocal.

Babu Rao (1965) obtained fertile reciprocal hybrids of *S. melongena* (cultivar) x *S. melongena* var. *insanum* but in the crosses *S. incanum* x *S. melongena* (cultivar) and *S. melongena* var. *insanum* x *S. xanthocarpum* fertile hybrids were obtained only when the former parents were used as female. Rao (1966) obtained fertile hybrids from crosses of all combination between *S. melongena* (cultivar), *S. melongena* var. *insanum* and *S. incanum*. Popova and Georgiev (1966) obtained highly fertile hybrids from the cross between *S. melongena* (cultivar) and *S. gilo* and they selected 5 promissing strains from back cross generations.

Pal and Rajki (1966) also obtained fertile hybrids from the cross between *S. melongena* x *S. gilo* but only when *S. melongena* was used as the female parent.

C. Intra specific

Reports on intervarietal crosses in *Solanum melongena* are many, majority of which in connection with the study of heterosis. Here only those crosses involving taxonomically approved varieties of *S. melongena* are reviewed since there is a lot of confusion in the usage of varietal names of the cultivated brinjal.

Swaminathan (1949), Mittal (1950) and Bhaduri (1951) obtained fertile hybrids from the crosses among *S. melongena* var.

insanum and S. melongena var. potangi and S. melongena (cultivar). Argikar (1952) crossed a new variety S. melongena var. bulsarensis var. Argikar with few of the cultivated Gujarat varieties of S. melongena but failed to get fruit set.

Anonymous (1956) effected a successful cross between S. melongena var. Wynad giant and S. melongena (cultivar) and obtained fertile hybrids.

Rai (1959) obtained fertile hybrids from the cross between S. melongena var. insanum and S. melongena (cultivar).

Magoon et al. (1962) obtained fertile hybrids from the crosses among S. melongena var insanum, S. melongena var. potangi and S. melongena (cultivar).

Rajki cicer and Pal (1964) obtained fertile hybrids from the cross between S. melongena (Long purple) S.Sp. occidentale var. bulgaricum x S. melongena (White variety) S.sp. Sub spontaneum var. Liucoum.

Krishnappa and Chenneveeriah (1964) crossed different strains of S. indicum in all possible combinations and obtained results varying from cross unsuccessful to highly fertile hybrids. They also found that certain races of S. melongena failed to cross each other and set fruit.

At IARI, New Delhi, the crossability between different species available in the Solanum collection of the Plant Exploration

Section has been studied by Swaminathan (1949), Mittal (1950), Bhaduri (1951) and Swaminathan and Magoon (1962). The non-tuber bearing species of Solanum studied by these authors fall into two clear cut morphological groups. One with and one without thorns on the various parts of the plant especially stem, leaves, calyces etc. The two morphologically separate groups were shown to be also reproductively isolated. According to these authors the spine bearing species could be grouped into two classes from the point of view of crossability. In one the relationship appeared to be somewhat complex. This group includes S. melongena Linn; the cultivated egg plant though the cultivars of this variety are often completely devoid of thorn, and the wild forms such as S. incanum S. melongena Var. insanum, S. melongena Var. potangi etc. which are always armed with thorns. Except for S. indicum L. all the members of this group viz., S. melongena var. insanum Prains, S. incanum L., S. melongena Var. Potangi and S. xanthocarpum Schrad. and Wendl. cross easily with cultivated S. melongena. The inter specific cross however, succeeds only when the cultivated melongena is used as the pollen parent. These authors have pointed out that S. indicum was one of the most variable species in the genus Solanum.

4. Study of heterosis in Brinjal

The earliest recorded artificial hybridization in egg plant was those carried out by Bailey and Munson in U.S.A. in 1889. Their hybrids were intermediate between the parents. The first positive report of heterosis in egg plant came from Munson (1892). Subsequently Halsted (1918) reported that one of his crosses was double the size of the parents and also yielded more. Odland and Noll (1948) experimented with 16 hybrid types and recorded that in every case the hybrids out-yielded their respective parents besides being earlier. The percentage of increase ranged from 11 to 153. The mean of all the 16 hybrids over the mean of all the parents was 62.1. They also observed that the two parental lines with the lowest mean yields were able to combine to produce hybrids of excellent productivity.

In Philippines Bayla (1918) hybridized some local varieties and found that the hybrids were much more vigorous, stronger and healthier than the respective parental lines.

In Japan Nagi and Kida (1929) studied certain quantitative characteristics in the hybrids and found that heterosis was manifested in total yield, number of fruits/plant, earliness of blossoming, earliness of maturity, plant height, number of branches, number of spines on the pedicel, and the length of the fruit. No heterosis was found with regard to leaf length and breadth.

Kakizbaki (1929) made an experiment with 41 inter-varietal crosses of egg plants to found the utilization of hybrid vigour in commercial cropping and found heterosis in the following characters.

Comparing the seed weight of 28 crosses and their parental selfed seeds, most of the F_1 seeds were heavier. Similar effect of pollen parent on F_1 seeds was reported by Collins (1909) in Maize, Griffee (1922) in Wheat, and Tschermak (1922) in Beans.

Hybrid vigour was noted in stem diameter, height, earliness of production, yields, and greater vigour in growth of the hybrid seedlings. He also reported that the best hybrids were crosses between parents of widely divergent characters.

Sarvayya (1936) effected an interspecific cross between S. melongena (cultivar) and S. xanthocarpum and found that the hybrid was very vigourous in growth but the setting of fruit was very poor.

Pal and Singh (1946) from the study of certain intervarietal crosses of S. melongena found that majority of hybrids exhibited heterosis with respect to seed germination, height, spread, height and spread value, number of branches , earliness of flowering, number of fruits/plant, fruit size and yield.

Venkataramani (1946) reported hybrid vigour in height, spread, earliness and yield.

Lantican et al. (1963) observed hybrid vigour in the rate of growth of hybrid seedlings. They showed that the height of F_1 plants at maturity approached that of the taller parent, and the date of flowering was similar to the earlier parent.

Sambandam (1964) reported hybrid vigour in the reciprocal crosses of the Brinjal varieties for all the characters. There was no reciprocal difference except that in seed weight.

Rajkicicer and Pal (1964) in a cross between purple variety S. melongena S.sp. Occidentale Var. bulgaricam (L) and white variety S. melongena S.sp. subspontaneum var. leucoum (F) reported heterosis in both L x F and F x L combination, the greater yield by the result of mainly of an increase in number of fruits in L x F and of an increase in fruit size in F x L.

Babu Rao (1965) reported heterosis in certain characters like number of branches, number of flowers, percentage of fruit set, and number of fruits/plant in certain inter specific hybrids of Solanum.

Narasimha Rao (1966) reported heterosis for fruit setting, leaf width, flower production, flower diameter, fruit production and percentage of fruit set in a cross between a cultivated brinjal variety and two wild brinjal plants.

From a detailed study of F_1 hybrids of 8 crosses involving 5 parental varieties of Brinjal, Viswanath (1967) reported hybrid vigour in plant height, number of branches, number of leaves, spread, earliness, number of flowers, number of fruits, size and weight of fruits, weight and number of seeds and pollen diameter.

5. Inheritance of certain characters

1. Pigmentation

Bailey (1892) found that hybrids between green stemmed white fruited varieties and purple stemmed very dark purple fruited parents had purple tinged stem and fruits were usually purple with lighter apex. Halstead (1918) noted that purple fruit pigmentation could be formed either dependently or independently of light. He also reported that the purple colour disappears to a large extent if not totally as the fruit matures and is replaced by a dull yellow and that purple colour is dominant to white. As regards to other types when striped fruit groups were crossed with white sorts, the F_1 was slightly striped and when the striped variety was crossed with purple one the F_1 was solid purple and only a small fraction of striped fruited plants in F_2 were obtained, indicating its recessiveness. When long white was crossed with dwarf purple all the fruits in F_1 were purple but in F_2 four types were secured namely purple, pink, green and white in the ratio 9:3:3:1 suggesting two factors governing the colour. Nolla (1932) reported that plant, fruit and corolla colour and striping of anthers were simply inherited showing 3:1 ratio in F_2 with colour and striping being dominant over absence of colour and nonstriping.

Tatebi (1936) reported that purple plant colour of egg plant was dominant over green of scarlet egg plant.

Tatebe (1944) used four different egg plant varieties having 4 different colour patterns for crossing experiments to study colour inheritance and obtained the following results. Purple colour is dominant over green variegated and green variegated is dominant over white. But between green and green variegated the inheritance pattern showed much complexities. Paul and Singh (1946) reported that intensity of purple colour in F_1 was intermediate between the parents.

Nolla (1961) reported that red, purple and pink fruit colour was dominant over green. Janick and Topoleski (1963) reported that the F_1 of a cross between purple x green was intermediate i.e., violet and no pigment developed under the calyx indicating pigment development was dependent on light.

2. <u>Fruit shape</u>

Tatebe (1943) reported that in crosses between round and long fruited egg plants that F_1 had born fruits approximating to the geometric mean of the fruit of the two parents.

Khan and Ramzan (1953) estimated 5 pairs of genes to be governing the fruit shape. Capinpin, Lunde and Pancho (1963) reported that F_1 hybrids were intermediate between the parents in fruit shape.

3. Other characters

Tatebe (1936) observed adventitious roots on the part of the shoots of F_1 of the cross S. integrifolium x S. melongena which is a characteristic of tomato but of neither of the parents.

Hagiwara & Iida (1938) had shown that the presence of spines on the stem, leaf and oblate shape of the fruit of S. integrifolium were dominant in a cross between S. intergrifolium and S. melongena. Khan and Ramzan (1933) had shown that spiny condition was monogenically dominant over smoothness. Janick and Topoleski (1963) reported that pubescent leaf surface was dominant to glabrous nature. Capinpin, Lunde and Pancho (1963) reported that spiny stem was dominant over nonspiny stem and the character was monogenically inherited.

6. Floral biology and fruit set in egg plant

Smith (1931) and Magtng (1936) classified the flowers of egg plant with regard to the position of the stigma in relation to anther tips into long and short styled flowers and had shown that almost all fruits were formed only from long styled flowers.

Pal and Singh (1943) have further classified the short styled into true short styled and pseudo short styled based on the measurement of style and indicated that only the long styled and pseudo short styled flowers normally produced fruits while the short styled ones are seldom fertile.

Krishnamoorthy and Subramoniam classified the flower types in brinjal into 4 groups as follows:-

1. Short styled - Style is rudimentary
2. Pseudo short styled - Stigma comes upto ½ way of the anther length
3. Long styled - Stigma comes well above the anther tip
4. Medium styled - Stigma comes upto the anther tip level

They showed that under natural conditions 27 per cent of flowers set fruits and 93 per cent of these came from longstyled flowers.

Popova (1962) showed that the highest percentage of fruit set was observed when the stigma was above the anther tips. Sambandam (1964) reported that in egg plants the natural crossing is from 0.7 per cent to 15.0 per cent of which an average of 4.4 per cent was intra plant crossings and an average of 6.7 per cent was inter plant crossings. Bhore, Bhapkar and Chavan (1965) in an experiment to find the best method of selfing in brinjal found that the embroidery cloth bags gave the highest fruit set i.e., 83.3 per cent followed by perforated butter paper bags giving 56.6 per cent. Pal and Osvald (1967) reported that the percentage of fruit set in an interspecific cross between S.melongena (cultivar) x S. gilo increase by 2 - 3 folds by excission treatments on the pistil.

Quagliotti (1967) reported that the number of flowers produced in egg plants was the maximum at a plant age of 201 to 208 days.

7. Earliness and fruit bearing habits

Schmidt (1935) reported that the character of earliness was dominant and transgressive in certain egg plant crosses. Inouye (1936) had reported a variety producing twin fruits and this character was found to be dominant. Reddi and Subramoniam (1954) had noted cluster bearing habit in a variety called "Guttivanga". Nassarallah and Hopp (1963) showed that the cluster bearing habit of *S. gilo* which behaved as dominant could be transferred to the egg plant and suggested its practical utility in breeding programme. Sahakyan (1966) from an inter varietal crossing of tomato reported that hybrids had higher early fruit yields than both parents.

8. Study on pest and disease resistance

Davidson (1935) reported that in egg plants usually the green varieties are highly resistant to wilt diseases. Hutton, Mills and Giles (1947) have undertaken a study on the crosses of standard tomato varieties with 'Pan American' variety which has shown that the latter is valuable as a means of breeding for field immunity to Fusarium wilt in Australia combined with good commercial characters. In F_1 field immunity was completely dominant to susceptibility. In F_2 generation a preponderence of field immune segregants was obtained so that the expected 3:1 ratio was exceeded. In the cross the immune varieties were used as male parents. Sinclair and Walker (1955) in a study of inheritance of resistance to mosaic virus in cowpea have reported that resistance is determined by a single dominant gene. Clarke (1955) in a study of some aspects of tomato breeding has reported that in a cross of commercial varieties of tomato with disease resistant materials like certain Canadian varieties of tomato and the species Lycopersicon pimpinellifolium, resistance was dominant and apparently linked with a tendency to produce small fruits. Ramirez (1959) suggested that hybridization between egg plant and S. grandiflorum Hort. might be useful in introducing a perennial habit and resistance to certain pests and diseases in egg plant.

Srinivasan and Basheer (1961) reported that out of 22 brinjal varieties tried for borer resistance Cluster White (H. 128) and I.C. 1855 (H. 129) produced largest number of uninfested fruits per unit area. Suzuki, Sugahara, Kotani, Todaka and Shimada (1964) in a study on breeding egg plant and tomato for resistance to pseudomonas solanacearum, reported that in both crops the resistance appeared to be determined quantitatively. Acosta, Gilbert and Qinon (1964) in a study of heritability of bacterial wilt resistance in tomato reported that at an early stage of growth there was some evidence for partial dominance of resistance genes in F_1. In mature plants, they reported that resistance appeared to be controlled by recessive genes. In a cross between T.M.V. susceptible tomato cultivars and resistant strains Davis and Webb (1966) reported that F_1 showed a degree of resistance typical of the resistant parent. Cirulli and Alexander (1966) reported that a single dominant gene was responsible for resistance to the five strains of T.M.V. in tomato. In a study of inheritance of disease resistance in tomato Randall (1966) reported that resistance was associated with many morphological characteristics. Suzuki _et al._ (1967) suggested that bacterial wilt resistance in certain egg plant varieties was hereditary.

9. _Chemical studies_

Seven distinct genera of Solanaceae yield the alkaloid called Hyoscyamine, the form in which Atropine occurs in nature. Vincent and Mathou (1946) reported that in Solanaceae the root plays an essential role in the genesis of specific alkaloids. Choudhary, Vishwapaul, and Handa (1958) have studied the nature of alkaloid contents in the berries of three Indian _solanum_ species namely, _S. indicum_, _S. luteum_ and _S. verbascifolium_. The author found that all the 3 species contained the gluco-alkaloid solasonine, which on hydrolysis with 5 per cent hydrochloric acid yielded the alkaloid solasodine.

Mishra (1962) from a preliminary chemical studies in 4 varieties of brinjal and their F_1 hybrids reported that the hybrids showed 16 - 28 per cent increase in total solid percentage, a lesser acid content, and 6 out of 8 had a higher vitamin C content. But no significant difference was noted between hybrids and parents in sugar contents.

10. Cytology

Kojima (1925) showed that different varieties of S. melongena cultivated in Japan has 2n = 24. Vilmorin and Simonet (1927) made one of the earliest reports regarding the chromosome number in non-tuber forming Solanum species when they recorded a diploid number of 24 in about 10 different species.

Jorgensen (1928) reported the existence of species with 48 and 72 somatic chromosomes in some of the unarmed species especially those belonging to the section Morellae. Bhaduri (1933) reported the gametic number as n = 12 in 4 solanum species i.e., S. trilobatum, S. indicum, S. torvum, and S. verbascifolium. Tokunga (1934) reported n = 24 in S. miniatum and 3 n = 36 in S. nigrum. In IARI, New Delhi, Magoon and Swaminathan (1962) showed 24 to be the somatic number in several species of solanum.

Janaki Ammal (1934) could recognise atleast 5 different types of chromosomes in the mitotic plates of S. melongena. In the early stages of meiosis 5 different length groups all with median centromere could be recognised by her. She points out that a single long chromosome stands out conspicuously in all the cells at different stages of meiosis. Such a long chromosome is characteristic to many genera of the family as observed by Larley (1926) in tomato, by Belling and Blackeslee (1923) in Datura and by Janaki Ammal (1932) Nicandra.

Janaki Ammal (1934) has recorded regular meiosis in S. melongena (2n = 24). Studies conducted at the Bose Research Institute, Calcutta showed that meiosis was normal in a number of solanum spp. But there are contradictory reports as recorded by Jorgensen (1928) and Stebbins and Paddock (1949). They found occassional formations of multivalents and univalents in certain Solanum species.

Swaminathan and Magoon (1962) reported the constant occurrence of a closed type of ring in an inter specific cross between S. torvum x S. hispidum and concluded that the two morphologically allied species differ by a segmental interchange. Rai (1959) studied the chromosome morphology in 8 melongena varieties including one wild insanum and also two intervarietal crosses. In all varieties the diploid number of chromosome was found to be 24. Out of this two medianlly constricted chromosome bear satellites. He also reported that in some cells of var. insanum (small leaf) an acentric fragment was clearly observed. The nucleoli found in the variety was six as in some other cultivars. In every case a single large nucleoli eventually resulted from their fusion.

MATERIALS AND METHODS

MATERIALS AND METHODS

The present study was undertaken in the Division of Agricultural Botany, Agricultural College and Research Institute, Vellayani during the year 1967-'68. The experiment was spread over two seasons, May - September and October - February.

A. Materials

Materials involved in the present investigation consists of 4 different varieties of Solanum melongena L. (cultivars) and one wild brinjal variety, S. melongena Var. insanum Prain. The 4 varieties of cultivated brinjal was (1) Round Special, (2) Round Mixed, (3) Purple Long Datta and (4) Thorny Giant. Pure seeds of these four varieties were obtained from the Division of Botany, Agricultural College and Research Institute, Vellayani. The variety mentioned as 'Thorny Giant' is an unidentified brinjal variety found growing as a stray plant along with one of the other varieties and the progenies of this plant was found to be true breeding. This plant is highly spinous and the fruits are very big, globose and greenish in colour and hence given the name 'Thorny Giant'.

The seed of the wild brinjal variety, S. melongena var. insanum Prain. (Syn. S. insanum Willd.) used in the present study was locally collected. The morphological description of the parents is summarised in Table I.

