STUDY OF HETEROSIS AND PERFORMANCE OF EGGPLANNT DURING SUMMER SEASON

MD.MAHAMUDUL BASHIR

DEPARTMENT OF HORTICULTURE
SHER-E BANGLA AGRICULTURAL UNIVERSITY

DHAKA – 1207

DECEMBER, 2020

Study of Heterosis and Performance of Eggplant During Summer Season

BY

MD. MAHAMUDUL BASHIR
REGISTRATION NO. 18-09084

A Thesis Submitted to
the Faculty of Agriculture
Sher- e-Bangla Agricultural University, Dhaka
In partial fulfillment of the prerequisites
for the degree
of

MASTERS OF SCIENCE (MS)
IN
HORTICULTURE

SEMESTER: JULY-DECEMBER, 2020

APPROVED BY:

Md. Hasanuzzaman Akand
Professor
Department of Horticulture
SAU, Dhaka
Supervisor

Dr. AKM Quamruzzaman
Principal Scientific Officer
BARI, Gazipur
Co-Supervisor

Prof. Dr. Md. Jahedur Rahman
Chairman
Examination Committee
Department of Horticulture

Department of Horticulture
Sher-e-Bangla Agricultural University Sher-e -Bangla Nagar, Dhaka-1207

Memo No.: Date:

CERTIFICATE

This is to certify that the thesis entitled ***"STUDY OF HETEROSIS & PERFORMANCE OF EGGPLANNT DURING SUMMER SEASON"*** *submitted to the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE IN HORTICULTURE****, embodies the result of a piece of Bonafede research work carried out by* ***MD. MAHAMUDUL BASHIR,*** *Registration No.* ***18-09O84*** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

Date: December 2020

Dhaka Bangladesh

Prof. Md. Hasanuzzaman Akand
Professor
Department of Horticulture
Sher-e- Bangla agricultural University
Sher -e- Bangla Nagar, Dhaka-1207
Supervisor

DEDICATED TO MY

BELOVED PARENTS

ACKNOWLEDGEMENTS

Author is prostrated before Almighty Allah, most merciful and beneficent, for giving the strength and courage to successfully complete the research work.

Firstly, I would like to express my sincere appreciation and gratitude to my supervisor, Md. Hasanuzzaman Akand, professor Department of Horticulture, Sher-e-Bangla Agricultural University for his guidance and constant encouragement during my research. His support and inspiring suggestions have been precious for the development of this thesis content.

I am also indebted to my co-supervisor, Dr. AKM Quamruzzaman and all my other teachers and stuff of Department of Horticulture, Sher-e-Bangla Agricultural University, they have been a constant source of encouragement and enthusiasm, not only during this thesis work but also during the two years of my Master's program.

My deepest gratitude goes to my family for their unflagging love and unconditional support throughout my life and my studies. You made me live the most unique, magic and carefree childhood that have made me who I am now.

Finally, I wish to thank all my fellow lab mates for being there in all the hard work and sharing my joys and sorrows. I am deeply indebted for their inspiration, co-operation and moral supports which can never be forgotten.