TABLE I

	Parents				
	Round Special (cultivar)	Round Mixed (cultivar)	Purple Long Datta (cultivar)	Thorny Giant (cultivar)	*S.melongena* var. *insanum* (wild)
1. Habit	Errect and bushy	Errect and bushy	Errect, bushy and open	Errect and bushy	Highly spreading
2. Plant height (Mean)	67.95 cm.	58.40 cm.	75.90 cm.	52.00 cm.	30.6 cm.
3. Stem colour	Green	Green	Light purple on lateral branches	Green	Purple pigmented
4. Foliage colour	Green	Green	Dark green with purple tints and purple veins	Green	Dark green with purple veins.
5. Leaf size and shape	Medium, elliptic	Medium, elliptic	Large, elliptic	Large, elliptic	Small ovate
6. Spines	Spineless	Spineless	Spineless	Pigment free spines on stem, leaf and calyx	Pigmented spines on leaves, stem and calyx
7. Inflorescence	Solitary	Solitary	Solitary	Solitary	Usually solitary rarely in cymes.
8. Flower colour	Light purple	Light purple	Purple	Light purple	Purple
9. Stigma colour	Green	Green	Purple	Green	Green
10. Fruit shape and colour	Medium globose, with purple streakes on white, turning yellow on ripening	Medium globose, with purple and green streakes on white, turning yellow on ripening	Long, deep, purple, turning dull yellow on ripening	Large globose, green check on white turning yellow on ripening	Small globose, green check on white, turning yellow on ripening

B. Methods

1. Technique of selfing and crossing

Under Vellayani conditions the time of flower opening and dehiscence of anthers were simultaneous and found between 7 and 10 A.M. Crossing and selfing were done during 8 to 8.30 A.M.

The following method was adopted for crossing. In the evening of the day previous to crossing, the correct sized buds that appear bulged and purple in colour which would open next day were selected and with the help of a fine pointed dissecting needle a longitudinal split was made on the Corolla. Then using a pair of pointed forceps the anthers were removed one after another. Utmost care was taken not to injure any other floral parts including the removed anthers. After ensuring the stigma to be free from pollen the emasculated flower buds were covered with a butter paper bag and pinned the free end of the bag to prevent contamination with foreign pollen. Some matured flower buds which would open next day were selected from the male parent and bagged in the same evening as a safeguard against any admixture of pollen.

Next morning at about 7 A.M. the protected flower buds from the male parent plant were plucked and kept in a petridish in which a little water was sprinkled to keep up the humidity. Then a few anthers were taken out and a longitudinal split was made on it using the needle and the outcoming white powdery pollen grains were dusted gently over the stigma of the emasculated flower bud on the female parent plant using a camel hair brush. Dusting was done between 8 A.M. and 8.30 A.M. After pollination the flower buds were again bagged and labelled. The bags were removed only after 7 days.

In order to get selfed seeds of the parental varieties, in each case 5 well developed long-styled flower buds which would open the next day were covered with butter paper bags in the previous evening and labelled. The bag was allowed to remain for 3 to 4 days until all the flower parts except the ovary had fallen off. The bag was then removed after tying the label on the developing fruit.

The fruits of both selfed and crossed flowers were harvested when completely matured, the maturity being judged by the standard ripening yellowish tinge of the rind of the variety. The seeds were then extracted, cleaned, dried and stored.

The details of crosses effected are given in Table II.

Table II

Sl. No.	Female parent	Male parent	No. of flowers crossed	No. of fruits obtained	Remarks
1	Purple Long Dutta	S. melongena Var. insanum	3	2	
2	Round Mixed	"	3	3	
3	Long Green Cluster	"	2	1	Fruit lost due to borer attack
4	Mukthakeshi	"	2	1	Fruit lost due to wilt
5	Banaras Giant	"	2	1	Fruit lost due to wilt
6	Early Round Market	"	3	2	Fruit lost due to wilt
7	Thorny Giant	"	3	2	
8	White Long	"	3	2	Fruit lost due to wilt
9	Round Special	"	3	1	
10	S. melongena Var insanum	Thorny Giant	3	3	Small fruits found without any seeds

Out of the 10 crosses effected seeds were obtained only from 4 crosses. In all other cases the fruit was lost either due to borer attack or due to wilt. From the cross (No. 7) Thorny Giant x S.m. var. insanum eventhough viable seeds were obtained, the seedlings failed to establish and 2 weeks after germination they declined and dried off.

2. Field plot technique and study of the F_1 generations

The study of the F_1 generation of plants along with their parents was conducted under the following major heads.

I. Morphological studies

II. Study on insect resistance

III. Study on wilt disease resistance

IV. Chemical studies

V. Cytological studies

The methods adopted for each of the above studies are detailed below:-

I. Morphological studies

1. Lay out

The experiment was laid out in a randomised block design with two replications. In each replication there were 9 plots. The hybrids were planted in the middle with the respective male and female parents flanked on either side. Each plot consisted of 2 rows of 3 plants, each planted 1 meter apart, thus a total of six plants in each plot.

2. Treatments

The seven treatments consisted of 3 F_1 hybrids and 4 parents as follows:-

Parents: Treatment I. S. melongena (cultivar) (Round Special)

" II S. melongena (cultivar) (Round Mixed)

Parents: Treatment III. *S. melongena* (cultivar) (Purple Long Dutta)

,, IV. *S. melongena* Var. *insanum*

F_1 hybrids

Treatment V. F_1 of *S. melongena* (cultivar) (Round Special) x *S. melongena* Var. *insanum*

,, VI. F_1 of *S. melongena* (cultivar) (Round Mixed) x ,,

,, VII. F_1 of *S. melongena* (cultivar) (Purple long Dutta) x ,,

For the sake of convenience the parents are represented as follows.

1. *S. melongena* (cultivar) (Round Special) - RS
2. *S. melongena* (cultivar) (Round Mixed) - RM
3. *S. melongena* (Purple Long Dutta) - PLD
4. *S. melongena* Var. *insanum* - SI

3. Nursery

Well developed good seeds from the 3 crosses and 4 parents were separately sown in pots of 50 cm. x 50 cm. The pots were filled up with standard pot mixture and seeds were sown at the rate of 100 seeds per pot.

4. Transplanting

Thirty days after sowing healthy and vigorous seedlings of uniform growth were selected for transplanting in the main field. Before transplanting the main field was thoroughly prepared and levelled. Small pits were taken in rows of 1 meter apart at a spacing of 1 meter between pits. Then the pits were burnt with dry leaves as a preventive measure against bacterial wilt. One small basketful of farm yard manure was applied as basal dressing in each pit and mixed well with the soil. Then two seedlings were planted in each pit.

15 days after transplanting when the seedlings had established well, thinning was done leaving only one healthy seedling in each pit. Standard vegetable mixture (12:24:12) was applied twice as top dressing, the first 25 days after transplanting and the second after 60 days at the rate of 2 ounce/plant each time. The crop was regularly irrigated twice every day.

Observations on the following characters were recorded for both the F_1 hybrids and the parents.

A. Quantitative characters.

(1) Number and weight of F_1 and parental seeds.

(2) Germination capacity of F_1 and parental seeds.

(3) Root length of seedlings.

(4) Height of seedlings.

(5) Height of plant.

(6) Number of branches.

(7) Number of leaves.

(8) Spread of plants.

(9) Internodal length.

(10) Area of leaves.

(11) Flower size.

(12) Time of flowering.

(13) Number of flowers.

(14) Percentage of fruit set.

(15) Number of total fruits.

(16) Size and weight of fruits.

(17) Number and weight of F_2 seeds.

(18) Germination capacity of F_2 seeds.

(19) Length of tap root.

The details of observations taken in each cases are given below:-

(1) Number and weight of F_1 and parental seeds

The number of seeds in the crossed and selfed fruits was counted. For finding the weight of seeds 3 samples of 200 seeds each was taken from each treatment and weighed in a chemical balance and the weights recorded.

(2) Germination capacity

For finding the germination capacity a random sample of 100 seeds from each treatment was placed in petridishes containing moist blotting paper. The number of seeds germinated after 48 hours was counted on every day for 15 days and the percentage of germination calculated.

(3) Root length of seedlings

The root length of a random sample of 12 seedlings from each of the seven treatments was recorded. The measurement was done on the 30th day of sowing.

(4) Height of seedlings

The height of seedlings was also taken on the 30th day of sowing. The measurement was taken for a random sample of 12 seedlings (the same on which root length was taken) for each of the seven treatments.

(5) Height of plants

Measurements were taken from the ground level to the top most bud leaf of all the six plants in each treatment by a meter scale. The first observation was taken on the 20th day after transplanting and the subsequent ones at 10 days intervals. The last one was taken on the 70th day. The mean of 12 plants was taken and recorded.

(6) Number of branches

While counting the total number of branches both primary, secondary and tertiary branches were taken into account. The same method, as in the case of height of plant was adopted. The mean of 12 plants was taken and recorded.

(7) Number of leaves

Total number of leaves on all the plants in each treatment was counted at each observation, as in the case of height of plants.

(8) Spread of plants

Observations were recorded on the 60th day after transplanting when the plant attained full growth. Measurement was taken in the direction where there was maximum spread of plant.

(9) Internodal length

Observations were recorded on the 60th day after transplanting. The length of 5 randomly selected internodes in each plant was measured and recorded.

(10) Area of leaves

This observation was also taken on the 60th day after transplanting. In each plant the length and breadth of 5 largest leaves were taken to find the area of the leaf. It was found that the area of any leaf similar to the shape and size of brinjal plant was equal to length x breadth/1.5 expressed in sq. cm. when the measurements were in cm. The length was taken as from the tip of the petiole to the tip of the leaf and the breadth as on the middle of the leaf having the maximum width. The mean of the 12 plants in each treatment was taken and recorded.

(11) Flower size

The diameter of the corolla was measured from the tip of one lobe to the tip of the opposite lobe. In each plant the observation was taken for 5 random flowers and the mean of 12 plants was taken and recorded.

(12) Time of flowering

The total number of days for sowing to the first flower blooming was calculated and recorded for each plant in each treatment. The mean of 12 plants was taken and recorded.

(13) Number of flowers

In the present study only three different types of flowers were recorded viz., long styled, medium styled and short styled. The number of flowers in each category was counted, starting from the commencement of flowering till its completion. The counted flowers were marked by tying three different coloured threads on the pedicel of each category.

(14) Percentage of fruit set

7 days after the last observation of flower count was taken the total number of fruits was counted in each plant and percentage of set was calculated as the number of fruit set over the total number of flowers.

(15) Number of total fruits

The total number of fruits set from long styled and medium styled flowers was separately counted. This observation was taken when the first phase of flower production was over.

(16) Size and weight of fruits

Six random fruits from each plant were selected and their length and maximum girth were measured.

Mature fruits suitable for vegetable purpose were harvested periodically and the total weight of fruits obtained from individual plants was recorded separately and the mean of 12 plants worked out and recorded.

(17) Number and weight of F_2 seeds

One well ripened fruit from each plant was selected at random and seeds were extracted carefully and their number counted. 3 samples of 200 seeds from each treatment were taken and weight recorded.

(18) Germination capacity of F_2 seeds

3 samples of 100 well developed seeds from each treatment were counted out and placed in petridishes containing moist blotting paper. The number of seeds germinated was counted after 14 days and the percentage of germination calculated.

(19) Length of tap roots

This observation was taken after the last harvest was over. Each plant was uprooted without breaking the roots and then the total length of the tap root starting from the collar region to the tip was measured and recorded.

B. Qualitative characters

The following qualitative characters were studied.

1. Habit.
2. Colour of foliage.
3. Colour of stem.
4. Presence or absence of prickles.
5. Colour of prickles.
6. Flower bearing habit.
7. Colour of corolla.
8. Fruit shape and colour.
9. Fruit colour at maturity.
10. Fruit bearing habit.

Statistical procedure

For the comparison of the F_1 hybrids with their parents and parental means, the mean of the observations from the 12 plants in a treatment was taken and where the variances were same the T-test, and where the variances were not same the Fisher Behren's test, were applied.

II. Study on insect resistance

The comparative resistance of the 4 parents and 3 F_1 plants against 4 important pests of brinjal was studied. The 4 insect pests studied were (1) Aphis and jassids (2) Epilachna beetles (3) Shoot borers (4) Fruit borers.

For this study a separate experiment was laid out in a randomised block design with 3 replications. In each replication there were 7 treatments, the 4 parents and the 3 hybrids. Preparation of land, transplanting, manuring etc. were done exactly like in the other experiment already explained. The natural infestation of pests was studied. In order to enhance the natural infestation plant protection measures were completely avoided for the plants raised in this experiment.

The following observations were taken.

(1) Jassid and Aphis count

The first count was done on the 45th day after transplanting. The number of Jassids found on the top 4 leaves of each plant was counted. This was repeated twice at 15 days intervel and the average of the 4 plants in a plot was recorded.

(2) Epilachna count

The first count was done at the 45th day after transplanting and repeated twice at 15 days intervel. The total number of Epilachna beetles (both grubs and adults) in each plant was counted and the average of the 4 plants in a plot was recorded.

(3) Shoot borer attack counts

This count was done on the 75th day after transplanting. The total number of shoots affected in a plant was counted and the average of the 4 plants in a plot was recorded.

(4) Fruit borer attack counts

This observation was taken on 75th day after transplanting. The number of attack was taken by counting the total number of bores on the fruits in a plant. The average of the 4 plants in a plot was recorded.

III. Study on wilt disease resistance

For this study a pot culture experiment was layed out using a total of 54 pots of 50 cm. x 50 cm. The three female parents of the cultivated brinjal varieties were grown in 18 pots, giving 6 pots for each variety. The 3 F_1 hybrids were grown in another 18 pots giving 6 pots for each hybrid. The male parent, wild brinjal (*S. melongena* var. *insanum*) was grown in the remaining 18 pots. The pots were arranged in such a manner that the F_1 hybrids were in the middle flanked on either sides by the male and female parents.

For filling the pots sick soil collected from the spots in the vegetable field where brinjal plants were affected by wilt disease recently, was used. No organic manure was applied as an aid to enhance the susceptibility. In the pots filled with the sick soil one month old seedlings were transplanted. One month after transplanting the standard vegetable mixture was applied @ 2 oz/plant. The watering was limited to the minimum for enhancing the susceptibility of the plants. The number of plants wilted were noted as and when wilting was noticed.

IV. Chemical studies

In order to ascertain the nutritive value of the parents and the hybrids the dry matter percentage, the protein content, starch and total alkaloids were estimated.

For all these estimations the powdered dried fruit material was used. The dry matter percentage was found out by taking the initial weight of sliced marketable fruit samples and then the final weight after 3 days drying in bright sun.

The protein content was found out by estimating the nitrogen percentage and then converting it to protein percentage by multiplying with the factor 6.25. The starch content was estimated by the usual Fehling's solution method and was expressed as percentage in the raw fruit.

The total alkaloid was estimated by using the method described by Dunstan and Ransom.

V. Cytological studies

(a) Pollen size

Slides of fresh pollen grains were prepared in glycerine aceto carmine medium. The size of the pollen grain was measured by an occular micrometer. The diameter of one hundred pollen grains taken at random was measured and the mean worked out.

(b) Pollen sterility

Acetocarmine staining method was used to study 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 taken as fertile ones while those which took little or no stain were taken as sterile ones. Sterile and fertile pollen grains were counted from 30 microscopic fields and the percentage of sterility was calculated.

(c) Studies on pollen mother cells

In order to ascertain the meiotic behaviour of the F_1 hybrids and parents, studies on pollen mother cells were undertaken.

From experience it was found that the best time to fix flower buds for meiotic studies in PMC of brinjal was 10 - 12 A.M. Flower buds of appropriate size were collected and fixed in 3:1 mixture of ethyl alcohol and Acetic acid and kept in frigid for 12 to 24 hours. After that the buds were washed in water and preserved in 70 per cent ethyl alcohol. Meiosis was studied in temporary acetocarmine smears of pollen mother cells. A few permanent slides were also prepared for taking photographs.

EXPERIMENTAL RESULTS

EXPERIMENTAL RESULTS

I. MORPHOLOGICAL STUDIES

A. Quantitative characters

1. Number and weight of F_1 and parental seeds

The seeds collected from the crossed and selfed fruits were kept for 15 days in a dry cool place before sowing. The number of seeds per fruit and the weight of 200 seeds in each case are given in table III.

TABLE III

Mean number of seeds/fruit and mean weight of 200 seeds of the crossed and parental fruits

Treatments	No. of seeds/fruit			Weight of 200 seeds in grams		
	Mean	Mean increase or decrease (in %) of F_1 over		Mean	Mean increase or decrease (in %) of F_1 over	
		Brinjal parent	Parental mean		Brinjal parent	Parental mean
RS	1672			0.581		
RS x SI	762	-54.43	-37.28	0.780	+ 34.25	+ 43.12
RM	1360			0.475		
RM x SI	536	-60.63	-49.38	0.782	+ 64.64	+ 58.95
PLD	1264			0.670		
PLD x SI	281	-77.76	-72.20	0.935	+ 39.56	+ 58.76
Thorny Giant	2320			0.505		
Thorny Giant x SI	872	-62.41	-43.91	1.090	+115.84	+114.98
SI	758			0.509		

From the data presented in table III it can be seen that in all the crosses the number of seeds per crossed fruit was very much less than that in the selfed fruit of the respective brinjal parents and the parental means.

The percentage of decrease of F_1 over the brinjal parents vary from as high as 77.76 in the case of PLD x SI to 54.43 in the case of RS x SI.

In the case of the weight of seeds, all the crosses showed a high percentage of increase over the brinjal parent varying from 34.25 in the case of RM x SI to 115.54 in the case of Thorny Giant x SI. All the crosses showed an increase in seed weight over their respective parental means, varying from 43.12 per cent to 114.98 per cent in the same crosses as above.

2. <u>Germination capacity of F_1 seeds and the parental seeds</u>

The results are tabulated in table IV.

Among parents Round Special gave highest germination percentage being 100 and the lowest by <u>Solanum melongena</u> var. <u>insanum</u> being 15. It was also noted that the seeds of <u>Solanum melongena</u> var. <u>insanum</u> germinated only after 15 days. This delay was suspected to be due to the hard seed coat and hence hot water treatment was given to it by putting the seeds in a mixture of $\frac{1}{2}:\frac{1}{2}$ boiled and cold water for one night and then kept in moist blotting paper in petridishes. The treated seeds gave as high as 100 per cent germination. To get sufficient number of seedlings in the nursery this hot water treatment was given to S.I.

Among the F_1s, RS x SI gave the highest percentage of germination followed by RM x SI and PLD x SI. The lowest percentage was found in the cross between Thorny Giant and SI (34%). The

TABLE IV

Table showing germination capacity of F_1 and parental seeds.

Treatments	Number of seeds germinated out of 100														% of germination
	48 hours	3 days	4 days	5 days	6 days	7 days	8 days	9 days	10 days	11 days	12 days	13 days	14 days	15 days	
RS	58	74	89	100	100	100	100	100	100	100	100	100	100	100	100
RS x SI	50	68	88	98	98	98	98	98	98	98	98	98	98	98	98
RM	33	67	70	72	82	82	82	82	82	82	82	82	82	82	82
RM x SI	34	66	82	96	96	96	96	96	96	96	96	96	96	96	96
PLD	21	51	68	70	76	76	76	76	76	76	76	76	76	76	76
PLD x SI	35	55	65	78	78	78	78	78	78	78	78	78	78	78	78
Thorny Giant	31	56	66	74	75	75	75	75	75	75	75	75	75	75	75
Thorny Giant x SI	Nil	Nil	Nil	Nil	8	17	23	25	34	34	34	34	34	34	34
SI	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	15	15

seedlings from this cross never grew beyond the 2 leaf stage and about 30 days after sowing all of them withered and dried off.

3. Root length of seedlings

The results are tabulated in table V.

TABLE V

Mean root length of the seedlings of F_1 hybrids and parents (in cm.) on 30th day of sowing

Treatments	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	8.46	6.0-12.5	1.91			
RS x SI	21.17	17.0-26.5	2.81	+150.2**	+79.2**	T-test
RM	12.87	6.5-17.0	3.51			
RM x SI	23.31	17.5-30.5	4.31	+ 81.03**	+61.1**	T-test
PLD	8.96	6.0-14.0	2.55			
PLD x SI	22.96	17.5-26.5	2.66	+156.2**	+89.8**	T-test
SI	15.25	9.0-20.0	3.53			

** Significant at 1% prob. level

From table V it can be seen that in all the 3 crosses the increase of tap root length of the F_1s over their respective brinjal parents and parental means was highly significant. The maximum increase was shown by PLD x SI (156.2% and 89.8%) followed by RS x SI (150.2% and 79.2%) and RM x SI (81.03% and 61.1%).

4. Height of seedlings

The results are tabulated in table VI.

TABLE VI

Mean height of seedlings of F_1 hybrid and parents (in cm.) on 30th day of sowing

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over: Brinjal parent	Mean increase or decrease (in %) of F_1 over: Parental mean	Test applied
RS	10.30	7.5-12.5	0.81			
RS x SI	10.20	7.0-13.0	0.85	- .97	+71.43**	T-test
RM	9.51	7.0-11.5	0.63			
RM x SI	8.62	7.0-10.0	0.61	-9.35**	+55.03**	T-test
PLD	6.21	4.5- 7.5	0.53			
PLD x SI	7.71	7.0- 8.5	0.62	+24.18**	+97.18**	T-test
SI	1.61	1.0- 2.0	0.30			

** Significant at 1% prob. level

Among the parents Round Special showed the maximum seedling growth followed by RM and PLD where as the wild parent S. melongena var. insanum showed very poor growth. All the 3 F_1s showed significantly increased growth over their respective parental means. While only 2 F_1 hybrids namely RM x SI and PLD x SI showed significant increase in growth over their respective brinjal parents, RS x SI showed a slight decrease in the height but it is not significant.

5. Height of plants

The height of plants at six different stages commencing from the 20th day after transplanting at equal intervals of 10 days, was recorded. The data pertaining to the 3 crosses are presented graphically along with their respective parents. (See Fig. 1). It can be seen from the graph that the pattern of growth was same in the F_1 and parents. It can also be seen that all the 3 F_1 hybrids showed an increased height over their better parents till the 40th day after transplanting. The data relating to final observations were analysed statistically and the mean values are furnished in Table VII.

TABLE VII

Mean height of the F_1 hybrids and parents (in cm.) on 70th day of transplanting

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	67.95	57-94	9.4			
RS x SI	61.50	54-69	4.5	- 9.47	+24.73**	Fisher-Behren
RM	58.40	52-71	7.4			
RM x SI	60.8	48-80	8.2	+ 4.18	+37.86**	T-test Fisher-Behren
PLD	75.9	68-85	2.3			
PLD x SI	64.0	53-76	5.8	-15.68**	+21.92**	Fisher-Behren
SI	30.6	22-34	2.8			

** Significant at 1% prob. level

Fig. 1 Graph showing growth pattern in height of parents and hybrids at 10 days' interval.

RS	=	Round Special
RM	=	Round Mixed
PLD	=	Purple Long Datta
SI	=	*S. melongena* var. *insanum*.

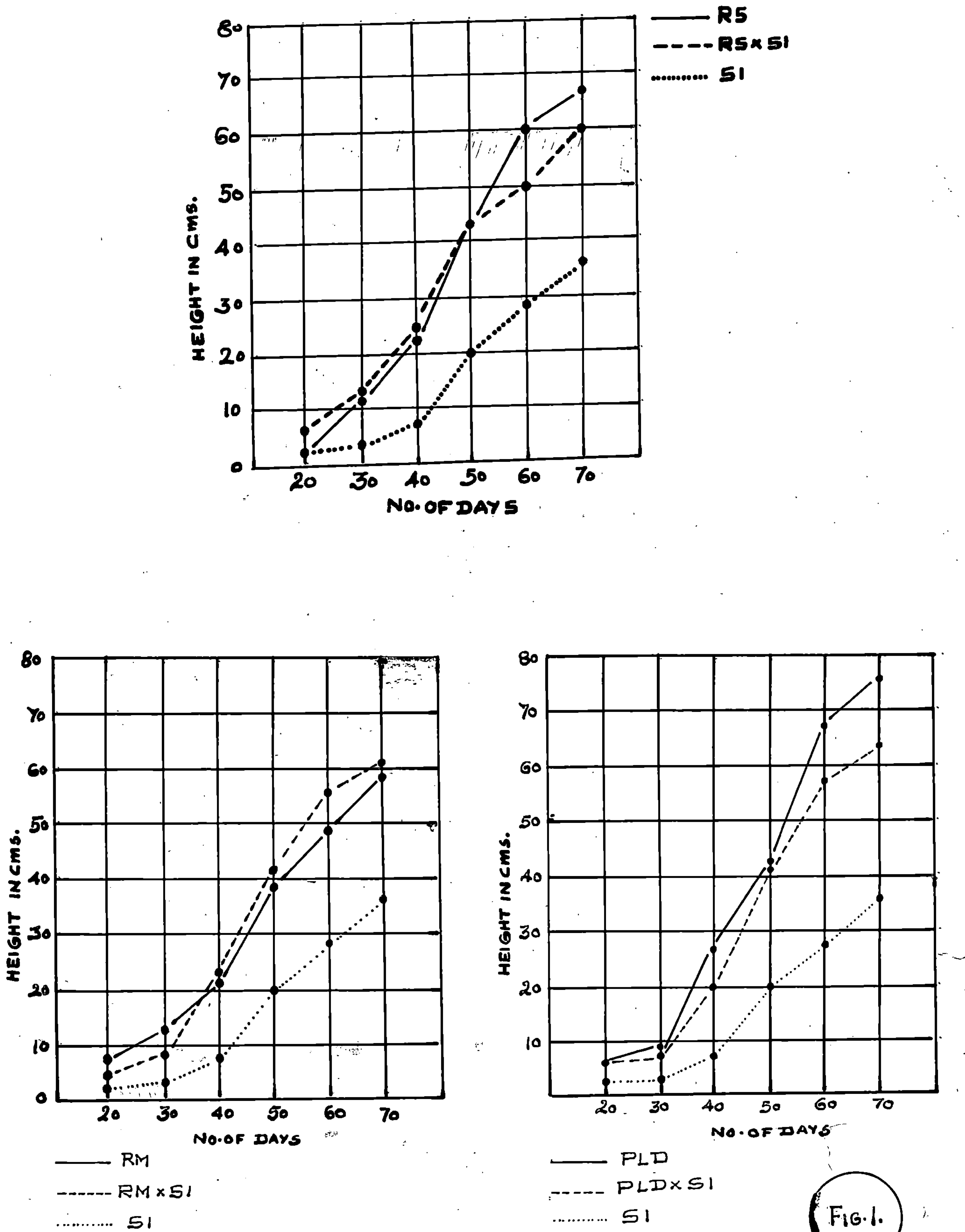

R5
R5 × S1
S1
HEIGHT IN CMS.
NO. OF DAYS
0
10
20
30
40
50
60
70
80
RM
RM × S1
S1
PLD
PLD × S1
S1

FIG. 1.

From the data presented in the table VII, it can be seen that in all the crosses the height of F_1 plants was significantly superior over the parental mean. This increase ranged from 21.92% (PLD x SI) to 37.86% (RM x SI).

When the better parental mean was considered only one hybrid (RM x SI) showed a slight superiority but this increase was not stastically significant. The other two hybrids showed decrease in height of which one PLD x SI showed a significant decrease of 15.68%.

6. Number of leaves

Results of the observations are furnished in table VIII.

TABLE VIII

Mean number of leaves of F_1 hybrids and parents on 70th day of transplanting

Treatments	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over Brinjal parent	Parental mean	Test applied
RS	206.3	119-278	48.1			
RS x SI	382.9	250-475	66.6	+ 85.61**	+63.28**	T-test
RM	238.2	182-312	43.6			
RM x SI	396.6	245-462	65.6	+ 66.49**	+62.27**	T-test
PLD	159.4	124-206	26.5			
PLD x SI	348.0	285-404	61.4	+118.30**	+62.21**	Fisher-Behren
SI	250.6	188-385	47.8			

** Significant at 1% prob. level

Fig. 2 Graph showing the growth pattern in the number of leaves produced by the parents and hybrids at 10 days' inverval.

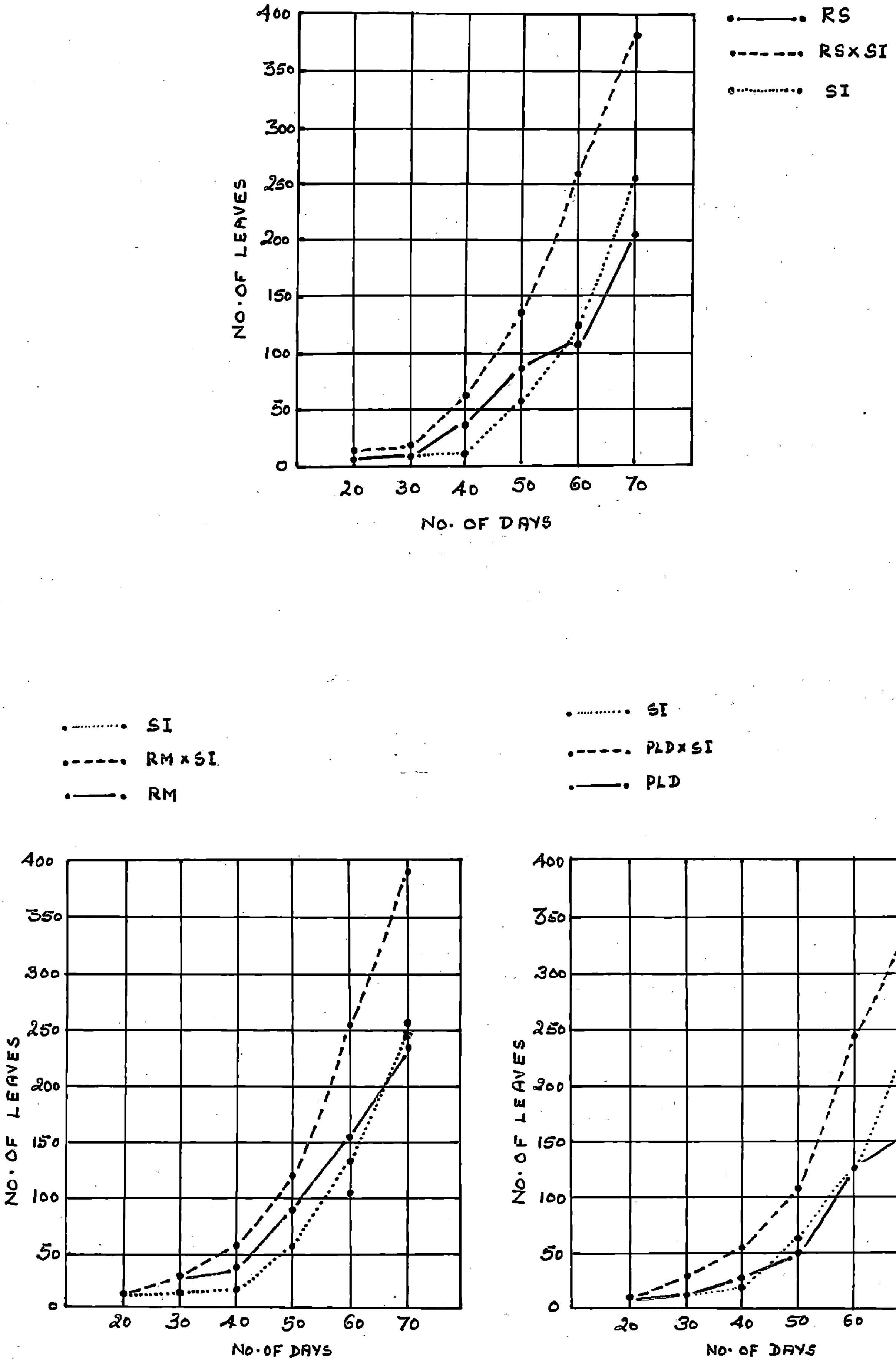
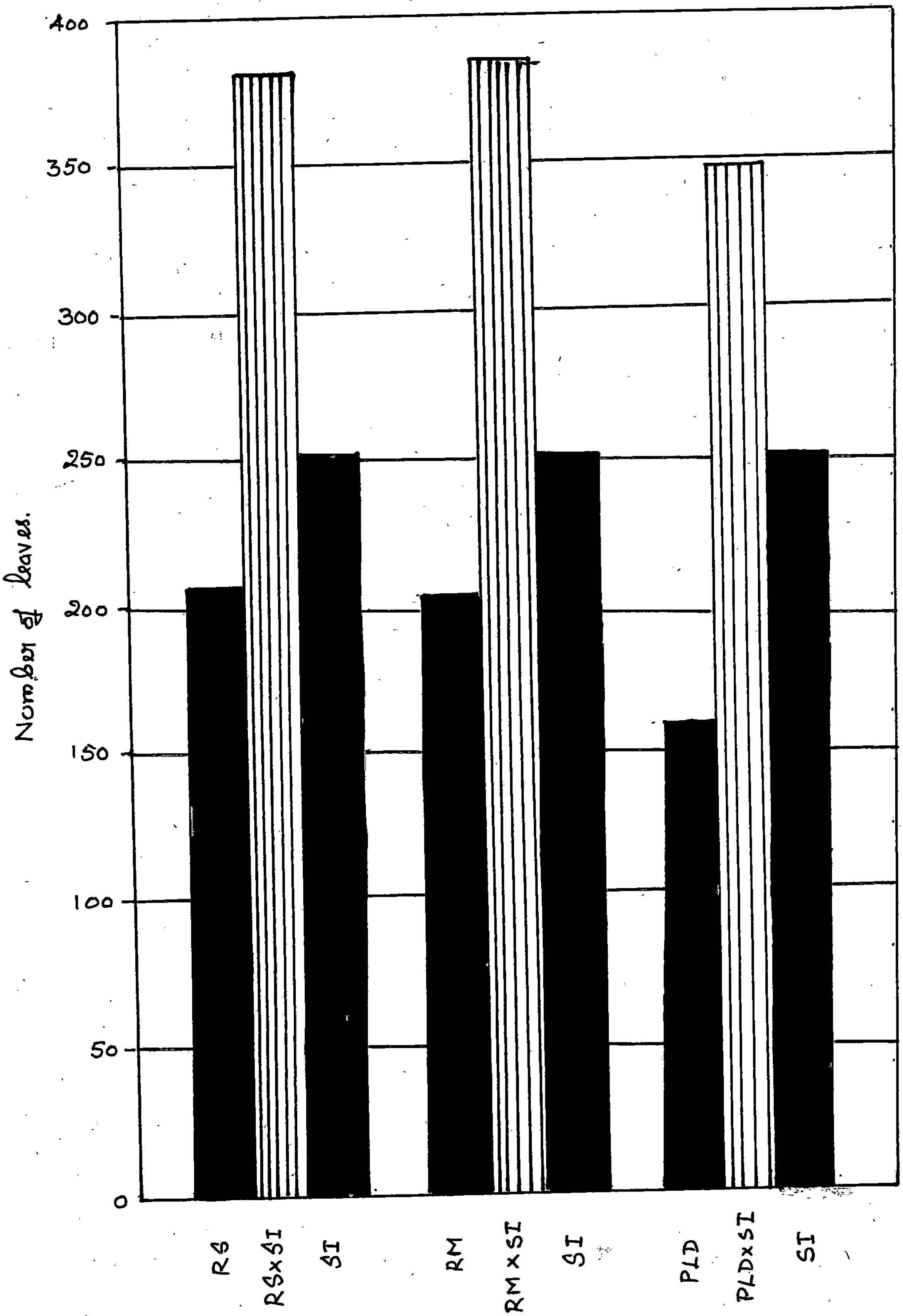


FIG. 2

Fig. 3 Bar diagrams showing the mean number of leaves produced by the parents and hybrids.



Number of leaves.
0
50
100
150
200
250
300
350
400
RS
RS×SI
SI
RM
RM×SI
SI
PLD
PLD×SI
SI

FIG. 3

From the data presented in table VIII, it can be seen that in all the 3 crosses the number of leaves produced by the F_1 was significantly greater than those produced by the brinjal parent and parental means. The highest percentage of increase was shown by the F_1 of PLD x SI (118.3) followed by RS x SI and RM x SI (85.61% and 66.49%) when compared with brinjal parental mean and RS x SI showed the highest percentage of increase (63.28%) followed by RM x SI and PLD x SI (62.27% and 62.21%) when the comparison was with parental means.

The growth pattern taking the number of leaves produced by the parents and F_1 hybrids is represented graphically in Fig. 2 and 3.

7. Number of branches

The results are tabulated and presented in table IX.