The Author

Study of Heterosis and Performance of Eggplant During Summer Season

BY

MD. MAHAMUDUL BASHIR

ABSTRACT

The study was conducted at the experimental farm of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh during the period from March to September 2019.The main objective of the experiment was to study the heterosis and horticultural performance of newly developed eggplant hybrids during summer season. The heterotic performance for different parameters were estimated in a 7×7 half-diallel fashion of eggplant (*Solanum melongena* L.). The cross P4 x P6 took shortest time(73.67days) for 50% flowering followed by P1 x P6 (74.67days). The parent P1 took shortest time for first harvest (46.67days) followed by P1 x P7 (57.67 days). The parent P4 showed highest no. of primary branches at last harvest (6.67) followed by P3 x P4 (6.07) and P1x P7 (6.03). The parent P1 and P7 showed highest no. of flowers/ cluster (5.33) followed by P1 x P5 (4.33), P4 x P6 (4.33) and P3 (4.33), while P7 showed highest no. of fruits/ cluster (4.00) followed by P1 x P7 (3.33), P1 (3.33). The hybrid P2 x P4 showed highest % fruit set (97.67) followed by P2 x P5 (81.00). The parent P2 showed highest individual fruit weight (445.00g) followed by P2 x P6 (401.33g). The hybrid P3 x P4 showed longest fruit length (26.67cm) followed by P4 (24.33cm), P3 (23.00cm) and P7 (23.00cm), while P2 showed longest fruit diameter (11.67cm) followed by P2 x P6 (9.73cm) whereas P3 showed shortest fruit diameter (2.70cm) followed by P3x P4 (2.73cm). The hybrid P3 x P7 showed highest no. of fruits per plant (39.67) followed by P1x P7 (38.30). The significant highest fruit yield/plant was produced in P1 x P6 showed highest yield/plant (4.10kg) followed by P4 x P5 (4.03kg), P2 x P5 (4.02kg), P5 x P6 (3.77kg) and P4 x P6 (3.74kg) The 7×7 half-diallel fashion (twenty cross combinations) showed significant variation for better parent heterosis of different characters studied. Twenty cross combinations showed significant better parent heterosis for earliness. The highest heterobeltiotic effect was observed in the P2 x P5 (16.96%), for early flowering. Maximum heterotic effect for individual fruit weight was found in the cross P1 x P4 (11.74 %) followed by P1 x P7 (9.96 %), The best heterotic cross for fruits per plant and it was observed from the cross no. of fruits/plant was observed in the hybrid P5 x P6 (35.80%) followed by P1 x P4 (28.37%). In terms of yield per plant the highest heterobeltiosis produced by the cross P1 x P2 (48.65%) followed by P1 x P6 (43.02%).

LIST OF CONTENTS

LIST OF TABLES

LIST OF PLATES

LIST OF APPENDICES

LIST OF ABBREVIATION AND ACRONYMS

ABBREVIATION	FULL WORD
AEZ	Agro-Ecological Zone
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
BP	Better parent
cm	Centimeter
CV	Co-efficient of Variation
et al.	And others
etc.	Etcetera
G	Genotype
GA	Genetic Advance
GCV	Genotypic Co-efficient of Variation
g	Gram
H	Heterosis
J.	Journal
Kg	Kilogram
m	Meter
MP	Mid Parent
MSE	Mean Square of Error
MSS	Mean Sum of Square
mm	Millimeter
No.	Number
%	Percent
P	Parent
RCBD	Randomized Complete Block Design
R	Replication
Res.	Research
SAU	Sher-e-Bangla Agricultural University
SE	Standard Error

CHAPTER I

INTRODUCTION

Eggplant or brinjal is a member the family Solanaceae and under the botanical name *Solanum melongena* L. (Thompson, 1951). It is one of the most important vegetable crops in the tropic and subtropics areas (Bose and Som, 1986). There are three key botanical cultivars beneath the species *Solanum melongena*. The round or eggs shaped cultivars are belonging to var. *esculentum* group. The long and slender kinds are grouped below var. *serpentinum*, and the dwarf brinjal plants are placed in var. *depressum* group. The cultivated kinds of eggplant spreaded eastward from India into China by fifth century B.C., so, the center of origin is the Indian Sub-continent with a secondary center of origin in China (Bosewell, 1937; Yamaguchi, 1983). The eggplant has been grown extensively in Bangladesh, India, Pakistan, Nepal, China, Japan and Philippines. It is also famous in France, Italy, USA, the Mediterranean and Balkan area. Fruits of eggplant contains 92.7 % water, 1.4 % protein, 0.3 % fat, 1.3% fibre and 4.0% Carbohydrate, having a good supply of vitamin A and B but low in vitamin C (Bose and Som, 1986).

From the ancient time, Eggplant has been a popular vegetable in Bangladesh which is widely cultivated and grown up in homestead and commercial land round the year. Eggplant is the most significant vegetable crop in respect of total acreage (126378 ha) and production (516011 ton) in Bangladesh with an average yield of 8.13 tons per hectare (Anonymous, 2019). But the production in summer season is 160149 ton, while in winter is 355862 ton, which is quite little compare to winter season. There are several reasons behind this low production, like pest infestation, warm and humid climate, rainfall and scarcity of suitable summer variety. Whereas the average national per hectare yield of India and Japan is 20.0 and 30.00 t/ha, respectively. In Japan 90% of the brinjal area is planted by F_1 hybrid varieties. The low national yield average of this crop in Bangladesh is owing to comparatively poor yield potential of the present cultivars, which are open-pollinated and prone to bacterial wilt (*Pseudomonas solanacearum*) and brinjal fruit and shoot borer (*Leucinodes orbonalis*). A wide range of changeability of diverse desired characters initiated in eggplant presented few indications of their use in rising the crop through hybridization program. Several studies investigated in Japan and India, have presented distinct hybrid vigour in brinjal. Nagi and Kida (1926) were perhaps the foremost to detect hybrid vigour in crosses among some Japanese eggplant cultivars. Subsequently, several researchers (Kakizaki, 1931; Daskaloff, 1937; Pal and Singh, 1946, 1949; Odland and Noll, 1948). Kakizaki (1931) investigated the heterosis for yield and its component and their findings illustrated 14.8% increased yield of the highest yielding F_1 hybrid. Daskaloff (1937) stated that the typical rise in yield for all crosses ranged from 21.7 to 27.65%. Venkataramani (1946) illustrated that the F_1 hybrids provided increased yield. Pal and Singh (1946, 1949) demonstrated that hybrid in brinjal presented 48.8 to 56.6% raised yield over better parent. Odland and Noll (1948) observed that F_1 hybrid exceeded the parental mean. The hybrids were also early bearing and high yield obtained was investigated to be owing to additional amount to fruits rather than fruit size. Srivastava and Bajpai (1977) have furnished valuable findings about the choice of appropriate parents for hybridization program for developing varieties with desirable characters. Som and Mallik (1979) confirmed 164% yield increase in brinjal from India. In recent years, hybrid vigour in eggplant has also been reported in India by Singh *et al.* (1982), Dhaiya *et al.* (1984), Patil and Shinde (1984), Rajput *et al.*

(1984), Gopinath and Madalageri (1986), Verma (1986), Kumar and Ram (1987). While Rashid *et al.* (1988) demonstrated 50% yield increase in Bangladesh.

Although brinjal is one of the popular vegetables in Bangladesh, yet a prepared and efficient investigation has not been performed for its development, particularly from a breeding point of view. In Bangladesh, Rashid *et al.* (1988) studied the heterosis in eggplant for the first time to investigate the yield and yield contributing characters. They presented best performance in yield per plant up to 48.27% higher than the better parent. Recently, Olericulture Division of Bangladesh Agricultural Research Institute (BARI) invented and released two eggplant hybrids named Tarapuri and Suktara. As the horizontal land increment for the cultivation of brinjal in this country is not possible, and the existing cultivars are prone to insect-pests and diseases, it is almost important at this stage to identify major pest and diseases tolerant strains and to combine these traits together along with high yield. As there are reports about high yielding disease-pest resistant F_1 hybrids in the sub-continent as well as in the world and there are of varieties for diverse characters in brinjal in this country, hybridization can be one of the important solutions in order to increase the yield of this crop. Therefore, the current research was performed to enhance the high yielding hybrid varieties resistant to above mentioned disease-pest and appropriate for summer seasons cultivation and to investigate the heterosis and genetics of yield and yield component in eggplant.

Considering the above scenario, the following objectives were considered for this research experiment:

1. To study heterosis and as well as the best eggplant hybrid varieties for summer season.
2. To measure the horticultural performance of newly developed eggplant hybrids during season of Bangladesh.

CHAPTER II

REVIEW OF LITERATURE

2.1 Heterosis

Heterosis study is one of the efficient methods for the selection of superior cross combinations. Since the exploitation of heterosis has become commercially feasible and more attention is being paid to investigate the phenomenon of hybrid vigour in Eggplant (Kumar *et al.* 2012). A study was performed to classify the superior parental combination and to predict the characteristics of heterosis for yield and its eleven yield components (Dubey *et al.* 2014). Therefore, information available in the literature pertaining to the combining ability analysis, heterotic effect with regards to yield and yield contributing characters in eggplant are reviewed and presented in this section.

2.1.1 Heterosis in Crop Plants-Early History

Heterosis- a intricate biological spectacle observed as the advantage of hybrids over their parents has been a subject of interest for many years. Koelreuter as early as 1893 observed that hybrids often possess increased vigour by comparison with their parents (Sprague, 1983). He found the yields of the hybrids to be higher than those of the parents by as much as 50 % and suggested the use of varietal hybrids in maize (Sprague, 1983). The renewal of Mendel's law in 1900 brought the consideration of the biological creation on difficulties of heredity and led to transformed interest in hybrid vigour as aspect of quantitative inheritance.