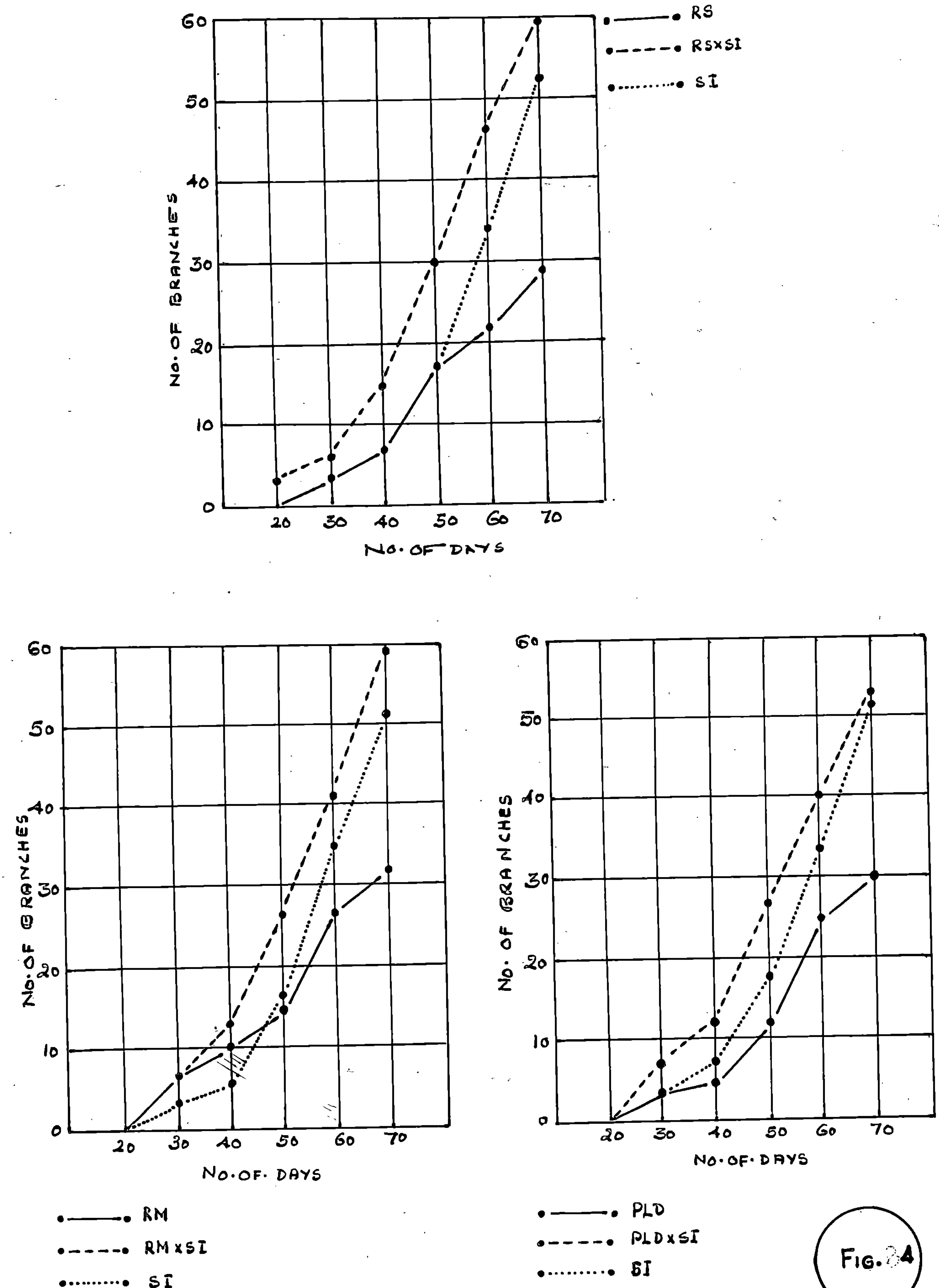
TABLE IX

Mean number of branches of F_1 hybrids and parents on 70th day of transplanting

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	29.2	23-40	4.8			
RS x SI	59.9	48-68	7.5	+105.81**	+46.56**	T-test
RM	31.0	22-48	6.4			
RM x SI	59.5	51-69	6.5	+ 92.26**	+42.35**	T-test
PLD	29.2	27-31	7.2			
PLD x SI	52.35	45-57	9.8	+ 79.28**	+28.00**	Fisher Behren's test
SI	52.6	38-58	5.7			

** Significant at 1% prob. level

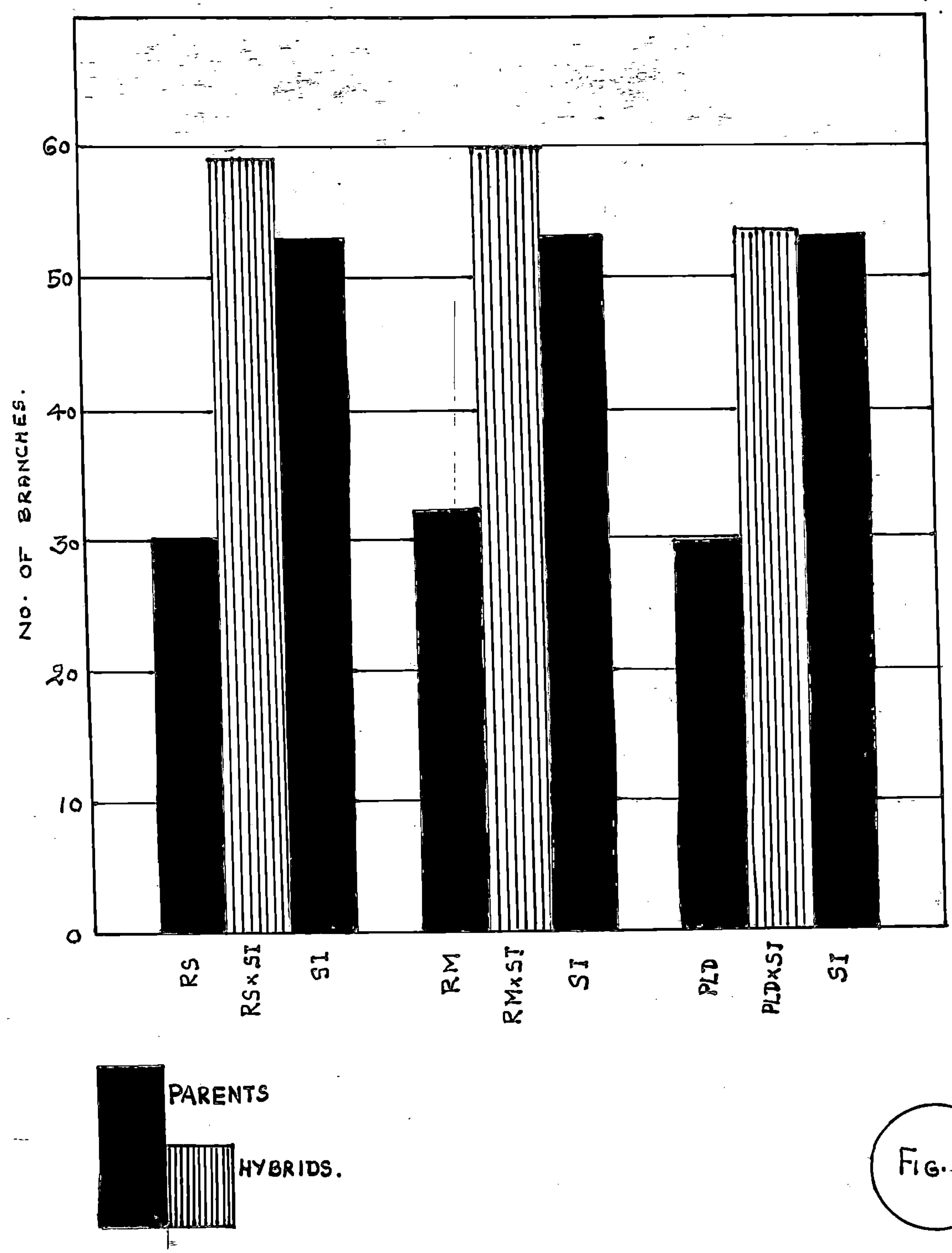
Fig. 4   Graph showing growth pattern in number of branches produced by the parents and hybrids at 10 days' interval.



RS
RS×SI
SI
No. OF BRANCHES
No. OF DAYS
0
10
20
30
40
50
60
70
RM
RM×SI
SI
No. OF BRANCHES
No. OF DAYS
PLD
PLD×SI
SI
No. OF BRANCHES
No. OF DAYS

FIG. 34

Fig. 5 Bar diagrams showing mean number of branches produced by the parents and hybrids.



60
50
40
30
20
10
0
No. of branches.
RS
RS x SI
SI
RM
RM x SI
SI
PLD
PLD x SI
SI
PARENTS
HYBRIDS.

FIG. 5

From the table IX it can be seen that all the 3 F_1 hybrids produced significantly higher number of branches when compared with brinjal parents and parental means. RS x SI gave the highest percentage of increase over the brinjal parent and the parental mean (105.81% and 46.56%) followed by RM x SI and PLD x SI (92.26%, 42.35% and 79.28%, 28.00%).

The growth pattern taking the number of branches produced by the F_1s and parents is represented graphically in Fig. 4 and 5.

8. Spread of the plants

Results are tabulated and presented in table X.

TABLE X

Mean spread of the F_1 hybrids and parents (in cm.) on 70th day of transplanting

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	70.25	57- 88	7.8			
RS x SI	105.60	89-126	11.6	+50.4**	+48.8**	T-test
RM	64.40	50- 74	7.5			
RM x SI	100.20	83-110	7.6	+55.6**	+47.3**	T-test
PLD	55.40	37- 70	9.9			
PLD x SI	97.70	83-110	7.5	+76.3**	+53.8**	T-test
SI	71.75	52- 86	9.7			

** Significant at 1% prob. level

All the 3 F_1 hybrids showed their superiority statistically with respect to spread of plants when mean of the F_1 was compared with the mean of brinjal parents as well as parental means. The range of increase of F_1 over brinjal parent was 50.4 per cent to 76.3 per cent and that over the parental mean was 47.3 per cent to 53.8 per cent. The highest increase was shown by PLD x SI followed by RM x SI and RS x SI.

9. Internodal length

The results are tabulated in table XI.

TABLE XI

Mean internodal length (in cm.) of the F_1 hybrids and parents on 70th day of transplanting

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	9.43	8.2-10.9	0.77			
RS x SI	11.20	9.8-14.5	0.89	+19.1**	+34.9**	T-test
RM	8.76	7.4- 9.4	0.63			
RM x SI	10.30	9.2-11.6	0.93	+17.5**	+21.3**	T-test
PLD	11.30	9.8-12.2	0.83			
PLD x SI	11.40	10.6-12.8	0.36	+ 0.89	+17.5**	T-test
SI	8.23	7.4- 9.1	0.63			

** Significant at 1% prob. level

All the 3 F_1 hybrids showed significant increase in internodal length, when compared with parental mean. But when the mean of F_1 is compared with the mean of brinjal parent only two showed significant increase. There was no significant difference in internodal length between PLD and PLD x SI.

10. Area of leaves

The results are tabulated in table XII.

TABLE XII

Mean leaf area (in sq. cm.) per leaf of the F_1 hybrids and parents on 70th day of transplanting

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of the F_1 over: Brinjal parent	Mean increase or decrease (in %) of the F_1 over: Parental mean	Test applied
RS	196.80	154-227	17.97			
RS x SI	124.75	107-139	12.28	-36.72**	- 5.72	T-test
RM	161.00	136-200	17.50			
RM x SI	108.10	86-136	14.10	-32.81**	- 5.61	T-test
PLD	260.25	224-288	23.70			
PLD x SI	111.41	86-140	16.18	-57.23**	-32.11**	T-test
SI	67.80	59- 83	8.46			

** Significant at 1% prob. level

Here all the three F_1 hybrids showed significant decrease in the leaf area when compared with the brinjal parent. The maximum decrease was shown by the cross PLD x SI (-57.23%) followed by RS x SI and RM x SI. When the mean of F_1 was compared with that of the parental mean only one cross i.e., PLD x SI showed significant decrease.

11. Time of flowering

The results are tabulated and presented in table XIII.

TABLE XIII

Mean number of days from sowing to flowering of F_1 hybrids and parents

Treatment	Mean	Range	S.D.	Mean increase or decrease of the F_1 over: Brinjal parent	Parental mean	Test applied
RS	77.00	72-81	0.80			
RS x SI	73.00	69-78	0.80	-5.9**	-5.3**	T-test
RM	75.60	72-78	0.73			
RM x SI	73.30	72-75	0.71	-3.07*	-4.06**	T-test
PLD	81.00	75-87	0.80			
PLD x SI	74.00	72-78	0.78	-8.64**	-6.41**	T-test
SI	77.30	75-84	0.79			

* Significant at 5% prob. level

** ,, ,, 1% ,, ,,

It can be seen from the table No. XIII that all the hybrids showed a significant earliness in flowering compared to the brinjal parent and parental mean. The maximum earliness was shown by the cross PLD x SI followed by RS x SI and RM x SI.

12. <u>Flower size</u>

The results are tabulated and presented in table XIV.

TABLE XIV

The mean petal spread (in mm.) of F_1 hybrids and parents

Treatments	Mean	Range	S.D.	Mean increase or decrease (in %) of the F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	46.00	42-50	3.74			
RS x SI	34.30	30-40	3.42	-25.4**	+ 0.6	T-test
RM	42.50	40-50	3.22			
RM x SI	35.75	30-40	3.50	-16.2**	+10.02*	T-test
PLD	47.25	40-50	3.60			
PLD x SI	36.66	32-40	2.82	-22.5**	+ 5.4	T-test
SI	22.33	17-26	3.16			

* Significant at 5% prob. level
** " " 1% " "

When the flower size of the F_1 hybrids was compared with their respective brinjal parents, all of them showed a significant reduction in size. The same when compared with the respective parental means, the two crosses RS x SI and PLD x SI showed no significant difference but in the case of RM x SI the flower size of the F_1 plant was slightly higher, the increase being significant at 5 per cent probability level.

13. Number of flowers

(a) Total number of flowers

The results are tabulated and presented in table XV.

TABLE XV

Mean number of flowers produced by the F_1 hybrids and parents till 70th day of transplanting

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of the F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	60.50	39- 80	12.23			
RS x SI	105.80	81-149	21.09	+66.60**	+70.70**	T-test
RM	65.50	38-102	16.85			
RM x SI	111.20	71-137	18.46	+69.90**	+72.41**	T-test
PLD	56.62	35- 85	19.75			
PLD x SI	114.31	97-147	13.97	+80.00**	+90.51**	T-test
SI	63.50	40-106	19.13			

** Significant at 1% prob. level

All the 3 F_1 hybrids produced significantly higher number of flowers when compared with their respective parents and parental means. The highest percentage of increase was shown by the PLD x SI followed by RM x SI and RS x SI.

(b) Number of long styled flowers

The results are tabulated and presented in Table XVI

TABLE XVI

Mean number of long styled flowers produced by the F_1 hybrids and parents till 70th day of transplanting

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over: Brinjal parent	Mean increase or decrease (in %) of F_1 over: Parental mean	Test applied
RS	30.41	18-44	8.36			
RS x SI	65.11	50-85	12.08	+114.12**	+62.25**	T-test
RM	27.80	19-40	5.89			
RM x SI	68.72	45-84	12.41	+147.23**	+65.8**	T-test
PLD	40.25	25-58	12.45			
PLD x SI	80.41	66-98	10.11	+ 99.75**	+70.71**	T-test
SI	53.90	28-82	16.01			

** Significant at 1% prob. level.

All the three hybrids produced significantly higher number of long styled flowers compared to the respective brinjal parents and parental means. The maximum increase of 147.23 percentage was shown by RM x SI followed by RS x SI (114.12%) and PLD x SI (99.75%).

(c) Percentage of short styled flowers

The results are tabulated and presented in table XVII.

TABLE XVII

Mean percentage of short styled flowers in the F_1 hybrids and parents

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	40.61	30-55	5.77			
RS x SI	38.01	31-44	3.71	-6.4	+40.21**	T-test
RM	44.58	30-49	4.63			
RM x SI	37.31	27-45	5.34	-16.3**	+24.35**	T-test
PLD	27.21	18-33	5.09			
PLD x SI	29.41	25-35	3.33	+ 8.08	+44.11**	T-test
SI	13.71	7-22	4.95			

** Significant at 1% prob. level

When the F_1 hybrids were compared with their respective brinjal parents only one cross namely RM x SI showed a significant decrease. Eventhough RS x SI showed a decrease of 6.4 per cent it was found to be not significant. The F_1 of PLD x SI showed a slight increase in the percentage of short styled flowers but it was also not significant. All the 3 hybrids showed significant increase when compared with the respective parental means.

14. Percentage of fruit set

The results are tabulated and presented in table XVIII.

TABLE XVIII

Mean percentage of fruit set in F_1 hybrids and parents

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	55.11	43-75	8.17			
RS x SI	65.21	58-88	7.28	+18.32**	-5.1	T-test
RM	50.75	47-57	2.83			
RM x SI	62.51	55-70	4.64	+23.21**	-6.01	T-test
PLD	72.11	66-84	5.74			
PLD x SI	70.25	64-76	3.44	- 2.5	-9.12*	Fish Behren test
SI	82.33	70-94	7.52			

* Significant at 5% prob. level
** ,, ,, 1% ,, ,,

When the mean percentage of fruit set of the F_1 hybrids were compared with their respective brinjal parents two of the crosses namely RS x SI and RM x SI showed significant superiority. But the F_1 hybrid of PLD x SI showed a slight decrease which was not statistically significant. When the comparison was with the parental mean all the 3 crosses showed decrease but it was significant only in one case i.e., PLD x SI.

15. Number of total fruits per plant

The results are tabulated and presented in table XIX

TABLE XIX

Mean number of fruits harvested/plant in F_1 hybrids and parents

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	33.92	19- 48	10.05			
RS x SI	65.91	50- 87	12.68	+ 99.41**	+49.81**	T-test
RM	33.25	22- 53	8.54			
RM x SI	69.25	47- 85	12.16	+100.91**	+47.31**	T-test
PLD	42.91	26- 57	11.95			
PLD x SI	80.38	65-100	10.25	+ 64.11**	+65.71**	T-test
SI	54.11	31.84	15.65			

** Significant at 1% prob. level.

All the 3 hybrids showed significant increase in the number of fruits produced per plant when compared with their respective brinjal parents and parental means. The maximum increase was shown by RM x SI (100.91%) followed by RS x SI and PLD x SI (99.41% and 64.11% respectively).

The number of fruits produced by the parents and F_1 hybrids is graphically represented by bar diagrams in Fig. 6.

Th 126

Fig. 6 Bar diagrams showing the mean number of fruits produced by the parents and hybrids.

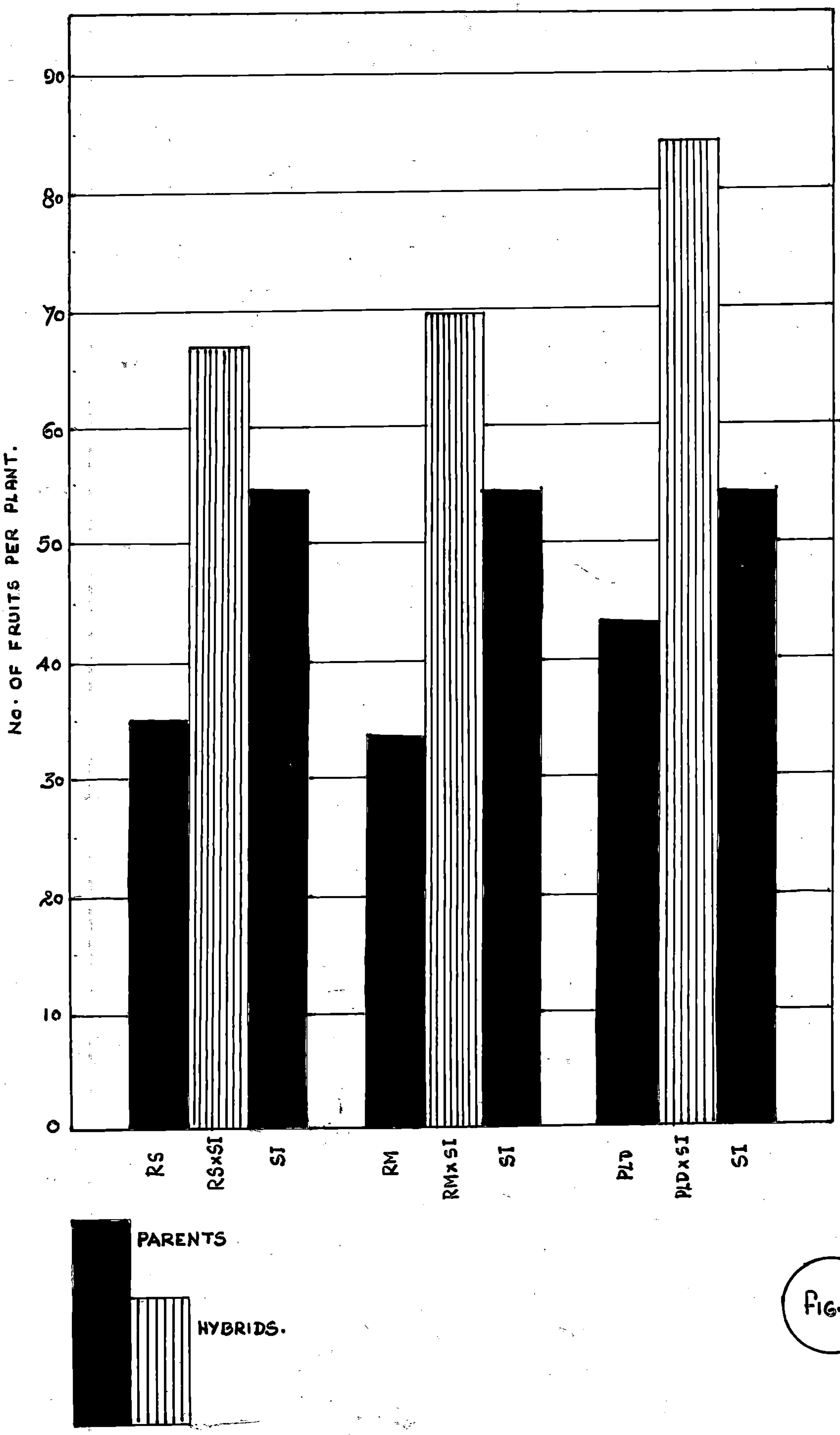

No. OF FRUITS PER PLANT.
90
80
70
60
50
40
30
20
10
0
RS
RSxSI
SI
RM
RMxSI
SI
PLD
PLDxSI
SI
PARENTS
HYBRIDS.