The basis for a further wide-ranging empathetic of heterosis was presented by Sprague, 1983. Inadequate earlier works on inbreeding of maize by others, had concentrated on the marked reduction in vigour. Shull was more concentrated with the genetic basis of his observations. The variability among strains undertaking inbreeding, including loss of vigour, was a consequence of segregation and the eventual homozygosity of desirable and deleterious alleles. He also demonstrated that when certain lines were combined, F_1's yields exceeded those of the parental varieties.

2.1.2 Commercial Exploitation of Heterosis in Crop Plants

The commercial exploitation of heterosis in the breeding and improvement of crop hybrids has brought a huge influence to 20th century agriculture, although the genetic basis of the phenomenon remained unclear (Sinha and Khanna, 1975; Mc Daniel, 1986; Rood *et al.*, 1988). Hayes (1952) reported the first recommendation that hybrid vigour be exploited in vegetables in 1916.

The commercial exploitation of heterosis, however, first occurred in 1930’s in maize. The economic impact of hybrid maize was so great that by 1944 more than 80 percent of acreage in USA was sown to hybrids, and by 1960 virtually entirely of the maize grown in the USA was hybrid varieties. Hybrid sorghum, sunflower, tomato, cucumber, onion, capsicum, eggplant, watermelon, cabbage, cauliflower, broccoli, radish and several other horticultural and forage crops are frequently grown on a large scale.

F_1 hybrid eggplants were commercially utilized in Japan before 1952 (Kakizaki, 1930). Hybrid rice is now being grown on an increasing area in China.

According to Mian (1985) heterosis of F_1 is the joint expression of genetical, cytoplasm and physiological features and might be accredited to stimulation resultant from the interaction of varieties heritable factors of the parents. Various manifestations of heterosis are increased yield, reproductive ability, size and general vigour, better quality, early flowering and maturity and greater adaptability.

2.1.3 Occurrence of Heterosis in Eggplant

The incidence of considerable hybrid vigour was documented earlier by Nagai and Kida (1926) and hybrid eggplants are nowadays usually utilized in numerous nations, particularly in Japan. Thus, most of the investigations of its breeding behavior are reported from India, Japan and Italy. A varied series of variability for different characters offers scope for improvement through hybridization. Investigations on heterosis in eggplant began almost simultaneously with those of maize and tomato and showed distinct hybrid vigour.

Many researchers performed experimental investigation mostly from Japan and India and their findings have presented distinct hybrids vigour in brinjal. Nagai and Kida (1926) were probably the first to report hybrid vigour in crosses among some Japanese eggplant varieties and subsequently Kakizaki (1931) and Daskaloff (1937) also demonstrated hybrid vigour. In India Pal and Singh (1946, 1949) informed that the hybrid eggplant showed 48.8 to 56.6% increased yield over the better parent. Venkataramani (1946) reported that the F_1 hybrids gave increased yield over the parents. Odland and Noll (1948) observed that F_1 hybrids exceeded the parental mean by 62% and the high yield was due to greater number of fruits produced rather than increased fruit size. Besides, Vijay and Nath (1974) reported 81.9%, Singh *et al.* (1982) reported 140.19% and Singh and Kumar (1988) observed 162.5% heterosis over better parent for yield in eggplant.

Recently hybrid vigour in eggplant has also been reported in India by Singh *et al.* (1982), Rajput *et al.* (1984), Patil and Shinde (1984), Dhaiya *et al.* (1984), Verma (1986), Gopinath and Madalageri (1986), Kumar and Ram (1987), Chadha and Hegde (1989) and Singh and Kalda (1989).

In Bangladesh Rashid *et al.* (1988) for the first time studied the heterosis in eggplant. They made some crosses of eggplant involving four local and one Indian variety and reported best performance in yield per plant up to 48.27% higher than the better parent. Since then, many studies have been made on eggplant heterosis by many workers throughout the world. With few exceptions, these also showed the widespread existence of heterotic effects.

Here, in this text, an attempt has been made to review those early studies on heterosis of eggplant and relevant crops, which are directly related to the present investigation.