FIG. 6.

16. Size and weight of fruits

(a) Length of fruits

The results are tabulated and presented in table XX

TABLE XX

Mean length of fruits (in cm.) of F_1 hybrids and parents

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	9.57	9.1-10.3	0.20			
RS x SI	6.04	5.8- 6.4	0.28	-37.11**	- 7.81**	T-test
RM	8.76	8.3- 9.2	0.33			
RM x SI	5.75	5.2- 6.0	0.20	-34.61*	- 6.49**	T-test
PLD	25.67	24.5-27.4	0.60			
PLD x SI	7.71	7.2- 8.0	0.34	-69.33**	-42.2**	T-test
SI	3.53	3.4- 3.8	0.20			

* Significant at 5% prob. level
** ,, ,, 1% ,, ,,

All the three F_1 hybrids showed significant decrease in fruit length when compared with the brinjal parents and parental means. The maximum decrease of 69.33 per cent was shown by PLD x SI followed by RS x SI and RM x SI (37.11% and 34.61% respectively.).

(b) Girth of the fruits

The results are tabulated and presented in table XXI

TABLE XXI

The mean girth (in cm.) of the fruits in parents and F_1 hybrids

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	18.17	18.3-19.2	0.37			
RS x SI	12.04	11.7-12.6	0.41	-34.11**	- 3.6*	T-test
RM	16.31	15.3-17.7	0.41			
RM x SI	11.23	10.5-11.7	0.40	-32.00**	- 3.4*	T-test
PLD	11.02	9.5-11.8	0.45			
PLD x SI	9.72	9.5-10.0	0.41	-11.81**	+10.3**	T-test
SI	6.97	6.5- 7.7	0.26			

* Significant at 5% prob. level
** ,, ,, 1% ,, ,,

All the three F_1 hybrids showed significant decrease in fruit girth when compared with the brinjal parents. The maximum reduction was shown by RS x SI (-37.11%) followed by RM x SI and PLD x SI (-32% and -11.81% respectively) when the comparison was with the parental mean two hybrids namely RS x SI and RM x SI showed significant reduction where as PLD x SI showed significant increase in girth.

When the fruit size index (taken as length x girth) of the F_1 hybrids was compared with that of the parents, the results showed that the F_1 mean is more approximating to the geometric mean of the parents than the arithmetic mean. The results obtained were as follows:

Fruit size index of F_1 hybrids and parents

Cross	F_1 fruit size	Arithmetic mean of the fruit size of parents	Geometric mean of the fruit size of parents
RS x SI	72.72	99.66	65.54
RM x SI	64.57	84.02	59.38
PLD x SI	74.94	153.48	83.34

From the above table it can be seen that the difference between the F_1 mean and the geometric mean of the parents was much less compared to the difference between F_1 mean and the arithmetic mean of the parents.

(c) Weight of total fruits harvested per plant

The results are tabulated and presented in table XXII.

TABLE XXII

Mean weight (in kg.) of the total fruits harvested per plant of parents and F_1 hybrids

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	1.46	1.0-2.0	0.28			
RS x SI	1.17	0.7-1.7	0.25	-19.81**	+42.6**	T-test
RM	1.35	0.9-1.7	0.25			
RM x SI	0.92	0.5-1.2	0.19	-32.11**	+19.4	T-test
PLD	1.09	0.8-1.4	0.23			
PLD x SI	0.93	0.6-1.1	0.15	-14.81	+45.32**	T-test
SI						

** Significant at 1% prob. level

Eventhough all the 3 F_1 hybrids showed decrease in weight of total fruits harvested when compared with the brinjal parents only two crosses namely RS x SI and RM x SI showed significance. The decrease in fruit weight in PLD x SI was not significant. When the comparison was with parental mean two hybrids namely RS x SI and PLD x SI showed significant increase whereas RM x SI eventhough showed an increase of 19.4 per cent it never came to significant level.

17. Number and weight of F_2 seeds

(a) Number of seeds per fruit

The results are tabulated and presented in table XXIII.

TABLE XXIII

Mean number of seeds per fruit in parents and F_1 hybrids

Treatment	Mean	Range	S.D.	Mean increase or decrease of F_1 over (in%)		Test applied
				Brinjal parent	Parental mean	
RS	1776.30	1625-1929	129.67			
RS x SI	1319.0	1212-1428	96.38	-25.35*	+7.52	T-test
RM	1436.0	1328-1512	78.43			
RM x SI	968.3	947-1010	38.43	-32.51**	-8.67	T-test
PLD	981.7	910-1023	50.34			
PLD x SI	653.3	582- 698	55.07	-33.45**	-9.56	T-test
SI	686.6	621-757	56.41			

* Significant at 5% prob. level

** ,, ,, 1% ,, ,,

In all the 3 crosses the number of seeds in the fruits of F_1 hybrid plants was significantly lesser than that in the respective brinjal parents. The maximum reduction of 33.45 per cent was shown by PLD x SI followed by 32.51 per cent in the case of RM x SI and 25.35 per cent in the case of RS x SI.

But when the comparisons of mean of F_1 were with parental means none of the crosses gave significant result.

(b) Weight of F_2 seeds

The results are tabulated and presented in table XXIV.

TABLE XXIV

Mean weight of 200 seeds (in g.) of parents and F_1 hybrids

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over Brinjal parent	Parental mean	Test applied
RS	0.581	0.573-0.590	0.0069			
RS x SI	0.666	0.665-0.670	0.0298	+14.45*	+21.98**	T-test
RM	0.475	0.470-0.483	0.0056			
RM x SI	0.568	0.565-0.575	0.0201	+19.78**	+15.10*	T-test
PLD	0.670	0.663-0.675	0.0051			
PLD x SI	0.766	0.760-0.775	0.0320	+14.35*	+29.61**	T-test
SI	0.513	0.522-0.512	0.0068			

* Significant at 5% prob. level

** ,, ,, 1% ,, ,,

Here all the three F_1 hybrids showed a significant increase in seed weight when compared with the respective brinjal parents and parental means. The maximum increase was shown by RM x SI (19.78%) followed by RS x SI (14.45) and PLD x SI (14.35).

18. Germination capacity of F_2 seeds

The results are tabulated and presented in table XXV.

TABLE XXV

Mean germination percentage of seeds of parents and F_1 hybrids

Treatments	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	59.3	56-65	4.47			
RS x SI	39.3	33-42	3.46	-33.47**	+21.31	T-test
RM	54.6	53-56	2.99			
RM x SI	33.0	30-35	2.00	-38.51**	+ 9.63	T-test
PLD	35.3	30-41	4.73			
PLD x SI	18.6	13-22	4.35	-47.31**	- 8.82	T-test
SI	5.6	2-10	3.47			

** Significant at 1% prob. level

In all the 3 cases the F_1 hybrids gave significantly lesser percentage of germination when compared with the brinjal parent. The maximum reduction was shown by the cross PLD x SI (-47.31) followed by RM x SI (38.51%) and RS x SI (33.47).

When the comparison was with parental means none of the crosses showed any significant difference.

19. Length of tap root

The results are given in table XXVI.

TABLE XXVI

Mean length (in cm.) of tap root of the fully grown up parents and F_1 hybrid plants on 90th day of transplanting

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal Parent	Parental mean	
RS	33.70	29-37	3.20			
RS x SI	71.81	68-75	3.31	+53.07**	+43.6**	T-test
RM	32.69	27-39	3.27			
RM x SI	75.90	71-82	5.15	+57.20**	+52.40**	T-test
PLD	42.21	36-47	3.95			
PLD x SI	60.33	55-69	5.41	+30.00**	+10.7*	T-test
SI	67.00	61.86	5.72			

All the 3 F_1 hybrids showed significant increase in tap root length when compared with their respective brinjal parents and parental means. The maximum increase of 57.2 per cent and 52.4 per cent was shown by RM x SI followed by RS x SI (53.07% and 43.6%) and PLD x SI (30.00% and 10.7%).

TABLE

Treatment	Growth habit	Colour of foliage	Colour of stem	Presence or absence of prickles	Colour of prickles
RS	Bushy	Green	Green	Absent	-
RS x SI	Intermediate	Green with purple vein	Green	Present on leaves, stem and Calyx	Dark purple
RM	Bushy	Green	Green	Absent	-
RM x SI	Intermediate	Green with purple vein	Green with purple tint	Present on leaves, stems and Calyx	Dark purple
PLD	Erect	Green with purple tint and veins purple	Green with purple tint	Absent	-
PLD x SI	Intermediate	Green with purplish tint with purple veins	Green with purplish tint	Present on leaves, stem and Calyx	Dark purple
SI	Spreading	Green with purple vein	Green with purplish tint	Present on leaf, stem and Calyx	Dark purple

XXVII

Flower bearing habit	Colour of Corolla	Fruit shape and colour	Fruit colour at maturity	Fruit bearing habit
Solitary	Light purple	Round Purple streakes on white	Yellow	Solitary
Solitary	Purple	Round with upper grey streakes like the male parent and the rest light pink	Yellow	Solitary
Solitary	Light purple	Round with purple and green streakes on white	Yellow	Solitary
Solitary	Purple	Round with upper grey streakes like the male parent and the rest light pink.	Yellow	Solitary
Solitary	Purple	Long, dark purple	Dull yellow	Solitary
Solitary rarely in cluster	Purple	Slightly oblong grey check pattern like the male parent with the rest light pink	Yellow	Solitary rarely in cluster of 2-3
Solitary rarely in cluster	Purple	Round with green check pattern half way from top and the rest white	Yellow	Solitary and rerely in clusters of 2 or 3

B. Qualitative characters

The observations regarding the qualitative character are furnished in table XXVII.

C. Study of the reciprocal crosses

The F_1 progenies from the reciprocal crosses taking S. melongena var. insanum as female parent and the 3 brinjal varieties (cultivars) namely Round Special, Round Mixed, Purple Long Datta as male parents were separately raised and the morphological characters were noted. It was found that it took more days for germination of the F_1 seeds of reciproval crosses and also that the initial growth of the seedlings before and after transplantation was much slower compared to the F_1 progenies raised from the cross taking cultivated brinjal varieties as female parents. But this initial growth difference was made up one month after transplanting. Apart from this there was no other differences noted in the reciprocal crosses.

II. STUDY ON INSECT RESISTANCE

1. Jassid and Aphid count

The results are tabulated and presented in table XXVIII.

TABLE XXVIII

Mean number of insects per plant in parents and F_1 hybrids

Treatments	Mean	Range	Mean increase or decrease (in %) of F_1 over		
			Brinjal parent	Wild parent	Parental mean
RS	29.40	20.7-43.0			
RS x SI	25.20	23.5-26.5	-14.28	+117.24**	+25.85
RM	25.60	18.0-30.7			
RM x SI	26.10	14.0-35.7	+ 1.95	+125.00*	+40.32
PLD	12.80	5.2-26.0			
PLD x SI	17.40	14.5-20.5	+35.94	+ 50.00	+42.60
SI	11.60	9.7-13.2			

* Significant at 5% prob. level

** ,, ,, 1% ,, ,,

The results showed that there is no significant difference between the F_1s and their respective brinjal parents or parental means. But in the case of RS x SI and RM x SI, the F_1s showed a high incidence of the pest when compared to the male parent i.e., *S. insanum*.

2. Epilachna beetle count

The results are tabulated and presented in table XXIX.

TABLE XXIX

Mean number of Epilachna beetles per plant in the parents and F_1 hybrids

Treatment	Mean	Range	Mean increase or decrease (in %) of F_1 over		
			Brinjal parent	Parental mean	Wild parent
RS	10.00	5.2-12.5			
RS x SI	12.80	0.2-35.2	+ 2.87	+103.55	+392.51
RM	52.70	45.5-56.2			
RM x SI	9.91	0.0-20.2	-432.35**	+ 64.15	+280.78**
PLD	10.59	4.0-16.0			
PLD x SI	18.00	8.2-26.7	+ 69.80	+172.71	+592.81
SI	2.60	0 - 6.7			

** Significant at 1% prob. level

When the F_1s were compared to their respective brinjal parents, only RM x SI showed a significant decrease in the incidence of the pest. When the same F_1 was compared with its male parent (S. incanum) it showed a significant increase in the incidence. In all other cases there was no significant differences between the F_1s and their respective parents and parental means.

3. Incidence of shoot borer

The results are tabulated and presented in table XXX

TABLE XXX

Mean number of shoot borers per plant in parents and F_1 hybrids

Treatment	Mean	Range	Mean increase or decrease (in %) of F_1 over		
			Brinjal parent	Parental mean	Wild parent
RS	0.15	0-0.25			
RS x SI	0.00	0-0	-100	-100.0	0.0
RM	0.35	0-0.75			
RM x SI	0.00	0-0	-100	-100.0	0.0
PLD	0.17	0-0.50			
PLD x SI	0.40	0-1.20	+135.3	+400.0	+40.0
SI	0.00	0-0			

On analysing the results it was found that there was no significant difference between the F_1s and their respective parents and parental means.

It was noted that the incidence was nil in the case of the wild brinjal parent.

4. Incidence of fruit borer

The results are tabulated and presented in table XXXI.

TABLE XXXI

The mean number of fruit borer per plant in the parents and F_1 hybrids

Treatment	Mean	Range	Mean increase or decrease (in %) of F_1 over		
			Brinjal parent	Parental mean	Wild parent
RS	0.82	0.25-1.20			
RS x SI	1.65	0 -4.2	+103.57	+302.45	+100.00
RM	3.43	2.3 -5.7			
RM x SI	1.40	0 -3.0	- 59.20*	+ 18.18	+100.00
PLD	2.43	0.3 -4.0			
PLD x SI	2.72	0.75-4.2	+ 11.87	+124.51	+100.00
SI	0	0 -0			

* Significant at 5% prob. level

When the F_1s were compared with their respective brinjal parents one cross i.e., RM x SI showed a significant decrease in incidence. In all other comparisons the differences were not significant. It was also seen that the incidence of the pest in the wild parent (S. insanum) was nil.

III. STUDY OF WILT DISEASE RESISTANCE

The results obtained were as follows:

Among the total 18 potted plants of the brinjal parents 10 have wilted. The maximum number wilted out of a total number of 6 was 5 in RM followed by 3 in PLD and 2 in RS. Among the total 18 potted plants of F_1 hybrids of the 3 crosses none of the plants wilted. Similarly there was no incidence of wilt in any plants out of 18 wild brinjal plants (*S. melongena* var *insanum*).

It was also found that when among the total 72 brinjal plants (RS, RM and PLD) grown in the other two experimental plots 6 have wilted, none of the F_1 hybrids and the *S. melongena* var. *insanum* plants were affected by the disease.

IV. CHEMICAL STUDIES

1. Dry matter percentage

The results are tabulated and presented in table XXXII.

TABLE XXXII

Percentage of dry matter in fruits of the parents and F_1 hybrids

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	11.41	11.2-11.6	0.173			
RS x SI	15.40	15.0-15.8	0.316	+35.08**	- 3.15	T-test
RM	12.11	11.1-12.8	0.721			
RM x SI	15.28	15.0-15.8	0.346	+26.47**	- 5.51	T-test
PLD	12.61	12.1-13.1	0.400			
PLD x SI	14.60	14.5-14.8	0.141	+15.85**	-11.51**	T-test
SI	20.41	19.6-21.2	0.655			

** Significant at 1% prob. level

In all the 3 crosses when the mean of F_1 is compared with its brinjal parent it showed a significant increase in dry matter percentage. The maximum increase of 35.08 per cent was shown by RS x SI followed by 26.47 in the case of RM x SI and 15.85 by PLD x SI. When the comparison was with parental mean only one hybrid showed significant difference i.e., PLD x SI showed 11.51 per cent decrease in dry matter percentage.

2. Starch content

The results are tabulated and presented in table XXXIII.

TABLE XXXIII

Starch percentage in the fruits of parents and hybrids

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over: Brinjal parent	Parental mean	Test applied
RS	1.62	1.61-1.64	0.108			
RS x SI	2.13	2.01-2.24	0.109	+23.87**	-20.25*	T-test
RM	1.63	1.62-1.64	0.038			
RM x SI	2.14	2.05-2.23	0.024	+31.28**	-20.18**	T-test
PLD	1.63	1.6 -1.65	0.015			
PLD x SI	2.50	2.46-2.55	0.145	+53.87**	- 6.66	T-test
SI	3.73	3.72-3.75	0.158			

* Significant at 5% prob. level

** " " 1% " "

In all the 3 crosses the F_1 hybrid was found to be significantly superior in starch content when compared with their respective brinjal parents. But when the comparison was with the parental mean two hybrids (RS x SI and RM x SI) showed a significant decrease while the hybrid PLD x SI showed no difference.

3. Protein content

The results are given in table XXXIV.

TABLE XXXIV

Percentage of protein content in the parents and F_1 hybrids

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	2.156	2.12-2.22	0.070			
RS x SI	2.41	2.38-2.45	0.028	+11.75**	-5.06*	T-test
RM	2.24	2.2 -2.31	0.0556			
RM x SI	2.48	2.42-2.52	0.121	+10.75**	-3.87	T-test
PLD	1.803	1.72-1.88	0.125			
PLD x SI	2.276	2.26-2.29	0.185	+26.51**	-3.38	T-test
SI	2.92	2.88-2.95	0.031			

** Significant at 1% prob. level

In all the 3 crosses the F_1 hybrids were found to be significantly superior over their respective brinjal parents in the protein content of the fruit. The maximum increase was shown by PLD x SI (26.57%) followed by RS x SI (11.75%) and RM x SI (10.75).

When the comparison was with the parental mean, RS x SI showed a significant decrease at 5% prob. level where as the other two F_1 hybrids showed no difference.

4. Alkaloid content

The results are given in table XXXV.

TABLE XXXV

Total alkaloid percentage in the plants and F_1 hybrids

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	0.0616	0.057-0.065	.00346			
RS x SI	0.3066	0.288-0.338	.0220	+397.51**	+ 1.31	T-test
RM	0.0746	0.057-0.094	.0151			
RM x SI	0.3191	0.294-0.347	.0256	+331.08**	+ 3.50	T-test
PLD	0.0366	0.034-0.041	.0012			
PLD x SI	0.1416	0.133-0.157	.0115	+291.71**	-56.45**	T-test
SI	0.5431	0.512-0.583	.0345			

** Significant at 1% prob. level

In all the 3 crosses the F_1 hybrids showed significant increase in the alkaloid content over their respective brinjal parents. The maximum increase was shown by RS x SI (397.51) followed by RM x SI and PLD x SI (331.08% and 291.71%).

When the F_1s were compared with their respective parental mean one cross (PLD x SI) showed a significant reduction where as in the other two crosses the difference was not significant.

V. CYTOLOGICAL STUDIES

(a) Pollen size

The results are given in table XXXVI.

TABLE XXXVI

The mean pollen diameter of parents and F_1 hybrids (in μ)

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parents	Parental mean	
RS	27.97	24.75-30.10	0.655			
RS x SI	27.93	25.80-30.10	0.670	-0.14	+0.21	T-test
RM	27.24	25.10-30.10	0.565			
RM x SI	28.57	24.75-32.25	0.624	+4.8**	+3.8**	T-test
PLD	27.69	25.80-30.10	0.479			
PLD x SI	27.71	25.80-30.10	0.469	+0.078	-0.076	T-test
SI		24.75-30.10	0.556			

** Significant at 1% prob. level

Among the 3 F_1 hybrids only one (RM x SI) showed significant increase in pollen size. When the comparisons were with the parental mean the same cross (RM x SI) along gave any significant increase in size. In all other cases the differences were not significant.

(b) Pollen sterility

The results are presented in table XXXVII.

TABLE XXXVII

Percentage of pollen sterility in the parent and hybrids

Treatment	Mean	Range	S.D.	Mean increase or decrease (in %) of F_1 over		Test applied
				Brinjal parent	Parental mean	
RS	8.12	4.10-14.67	3.41			
RS x SI	8.30	2.2 -17.4	4.73	+2.5	-25.4	T-test
RM	7.00	4.4 - 9.9	1.56			
RM x SI	17.30	7.8 -23.9	4.72	+147.0**	+64.80*	T-test and Fish Behren test
PLD	14.70	7.8 -21.1	4.48			
PLD x SI	11.10	1.6 -16.3	5.08	- 24.2	-22.8	T-test
SI	14.10	7.9 -25.5	5.96			

* Significant at 5% prob. level

** ,, ,, 1% ,, ,,

The F_1 hybrid RM x SI showed a significant increase in pollen sterility when compared with its brinjal parent as well as parental mean. None of the other crosses showed any significant difference.

(c) Studies on pollen mother cells

The meiotic behaviour of the 3 F_1 hybrids and their parents were found to be normal. There was normal pairing of the homologous chromosomes and 12 bivalents were formed at patchytene. At anaphase I the homologous chromosomes separated in 12 by 12 and moved to the opposite poles. From the hundreds of slides examined no abnormalities could be found out.

DISCUSSION

DISCUSSION

The results of the observation on the first generation hybrids and their respective parents have been analysed and the results presented. Now it remains to discuss briefly the interpretations of the data as a whole so as to draw valid conclusions regarding the performance and behaviour of the F_1 hybrids compared to their parents.

In the investigations reported herein four cultivated brinjal varieties (Solanum melongena) and a wild variety S. melongena var. insanum were utilised for inter crossings. Among the 4 varieties used as female parents all except Thorny Giant gave fertile hybrid seeds when crossed with S. melongena var. insanum. This shows that the two parents involved do not generally show any barrier for hybridization and the genomic differentiation between the two is not high enough to produce any sterility barriers which prevent gene exchange.

But in the case of cross between Thorny Giant and S. melongena var. insanum, eventhough seed setting took place and the seeds were apparently normal, the seedlings did not survive even the nursery stage. A similar result was reported by Krishnappa and Chenneveeriah (1964) in a cross between two wild species S. aculeatissimum and S. khasianum. Morphologically Thorny Giant has certain characteristics similar to the wild parent than the other cultivated varieties. Inspite of this the cross was a failure. This shows that morphological characters are not to be taken as a criterion for selecting parents for hybridization in Solanum species. The chromosome number of Thorny Giant was counted as n = 12 which is same as that of var. insanum. Most probably this particular variety belongs to a wild group and the cross between the two separately originated wild plants might have produced the lethality of certain growth genes.

The behaviour of morphological characters in the crosses is discussed below:

1. Quantitative characters

From the results of the present investigation it is primarily noted that in all the three successful crosses the F_1s showed a high degree of heterosis in many economically important characters. The characters for which heterosis was noted are number of branches, earliness, total number of flowers and total number of fruits per plant. Out of the total 19 quantitative characters studied only in 5 characters namely, flower size, mean leaf area (only in 2 crosses), percentage of fruit set, number of seeds per fruit and germination percentage of F_2 seeds, the F_1s showed a true intermediate position. This is in accordance with the Nelson-Ehle's theory of quantitative inheritance. In the case of fruit size index taken as the length x girth, the F_1 mean was more approximating to the geometric mean of the parental values. This is in accordance with the findings of Tatebe (1943) and Rao (1966).

In the case of leaf area it was noted that the F_1 plants were having intermediate size in the two crosses involving Round Special and Round Mixed varieties where as in the third cross involving Purple Long Datta the F_1 leaf size was significantly reduced from the parental mean. Here the only difference noted in the Purple Long Datta was the larger size of its leaves compared to the other two varieties. This shows that the F_1 leaf size can be intermediate only when the difference between the two parents is at a particular minimum level.

In all the crosses where cultivated brinjal varieties were taken as female parent F_1 seeds showed increase in size and weight compared to both parents. In the reciprocal crosses using var. insanum as female parent the weight and size of the F_1 seeds were just similar to the female parental seeds. Similar results were reported by Sambandam (1964) in intervarietal crosses. This observation suggests that the increase in the size and weight of F_1 seeds was due to an interaction between the nuclear genes from var. insanum and cytoplasm of the cultivated brinjal varieties.

The germination capacity of the seeds of S. melongena var. insanum was found to be very poor due to the thickness of seed coat. When hot water treatment was given, the percentage of germination increased to as high a level as 100. The F_1 seeds obtained from crosses using cultivated brinjal varieties as female parent showed high germination percentage similar to the cultivated brinjal varieties whereas F_1 seeds obtained from the reciprocal crosses showed very low percentage of germination similar to var. insanum. This shows that thick seed coat is a characteristic of the seeds developing in the var. insanum ovary.

It was seen from the results that the length of tap root of seedlings of all the 3 F_1s was much higher than that found in the cultivated brinjal varieties. At seedling stage this character showed a positive heterotic expression whereas at mature plant stage it was equal in length to the male parent (var. insanum). At seedling stage the growth rate of S. melongena var. insanum was much less compared to the F_1s and hence this heterotic expression. Much of the vigour shown by the F_1 plant can be attributed to its deep root system which enables it to draw nurishments from a more extensive soil area. This helps the plants to grow vigorously even under semi drought and other adverse soil conditions.

The F_1 plants showed hybrid vigour in number of leaves, number of branches, spread, internodal length, earliness, total number of flowers, number of long styled flowers, percentage of fruit set, and total number of fruits per plant. Eventhough the size of fruits of the F_1 plants showed values less than the midparental values it has to be pointed out that inspite of the disadvantage of smaller sized fruits, the decrease in total weight of harvested fruits per plant in the F_1 compared to brinjal parent was not significant in one cross atleast (PLD x SI) whereas in the other two crosses it ranged from only 19.81 per cent to 32.11 per cent. The compensation in yield to such an extent has been possible only because of the larger number of long styled flowers and the more number of fruits produced in the F_1 plants.

2. <u>Qualitative characters</u>

The growth habit of the F_1 plants was intermediate between the parents.

As opposed to the findings of Rao (1966) and in accordance with Khan and Ramzan (1953) the intensity of prickles on the leaf was found to be completely dominant over smoothness in the work reported here.

With regard to the pigmentation of fruits the observations are found to be in accordance with the findings of Janick and Topoleski (1963). The colour of F_1 fruits was intermediate in a cross between varieties with purple and green check colours i.e., the F_1 fruits showed grey check pattern similar to the green check of the var. <u>insanum</u> and pink colour in the rest of the portion. The pink colour was light dependent. In the cross between purple streaks on white and green check, the F_1 was grey check on pink. Here the effect of deep purple and purple streaks on white over the green check on white was similar. This shows that the green check pattern and the purple pigmentation are having the same degree of expression in the F_1 fruits giving it the peculiar colour pattern.

In fru it shape the F_1 was found to be intermediate, but in size it was more approximating to the geometric mean of the fruits of the two parents.

3. Insect resistance

One of the important aims of the present investigation was to find the possibility to transfer the insect resistance character from the solanum melongena var. insanum to the cultivated brinjal varieties. As a weed growing wild on waste lands, the var. insanum was observed to be showing strong resistance to pest attacks especially against shoot and fruit borers.

But the experimental results show that the F_1 hybrids have generally failed to produce any significant resistance to any of the 4 insects studied except in the case of one cross. HM x SI alone showed a significant resistance against the Epilachna beetles. With regard to the shoot and fruit borers, the general incidence of the pests itself was very poor to have an effective comparison of the F_1s with their parents. The wild parent (insanum) showed complete resistance to shoot and fruit borers and the lowest counts so far as the other pests are concerned. From these findings it is suggested that the pest resistant character in S. melongena var. insanum is controlled by a recessive gene or by polygenes which are inactive in the presence of an alien susceptible genome.

4. Wilt disease resistance

The most important economic objective in this study has been to transfer wilt resistance obtained in var. insanum into cultivated brinjal varieties. The experimental results clearly show that the wilt resistance of the S. melongena var. insanum has been fully transmitted to the F_1 plants in all the 3 crosses. In the special 'sick soil' pot culture experiment, it was noted that while none of the F_1 plants or the var. insanum plants was affected by wilt more than 60 per cent of the cultivated brinjal varieties wilted.

As Suzuki et al. (1967) suggested, it is clear that the wilt resistance in egg plants and related wild plants is controlled by hereditary units. Clarke (1955) has found that in tomato the disease resistance was dominant over susceptibility. Sinclair and Walker (1955) in a study of inheritance to mosaic virus in cowpea have reported that resistance is determined by a single dominant gene. The results from the present investigations are in line with the above findings. Based on the success obtained in this study it is suggested that there is possibility to breed wilt resistant brinjal varieties combining the desirable characters of both parents.

5. Chemical studies

From the results it is primarily noted that in all the 3 crosses the F_1 hybrids have showed a significant increase in all the 4 components investigated namely dry matter, starch, protein and total alkaloid, compared with the brinjal parents. In the case of protein it was noted that F_1 was intermediate in all the 3 crosses, where as in the case of dry matter, and alkaloids except the cross PLD x SI in all others the F_1 was intermediate. In the case of starch only in one cross (PLD x SI) the F_1 was intermediate. These results in a general way suggest that the dry matter as well as other chemical constituents in the brinjal fruits are controlled by polygenes. Only F_2 segregation studies would conclusively prove this point.

Since it is found that the alkaloid content of the wild parent is 8 to 18 times higher than that found in the cultivated brinjal varieties, during selection in the segregating generations for economic characters care should be taken to make sure that the selected plants have only a low level of alkaloid content.

6. Cytological studies

Except in one cross (RM x SI) the F_1s and parents showed no significant difference in pollen size or sterility. In the cross RM x SI the F_1s showed a significant increase in both pollen size and pollen sterility.

In accordance with the findings of Rai (1959), the Chromosome number of S. melongena var. insanum was counted as n = 12 in meiotic cells which is similar to that found in the other cultivated varieties of brinjal.

Studies of meiosis revealed no abnormalities. Pairing was found to be regular and normal, and 12/12 distribution at anaphase was observed. This is in accordance with the findings of Rao (1965) and Rao (1966).

7. Economic importance

The results of the present investigation point to certain advantageous aspects in the utilisation of the wild forms for the improvement of the cultivated varieties of S. melongena. The hardiness of the wild forms which is constituted by the association of different attributes like drought resistance, disease resistance, number of fruits per plant etc. can be transferred to the cultivated varieties by a back cross breeding programme. The characteristics of high percentage of fruit set and fruit bearing habit found in the wild form have been successfully introduced into the cultivated varieties. Based on this observation, it is suggested that there is great scope for getting a positive transgressive variation in respect to the fruit bearing habit in the progenies of hybrids of brinjal and this will afford the possibility of selection of types superior to the existing ones.

SUMMARY

S U M M A R Y

1. The cyto-morphological and chemical aspects of 3 F_1 hybrids of crosses involving 3 cultivated brinjal varieties (Round Special, Round Mixed and Purple Long Datta) and one wild brinjal variety (S. melongena var. insanum) were studied.

2. All the 3 F_1 hybrids showed a high degree of heterosis in many economically important characters like number of branches, earliness, total number of flowers and total number of fruits per plant.

3. The F_1 hybrids were intermediate in flower size, mean leaf area, percentage of fruit set, number of seeds per fruit and germination percentage of F_2 seeds.

4. In fruit size of the F_1s were approximating more to the geometric mean than arithmetic mean of the two parents.

5. The insect resistance capacity of Var. insanum was not observed in the F_1 hybrids and it is probable that the character is either controlled by a recessive gene or by polygenes which are inactive in the presence of an alien susceptible genome.

6. The F_1, like its male parent S. melongena var. insanum showed immunity against wilt disease. The results are

promising in revealing the possibility to select a wilt resistant brinjal plant which combines some of the economic characters of both parents from the segregating backcross generations in the course of continuing this line of work in future.

7. The chemical analysis showed that all the 3 F_1 hybrids showed a significant increase in dry matter, starch, protein and total alkaloids in line with high doses of these ingredients found in the wild parent S. melongena var. insanum.

8. The cytological studies revealed that the chromosome number of S. melongena var. insanum was n = 12 and that the meiotic behaviour of the F_1 hybrids was normal.

9. The possibility to utilize var. insanum, the wild relative of brinjal plant, in the breeding programme for the improvement of brinjal varieties to transfer hardiness, disease resistance, increased fruit number and higher nutritive value has been clearly established in this work.

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APPENDICES

APPENDIX

Test criteria and critical values for the various tests of significance applied in the analysis of data

1. **Table V**

Root length of seedlings

RS x SI	Vs	RS:	T.C.	= 12.31;	C.V. t 22(.05)	= 2.07
"	Vs	PM:	T.C.	= 11.40;	"	= 2.07
RM x SI	Vs	RM:	T.C.	= 6.21;	"	= 2.07
"	Vs	PM:	T.C.	= 5.82;	"	= 2.07
PLD x SI	Vs	PLD:	T.C.	= 12.61;	"	= 2.07
"	Vs	PM:	T.C.	= 9.27;	"	= 2.07

2. **Table VII**

Height of plant

RS x SI	Vs	RS:	T.C.	= 0.71;	C.V. t 22(.05)	= 2.07
"	Vs	PM:	T.C.	= 2.31;	C.V.11,11,17°-12'(.05)	=2.18
RM x SI	Vs	RM:	T.C.	= 2.12;	C.V.11,11,25°-12'(.05)	=2.17
"	Vs	PM:	T.C.	= 3.31;	C.V.11,11,29°-6' (.05)	=2.21
PLD x SI	Vs	PLD:	T.C.	= 6.32;	C.V.7,11,10°-24' (.05)	=2.17
"	Vs	PM:	T.C.	= 6.41;	C.V. 11,7,8°-0 (.05)	=2.18

3. **Table VIII**

Number of leaves

RS x SI	Vs	RS:	T.C.	= 7.3;	C.V-t 22 (.05)	= 2.07
"	Vs	PM:	T.C.	= 5.8;	"	= 2.07
RM x SI	Vs	RM:	T.C.	= 6.51;	"	= 2.07
"	Vs	PM:	T.C.	= 5.31;	"	= 2.07
PLD x SI	Vs	PLD:	T.C.	= 8.41;	C.V.10,10,10°-36'	= 2.21
"	Vs	PM:	T.C.	= 5.21;	C.V.10,10,15°-20'	= 2.25

4. <u>Table IX</u>

<u>Number of branches</u>

RS x SI	Vs	RS	:	T.C. =	11.47;	C.V.-t 22(.05)	= 2.07
"	Vs	PM	:	T.C. =	4.56;	"	= 2.07
RM x SI	Vs	RM	:	T.C. =	10.61;	"	= 2.07
"	Vs	PM	:	T.C. =	4.21;	"	= 2.07
PLD x SI	Vs	PLD	:	T.C. =	5.13;	C.V-7,7,1°-24'	= 2.35
"	Vs	PM	:	T.C. =	8.86;	C.V-11,7,24°-42'	= 2.52

5. <u>Table X</u>

Spread of the plant

RS x SI	Vs	RS	:	T.C. =	7.3;	C.V. t 22 (.05)	= 2.07
"	Vs	PM	:	T.C. =	7.9;	"	= 2.07
RM x SI	Vs	RM	:	T.C. =	7.7;	"	= 2.07
"	Vs	PM	:	T.C. =	9.2;	"	= 2.07
PLD x SI	Vs	PLD	:	T.C. =	7.2;	"	= 2.07
"	Vs	PM	:	T.C. =	8.1;	"	= 2.07

6. <u>Table XI</u>

<u>Internodal length</u>

RS x SI	Vs	RS	:	T.C. =	5.14;	C.V. t 22 (.05)	= 2.07
"	Vs	PM	:	T.C. =	8.5;	"	= 2.07
RM x SI	Vs	RM	:	T.C. =	4.5;	"	= 2.07
"	Vs	PM	:	T.C. =	5.3;	"	= 2.07
PLD x SI	Vs	PLD	:	T.C. =	0.38;	"	= 2.07
"	Vs	PM	:	T.C. =	7.1;	"	= 2.07

7. Table XII

Area of leaves

RS x SI	Vs	RS	:	T.C. = 11.1;	C.V. t 22 (.05)	= 2.07
"	Vs	PM	:	T.C. = 1.3;	"	= 2.07
RM x SI	Vs	RM	:	T.C. = 7.9;	"	= 2.07
"	Vs	PM	:	T.C. = 1.05;	"	= 2.07
PLD x SI	Vs	PLD	:	T.C. = 17.3;	"	= 2.07
"	Vs	PM	:	T.C. = 7.3;	"	= 2.07

8. Table XIII

Time of flowering

RS x SI	Vs	Rs	:	T.C. = 3.7;	C.V. t 22(.05)	= 2.07
"	Vs	PM	:	T.C. = 3.5;	"	= 2.07
RM x SI	Vs	RM	:	T.C. = 2.36;	"	= 2.07
"	Vs	PM	:	T.C. = 2.85;	"	= 2.07
PLD x SI	Vs	PLD	:	T.C. = 8.41;	"	= 2.07
"	Vs	PM	:	T.C. = 5.31;	"	= 2.07