2.1.3.1 Earliness

Earliness in flowering is generally considered to be one of the important features of heterosis and has been studied by many workers. All types of gene action - additive, dominance and epistasis have been presented. Lal and Pathak (1974) investigated that the parental populations and hybrids were significantly different with regard to flowering in eggplant. Singh *et al.* (1974b); Gill *et al.* (1976); Srivastava and Bajpai (1977); Dharmegowda *et al.* (1979); Singh *et al.* (1981); Kumar and Ram (1987); Rashid *et al.* (1988); Chadha and Hegde (1989); Padmanabham and Jagadish (1996) also reported the predominance of additive genetic control of earliness in eggplant. Kumar *et al.* (1996) reported additive gene action for days to 50% flowering.

Baha-Eldin (1968a) reported partial dominance of early flowering over late flowering while Peter and Singh (1973); Patil and Shinde (1984) and Ingale and Patil (1997b) revealed the presence of overdominance. Dominance or overdominance effect was observed for days to flowering by Hani *et al.* (1977).

Singh *et al.* (1974a) reported from a 7 × 7 diallel crossing of eggplant excluding reciprocals that F_1 hybrids exhibited heterosis over the better parent for days to flowering. Similar findings were also reported by Genchev and Popova (1973); Viswanathan (1973); Vijay and Nath (1974) and Singh *et al.* (1979b). Sawant *et al.* (1992) evaluated 7 characters of F1 hybrids from 7 lines and 2 testers reported that heterosis in F_1 hybrids was significant for days to 50% flowering and other characters.

Salehuzzaman (1981) evaluated 16 F_1 hybrids from crosses amongst 12 varieties for seven characters and found no desirable heterosis for earliness, whereas mid-parent heterosis for earliness was reported by Hani *et al.* (1977) in the cross Black Beauty ×Balady White Long.

Sanguineti *et al.* (1985) illustrated that the superiority of the hybrids was evident principally at early harvest, although the mean flowering dates of the hybrids were like those of the parents. Early maturity of F_1 hybrids of eggplant was also reported by Pan *et al.* (1996) and Tan *et al.* (1997). Tomar *et al.* (1997) reported high heritability and low genetic advance for days to first harvest while evaluating 44 F_1 hybrids of brinjal.

Additive gene action in controlling earliness has also been found in tomato by many workers. Singh *et al.* (1981) studied the nature of combining ability as well as heterotic performance of different characters in a set of diallel cross of four tomato cultivars. Several workers also found that flowering was determined mainly by additive variation.

In other studies, Peter and Singh (1976) using a 5 × 5 diallel cross found that non-additive genetic variance was involved in the inheritance of days to flowering. Similarly, Singh *et al.* (1979) and Verma (1986) also reported non-additive effects for flowering. Dahiya *et al.* (1985) investigated both additive and non-additive effects for this character (Days to 50% flowering). Two contrasting varieties were crossed by Cheah *et al.* (1981) and found that late flowering was partly leading over early, with number of days to first flowering being controlled by non-additive gene action.

Hani *et al.* (1977) reported non-additive effects predominated for early yield. From the analysis of data from a 6 ×6 diallel cross, excluding reciprocals, Kumar and Ram (1987) also revealed non-additive variance for early fruit yield per plant. Whereas, Sanguineti and Coltelli (1985) reported additive genetic variance for early yield from crosses among 7 purple-fruited varieties.

2.1.3.2 Plant height

The superiority of eggplant hybrids over their parents in respect of plant height has been reported by many workers. Gopinath and Madalageri (1986) presented significant and positive heterosis for plant height at first and peak flowering and showed that all types of gene effects - additive, dominance and epistatic were significant. Babu and Thirumurugan (2000) recorded 14.2% heterosis over better parent for plant height from the hybrid EP39 × Pusha Kranti. Saha *et al.* (1991) reported 26.4% heterobeltiosis for plant height from the cross Islampuri × 11-1-324. The heterotic effect for plant height was also reported by Viswanathan (1973); Singh *et al.* (1974a); Singh *et al.* (1978); Singh *et al.* (1979); Lester and Thitai (1986); Sawant *et al.* (1992); Ingale and Patil (1997b) and Prasath *et al.* (2000).

Ingale and Patil (1997b) observed the presence of overdominance effect for plant height in brinjal. Singh *et al.* (1991) reported dominant gene for plant height. Partial dominance of tall plants over dwarf was observed by Baha-Eldin *et al.* (1968a) in their study with interparietal crosses between Black Beauty and PI16965 of eggplant.