9. Table XIV

Flower size

RS x SI	Vs	RS	:	T.C. = 7.8;	C.V. t 22 (.05)	= 2.07
"	Vs	PM	:	T.C. = 0.14;	"	= 2.07
RM x SI	Vs	RM	:	T.C. = 4.3;	"	= 2.07
"	Vs	PM	:	T.C. = 2.3;	"	= 2.07
PLD x SI	Vs	PLD	:	T.C. = 7.5;	"	= 2.07
"	Vs	PM	:	T.C. = 1.5;	"	= 2.07

10. Table XV

Number of flowers per plant (total)

RS x SI	Vs	RS	T.C. = 4.9;	C.V. t 22(.05)	= 2.07
"	Vs	PM	T.C. = 5.5;	"	= 2.07
RM x SI	Vs	RM	T.C. = 6.1;	"	= 2.07
"	Vs	PM	T.C. = 6.1;	"	= 2.07
PLD x SI	Vs	PLD	T.C. = 7.1;	"	= 2.07
"	Vs	PM	T.C. = 7.5;	"	= 2.07

11. Table XVI

Number of long styled flowers per plant

RS x SI	Vs	RS	: T.C. = 7.89;	C.V. t 22(.05)	= 2.07
"	Vs	PM	: T.C. = 5.20;	"	= 2.07
RM x SI	Vs	RM	: T.C. = 10.2;	"	= 2.07
"	Vs	PM	: T.C. = 5.10;	"	= 2.07
PLD x SI	Vs	PLD	: T.C. = 8.35;	"	= 2.07
"	Vs	PM	: T.C. = 6.41;	"	= 2.07

12. Table XVII

Percentage of short styled flowers per plant

RS x SI	Vs	RS	: T.C. = 1.2;	C.V. t 22 (.05)	= 2.07
"	Vs	PM	: T.C. = 5.7;	"	= 2.07
RM x SI	Vs	RM	: T.C. = 3.5;	"	= 2.07
"	Vs	PM	: T.C. = 3.7;	"	= 2.07
PLD x SI	Vs	PLD	: T.C. = 1.2;	"	= 2.07
"	Vs	PM	: T.C. = 5.0;	"	= 2.07

13. <u>Table XVIII</u>

<u>Percentage of fruit set</u>

RS x SI	Vs	RS	:	T.C. = 3.06;	C.V. t 22 (.05)	= 2.07
"	Vs	PM	:	T.C. = 1.10;	"	= 2.07
RM x SI	Vs	RM	:	T.C. = 7.4;	"	= 2.07
"	Vs	PM	:	T.C. = 1.5;	"	= 2.07
PLD x SI	Vs	PLD	:	T.C. = 0.92;	"	= 2.07
"	Vs	PM	:	T.C. = 3.33;	"	= 2.07

14. <u>Table XIX</u>

<u>Number of total fruits harvested per plant</u>

RS x SI	Vs	RS	:	T.C. = 6.5;	C.V. t 22 (.05)	= 2.07
"	Vs	PM	:	T.C. = 4.05;	"	= 2.07
RM x SI	Vs	RM	:	T.C. = 8.21;	"	= 2.07
"	Vs	PM	:	T.C. = 4.71;	"	= 2.07
PLD x SI	Vs	PLD	:	T.C. = 5.82;	"	= 2.07
"	Vs	PM	:	T.C. = 6.02;	"	= 2.07

15. <u>Table XX</u>

<u>Length of fruit</u>

RS x SI	Vs	RS	:	T.C. = 34.0;	C.V. t 22 (.05)	= 2.07
"	Vs	PM	:	T.C. = 4.9;	"	= 2.07
RM x SI	Vs	RM	:	T.C. = 26.0;	"	= 2.07
"	Vs	PM	:	T.C. = 3.9;	"	= 2.07
PLD x SI	Vs	PLD	:	T.C. = 82.2;	"	= 2.07

16, Table XXI

Girth of fruits

RS x SI	Vs	RS	:	T.C.	= 36.1; C.V. t 22 (.05)	= 2.07
"	Vs	PM	:	T.C.	= 2.55; "	= 2.07
RM x SI	Vs	RM	:	T.C.	= 30.0; "	= 2.07
"	Vs	PM	:	T.C.	= 2.2; "	= 2.07
PLD x SI	Vs	PLD	:	T.C.	= 7.3; "	= 2.07
"	Vs	PM	:	T.C.	= 4.9; "	= 2.07

17. Table XXII

Weight of fruit harvested per plant

RS x SI	Vs	RS	:	T.C.	= 2.42; C.V. t 22 (.05)	= 2.07
"	Vs	PM	:	T.C.	= 3.26; "	= 2.07
RM x SI	Vs	RM	:	T.C.	= 4.5; "	= 2.07
"	Vs	PM	:	T.C.	= 1.7; "	= 2.07
PLD x SI	Vs	PLD	:	T.C.	= 1.8; "	= 2.07
"	Vs	PM	:	T.C.	= 4.03; "	= 2.07

18. Table XXIII

Number of seeds per fruit (F_2)

RS x SI	Vs	RS	:	T.C.	= 3.91; C.V.t.4 (.05)	= 2.776
"	Vs	PM	:	T.C.	= 1.06; "	= 2.776
RM x SI	Vs	RM	:	T.C.	= 7.67; "	= 2.776
"	Vs	PM	:	T.C.	= 1.26; "	= 2.776
PLD x SI	Vs	PLD	:	T.C.	= 6.24; "	= 2.776
"	Vs	PM	:	T.C.	= 3.30; "	= 2.776

19. Table XXIV

Weight of F_2 seeds

RS x SI	Vs	RS	:	T.C.	= 3.88;	C.V.t4 (.05)	= 2.776
"	Vs	PM	:	T.C.	= 5.50;	"	= 2.776
RM x SI	Vs	RM	:	T.C.	= 4.61;	"	= 2.776
"	Vs	PM	:	T.C.	= 3.52;	"	= 2.776
PLD x SI	Vs	PLD	:	T.C.	= 2.97;	"	= 2.776
"	Vs	PM	:	T.C.	= 7.30;	"	= 2.776

20. Table XXV

Germination percentage of F_2 seeds

RS x SI	Vs	RS	:	T.C.	= 4.89;	C.V.t4 (.05)	= 2.776
"	Vs	PM	:	T.C.	= 1.92;	"	= 2.776
RM x SI	Vs	RM	:	T.C.	= 5.45;	"	= 2.776
"	Vs	PM	:	T.C.	= 0.93;	"	= 2.776
PLD x SI	Vs	PLD	:	T.C.	= 3.60;	"	= 2.776
"	Vs	PM	:	T.C.	= 0.41;	"	= 2.776

21. Table XXVI

Length of tap roots

RS x SI	Vs	RS	:	T.C.	= 27.2;	C.V.t22(.05)	= 2.07
"	Vs	PM	:	T.C.	= 12.8;	"	= 2.07
RM x SI	Vs	RM	:	T.C.	= 23.5;	"	= 2.07
"	Vs	PM	:	T.C.	= 12.4;	"	= 2.07
PLD x SI	Vs	PLD	:	T.C.	= 8.9;	"	= 2.07
"	Vs	PM	:	T.C.	= 2.6;	"	= 2.07

TABLE XXVIII

Analysis of variance table for Aphis and Jassids count

Source	S.S.	D.F.	Variance	F-ratio
Total	1586.49	20		
Replication	414.82	2	202.41	4.64*
Treatment	919.30	6	153.22	3.51*
Error	522.37	12	43.53	

* Significant at 5% prob. level

C.D. (.05) = 11.74

TABLE XXIX

Analysis of variance table for Epilachna beetle count

Source	S.S.	D.F.	Variance	F-ratio
Total	6193.63	20		
Replication	175.27	2	87.63	0.910
Treatment	4862.89	6	810.48	8.42**
Error	1155.47	12	96.29	

** Significant at 1% prob. level

C.D.(.05) = 17.455

TABLE XXX

Analysis of variance table for shoot borer count

Source	S.S.	D.F.	Variance	F-ratio
Total	1.8555	20		
Replication	0.0051	2	0.0025	0.0213
Treatment	0.4438	6	0.0740	0.6310
Error	1.4066	12	0.1172	

Treatments not significant

TABLE XXXI

Analysis of variance table for fruit borer count

Source	S.S.	D.F.	Variance	F-ratio
Total	52.25	20		
Replication	16.63	2	8.31	9.337**
Treatment	24.89	6	4.15	4.663*
Error	10.73	12	0.89	

* Significant at 5% prob. level

** .. .. 1% .. ..

C.D. (.05) = 1.6704

22. <u>Table XXXII</u>

<u>Dry matter content of the fruits</u>

RS x SI	Vs	RS	: T.C.	= 15.7;	C.V. t4 (.05) = 2.776
"	Vs	PM	: T.C.	= 1.25;	" = 2.776
RM x SI	Vs	RM	: T.C.	=, 5.71;	" = 2.776
"	Vs	PM	: T.C.	= 1.66;	" = 2.776
PLD x SI	Vs	PLD	: T.C.	= 6.66;	" = 2.776
"	Vs	PM	: T.C.	= 4.83;	" = 2.776

23. <u>Table XXXIII</u>

<u>Starch content of fruits</u>

RS x SI	Vs	RS	: T.C.	= 4.75;	C.V. t4 (.05) = 2.776
"	Vs	PM	: T.C.	= 4.45;	" = 2.776
RM x SI	Vs	RM	: T.C.	= 8.35;	" = 2.776
"	Vs	PM	: T.C.	= 4.72;	" = 2.776
PLD x SI	Vs	PLD	: T.C.	= 8.54;	" = 2.776
"	Vs	PM	: T.C.	= 1.46;	" = 2.776

24. <u>Table XXXIV</u>

<u>Protein content of fruits</u>

RS x SI	Vs	RS	: T.C.	= 4.78;	C.V. t4 (.05) = 2.776
"	Vs	PM	: T.C.	= 3.51;	" = 2.776
RM x SI	Vs	RM	: T.C.	= 5.00;	" = 2.776
"	Vs	PM	: T.C.	= 1.70;	" = 2.776
PLD x SI	Vs	PLD	: T.C.	= 6.41;	" = 2.776
"	Vs	PM	: T.C.	= 0.55;	" = 2.776

25. <u>Table XXXV</u>

<u>Alkaloid content of the fruits</u>

RS x SI	Vs	RS	: T.C.	= 14.89;	C.V. t4 (.05)	= 2.776
"	Vs	PM	: T.C.	= 0.169;	"	= 2.776
RM x SI	Vs	RM	: T.C.	= 11.60;	"	= 2.776
"	Vs	PM	: T.C.	= 0.318;	"	= 2.776
PLD x SI	Vs	PLD	: T.C.	= 28.16;	"	= 2.776
"	Vs	PM	: T.C.	= 9.65;	"	= 2.776

26. <u>Table XXXVI</u>

<u>Pollen size</u>

RS x SI	Vs	RS	: T.C.	= 0.42;	C.V. (.05)	= 1.96
"	Vs	PM	: T.C.	= 0.65;	"	= 1.96
RM x SI	Vs	RM	: T.C.	=15.81;	"	= 1.96
"	Vs	PM	: T.C.	=12.94;	"	= 1.96
PLD x SI	Vs	PLD	: T.C.	= 0.298;	"	= 1.96
"	Vs	PM	: T.C.	= 0.291;	"	= 1.96

27. <u>Table XXXVII</u>

<u>Pollen sterility</u>

RS x SI	Vs	RS	: T.C.	= 0.98;	C.V. t16(.05)	= 2.12
"	Vs	PM	: T.C.	= 1.30;	"	= 2.12
RM x SI	Vs	RM	: T.C.	= 6.10;	"	= 2.12
"	Vs	PM	: T.C.	= 2.70;	"	= 2.12
PLD x SI	Vs	PLD	: T.C.	= 1.51;	"	= 2.12
"	Vs	PM	: T.C.	= 1.32;	"	= 2.12

<u>Index</u>

PM = Parental Mean
TC = Test Criterion
CV = Critical Value

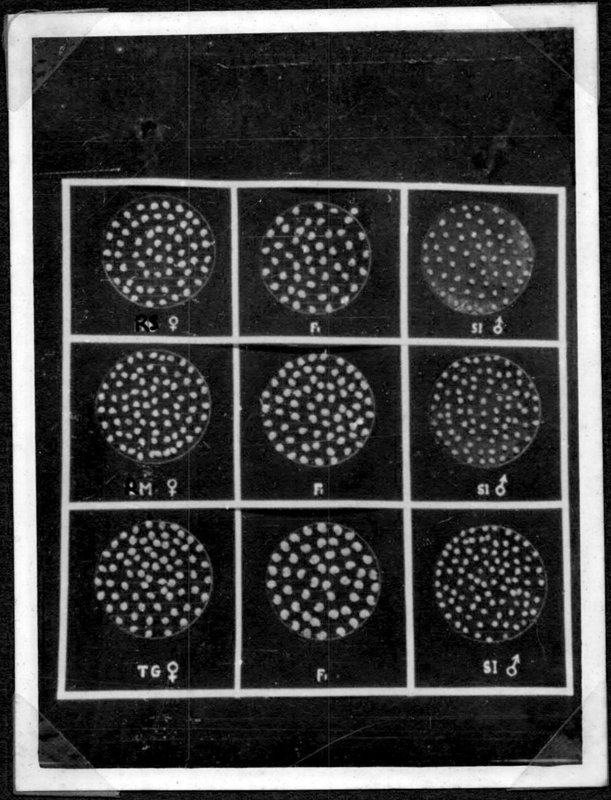
RS = Round Special
RM = Round Mixed
PLD = Purple Long Datte

PLATE I

Fig. 1 Photograph showing the comparative size of the F_1 and parental seeds.

RS	=	Round Special
RM	=	Round Mixed
TG	=	Thorny Giant
SI	=	*S. melongena* var. *insanum*.

Fig. 2 Photograph showing the taproot length of seedlings of F_1 and parents.

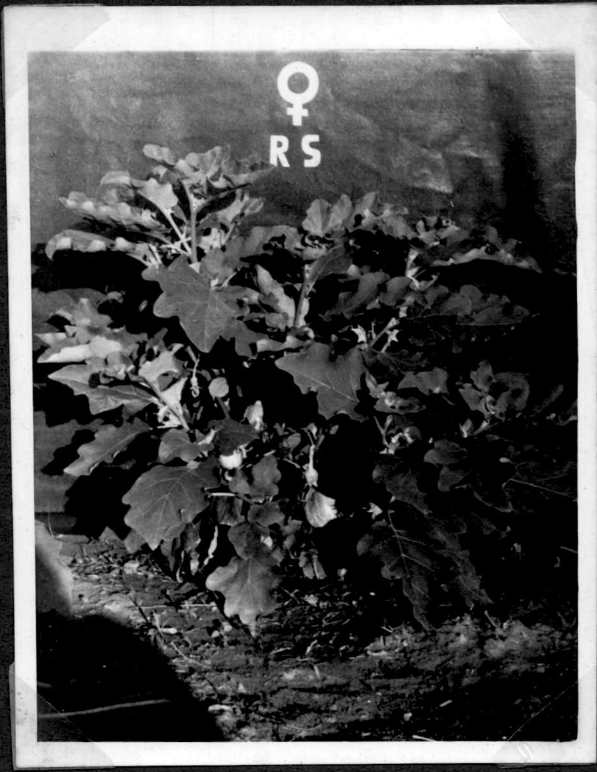

RS ♀
F1
S1 ♂
RM ♀
F1
S1 ♂
TG ♀
F1
S1 ♂


♀
RS PLD RM
F1
♂
S1

PLATE II

Fig. 1 Photograph showing the female parent Round Special.

Fig. 2 Photograph showing the female parent Round Mixed.

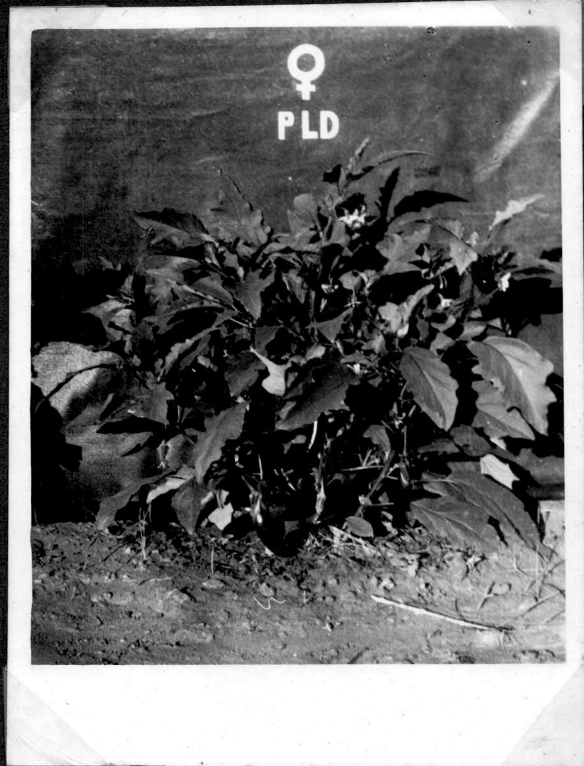

♀
RS


♀
RM

PLATE III

Fig. 1 Photograph showing the female parent Purple Long Datta.

Fig. 2 Photograph showing the male parent *S. melongena* var. *insanum*.


♀
PLD

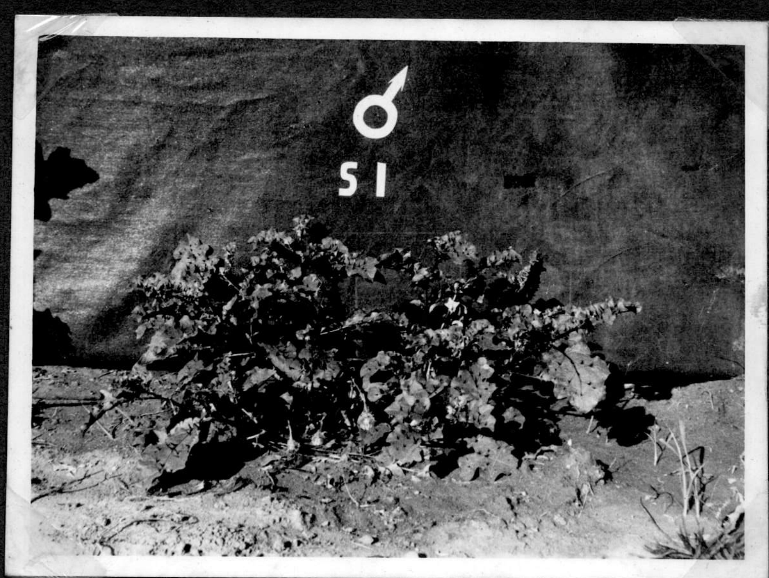
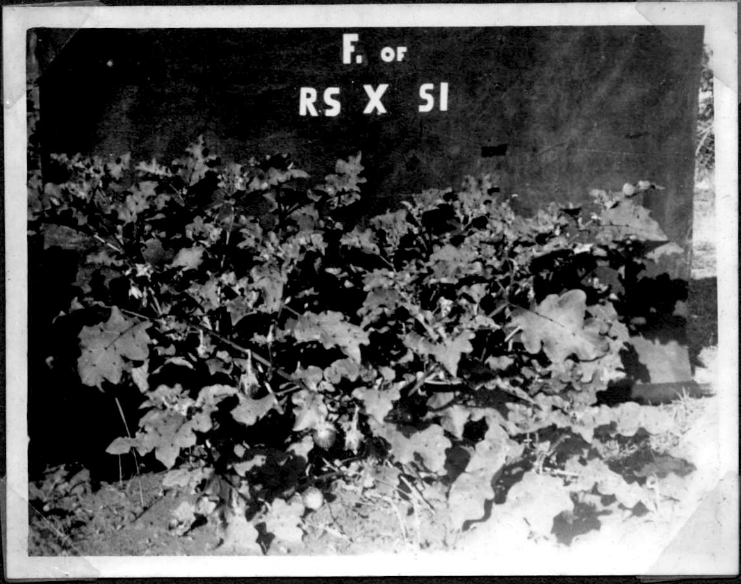

♂
S1

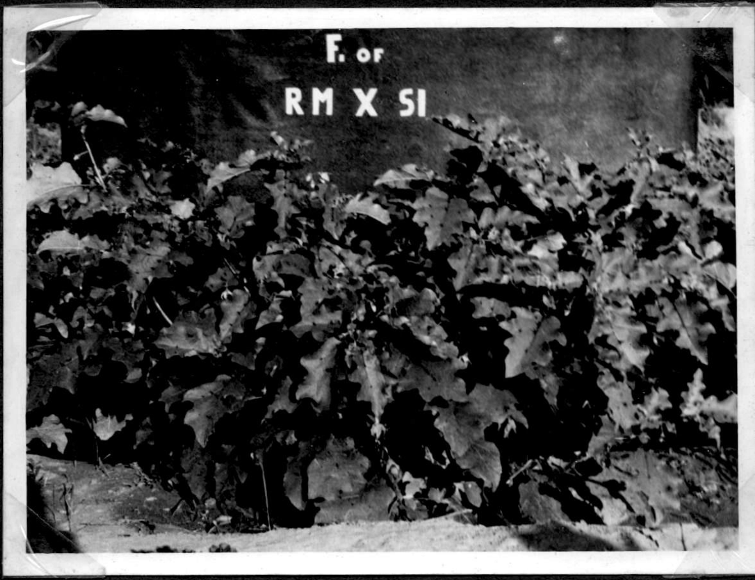
PLATE IV

Fig. 1 Photograph showing the F_1 hybrid of the cross Round Special x S. melongena var. insanum.

Fig. 2 Photograph showing the F_1 hybrid of the cross Round Mixed x S. melongena var. insanum.

Fig. 3 Photograph showing the F_1 hybrid of the cross Purple Long Datta x S. melongena var. insanum.


F. OF
RS X SI


F. OF
RM X SI

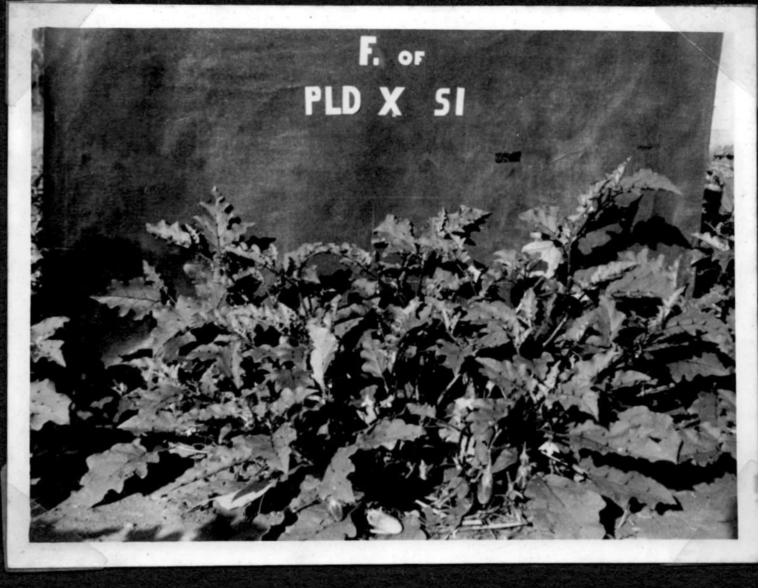
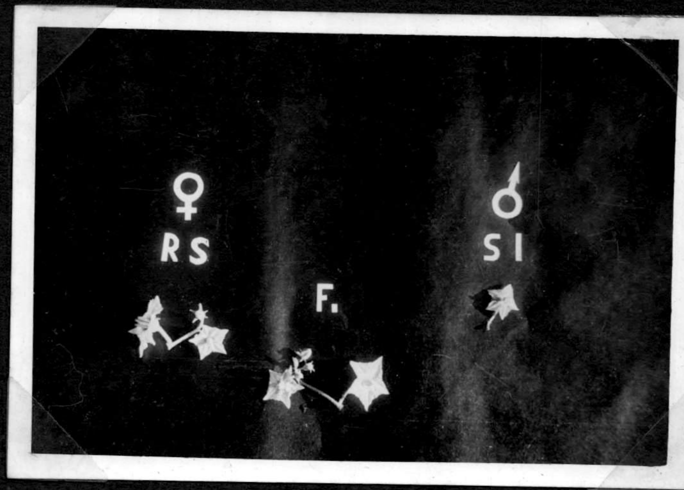

F. OF
PLD X SI

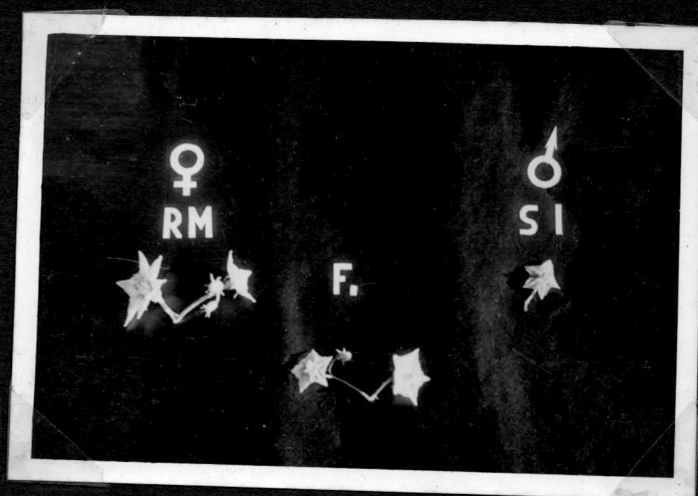
PLATE V

Fig. 1 Photograph showing the flower size of the F_1 hybrids and parents of the cross RS x SI.

Fig. 2 Photograph showing the flower size of the F_1 hybrids and parents of the cross RM x SI

Fig. 3 Photograph showing the flower size of the F_1 hybrids and parents of the cross PLD x SI.


♀
RS
F.
♂
S I


♀
RM
F.
♂
S I

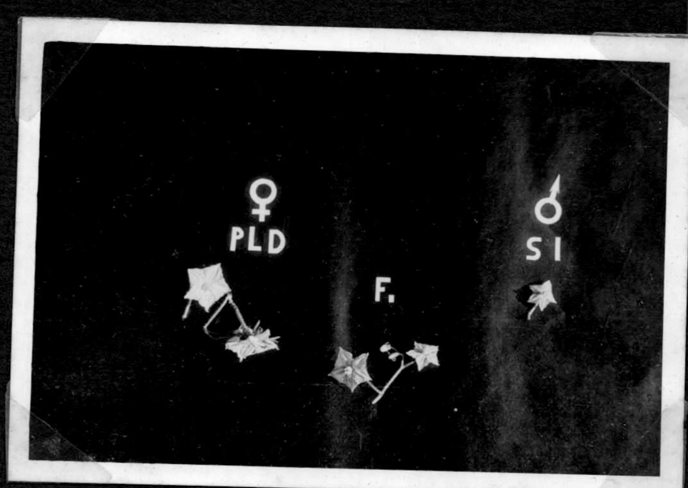
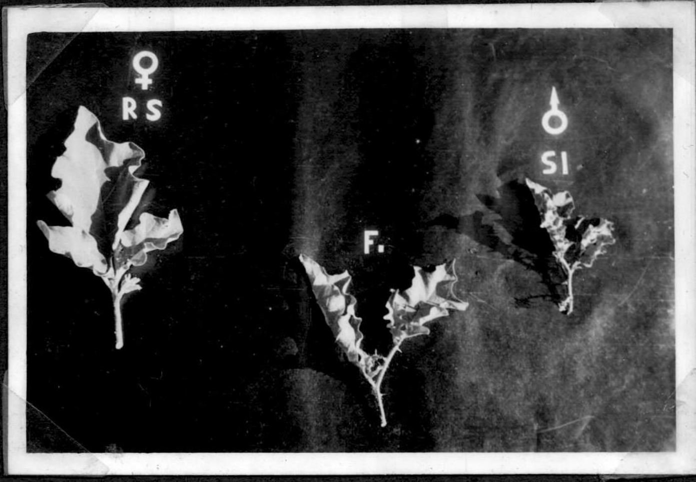

♀
PLD
F.
♂
S I

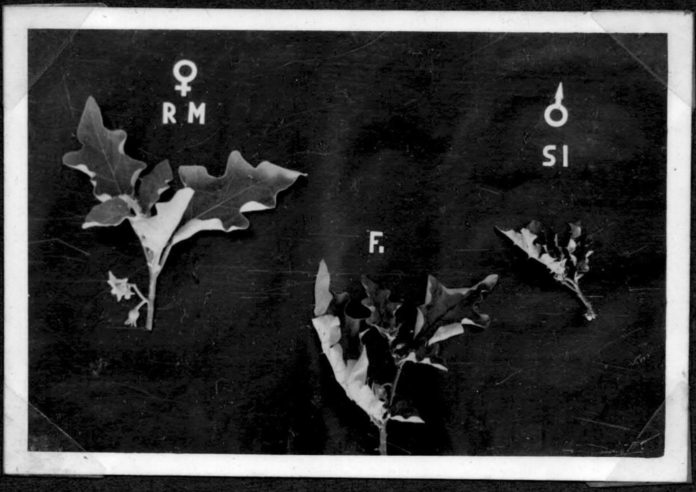
PLATE VI

Fig. 1 Photograph showing a shoot with leaves and flower buds of the F_1 hybrid and parents of the cross RS x SI.

Fig. 2 Photograph showing a shoot with leaves and flower buds of the F_1 hybrids and parents of the cross RM x SI.

Fig. 3 Photograph showing a shoot with leaves and flower buds of the F_1 hybrids and parents of the cross PLD x SI.


♀
RS
F.
♂
S1


♀
RM
F.
♂
S1

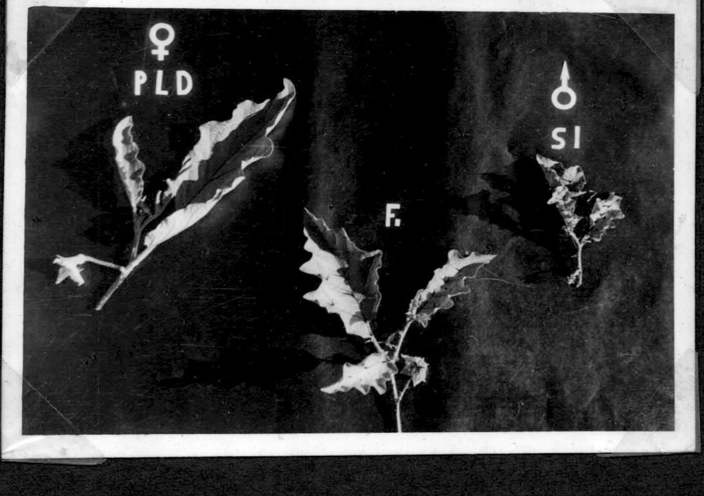
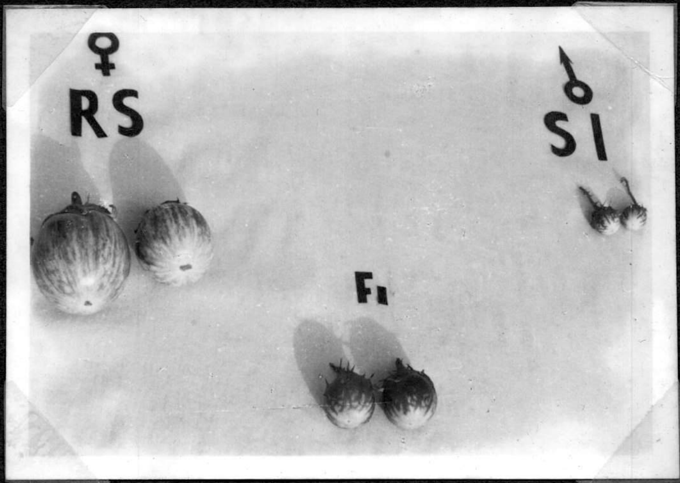

♀
PLD
F.
♂
S1

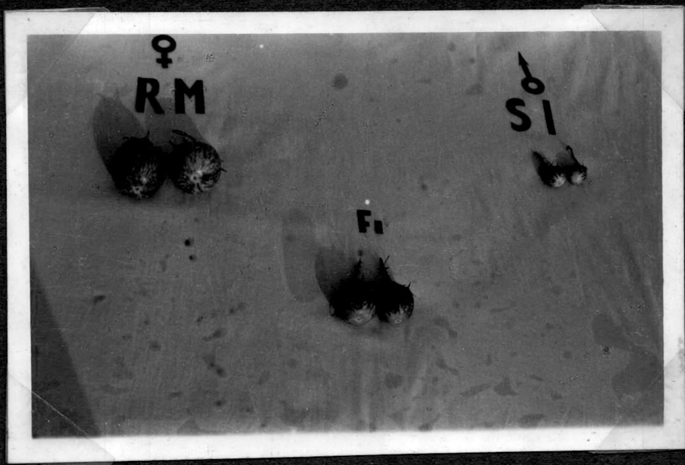
PLATE VII

Fig. 1 Photograph showing the fruit shape and size of the parents and F_1 hybrids of the cross RS x SI.

Fig. 2 Photograph showing the fruit shape and size of the parents and F_1 hybrids of the cross HM x SI.

Fig. 3 Photograph showing the fruit shape and size of the parents and F_1 hybrid of the cross PLD x SI.


♀
RS
♂
SI
F1


♀
RM
♂
SI
F1

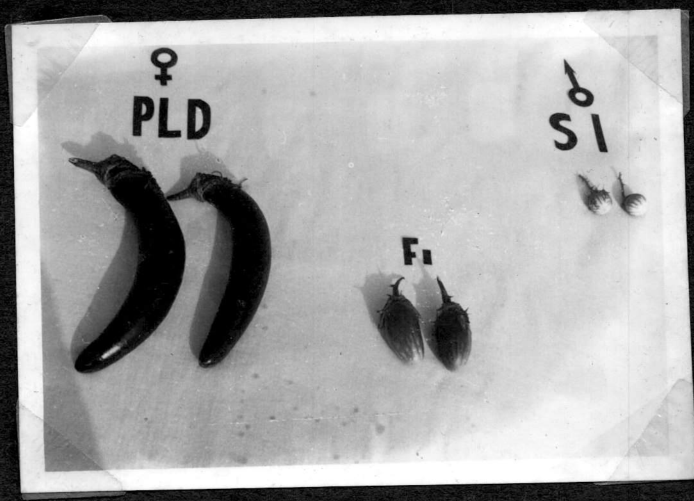

♀
PLD
♂
SI
F1

PLATE VIII

Fig. 1 Photograph showing the clustered fruit habit of the male parent and F_1 hybrid of the cross PLD x SI.

Fig. 2 Photo micrograph showing meiotic stages in P.M.C. of S. melongena var. insanum. In the left hand corner the metaphase chromosomes can be counted as n = 12.

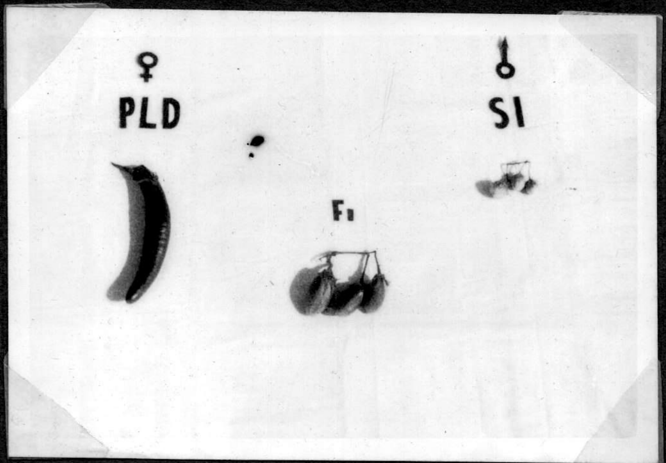
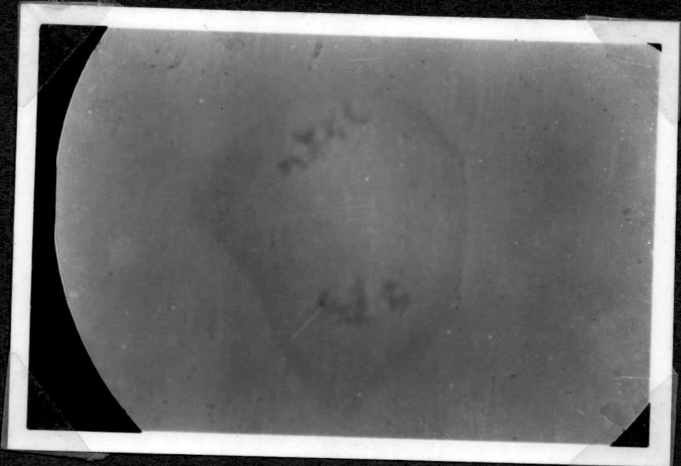

♀
PLD
♂
SI
F1

PLATE IX

Fig. 1 Photo micrograph showing the meiotic stages in P.M.C. of the F_1 hybrid of the cross PLD x SI. The 12/12 separation of the homologous chromosomes can be seen

Fig. 2 Photo micrograph showing the meiotic stages in P.M.C. of the F_1 hybrid of the cross RM x SI.

Fig. 3 Photo micrograph showing the meiotic stages in P.M.C. of the cross RS x SI.



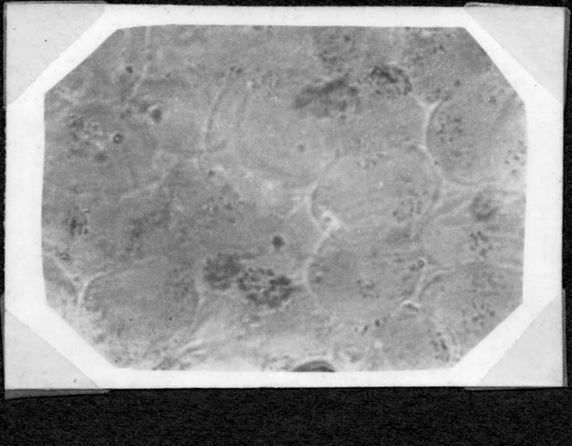


PLATE X

Figure showing the colour, shape and other morphological details of the fruits of parents and F_1 hybrids of the crosses PLD x SI and RS x SI.


PLD
♀
F1
SI
♂
RS
♀
F1
SI
♂
1