Additive genetic variance controlling plant height of eggplant has been stated by several researchers. Singh *et al.* (1974b) obtained additive gene action for plant height in F_1 and F_2 generations in a diallel mating of 7 varieties. Lal and Pathak (1974); Gill *et al.* (1976); Srivastava and Bajpai (1977); Boriker *et al.* (1981); Singh *et al.* (1981); Kandaswamy *et al.* (1983); Patil and Shinde (1985); Verma (1986); Kumar and Ram (1987); Rashid *et al.* (1988) and Chadah and Hegde (1989) also stated that plant height was controlled by additive gene action.

However, a predominance of non-additive genetic effects was also reported by Singh *et al.* (1979). Saha *et al.* (1991) crossed five genotypes in all possible combinations and initiated that most of the tall × tall crosses the SCA effects for plant height were positive. Peter and Singh (1976) in a 5 × 5 diallel cross in eggplant found that plant height was controlled by both additive and non-additive gene action.

2.1.3.3 Number of branches

Heterosis in number of branches is a common feature of F_1 hybrids. Singh *et al.* (1982) experimented that overdominance and partial dominance in the appearance of heterosis for number of branches per plant. Saha *et al.* (1991) stated that number of branches per plant was predicted being controlled by only one pair of genes. Singh *et al.* (1979) investigated 200 progenies of a diallel cross in eggplant and stated additive type of gene action was predominant in both F_1 and F_2 generations for number of branches per plant. Boriker *et al.* (1981) and Patil and Shinde (1985) also institute additive genetic variance to be the most significant.

In contrast, Peter and Singh (1976) in a 5 × 5 diallel and Dharmegowda (1977) in a 9 ×9 diallel cross found that number of branches per plant was influenced more by non-additive genetic variance. Srivastava and Bajpai (1977) reported that non-additive genetic variance was higher than additive genetic variance for number of branches per plant.

Dahiya *et al.* (1985) reported that variance due to the GCA of the parents and SCA for the hybrids were important for branches per plant Further Kumar and Ram (1987) from a 6 × 6 diallel cross detected both additive and non-additive genetic components in eggplant. Saha *et al.* (1991) reported SCA effect for number of branches per plant were positive in crosses involving parents with profuse branching.

Saha *et al.* (1991) observed maximum heterobeltiosis (48.45%) in a cross Uttara ×Shingnath Long. Mishra (1961) observed maximum heterosis (39.6%) in the hybrids besides Babu and Thirumurugan (2000) observed 25.5% heterosis over the better parent for number of branches per plant. Alike outcomes were also reported by Tiwari (1966); Dharmegowda (1977); Singh *et al.* (1978); Balamohon (1983); Patil and Shinde (1984); Ingale and Patil (1997b) and Prasath *et al.* (2000).

2.1.3.4 Fruit length

Fruit length is an important character to controlling yield, which is studied by many workers. Several workers reported about additive genetic variance for the control of fruit length in eggplant. Ingale and Patil (1997a) reported in a diallel analysis of ten parents without reciprocals in eggplant that a predominance of additive gene action was observed for length of fruit. Peter and Singh (1973) and Singh *et al.* (1974b) found it to be controlled by additive gene action whilst Lal and Pathak (1974) reported that the additive portion of genetic variance was quite considerable. Similar results were also reported several investigators such as Singh *et al.* (1979); Patil and Shinde (1985); Kumar and Ram (1987); Chadha and Hegde (1989) and Shaha (1989).

In contrast Gopinath and Madalageri (1986) investigated non-additive effects for fruit length in eggplant. Prasath *et al.* (2000) found overdominance effect for fruit length in eggplant. Singh *et al.* (1991) reported from six diverse and homozygous lines of eggplant were crossed in a half diallel fashion that the line CH13 was the greatest necessary general combiner possessing dominant genes for plant height. Patil and Shinde (1984) found overdominance effect for fruit length in eggplant.

Partial dominance effect was observed by Singh *et al.* (1982) for fruit length in eggplant. Dixit *et al.* (1982) reported from an 8 ×8 diallel, excluding reciprocals, highly significant difference of GCA for length of fruit and GCA effect was greater than SCA effect. Prakash *et al.* (1994a) reported from a 2 line ×9 tester brinjal cross that parents and hybrids varied significantly for GCA and SCA effects respectively. Alike outcomes were also found by Dahiya *et al.* (1985). Cheah *et al.* (1981) and their findings stated that fruit length was controlled by two loci when two contrasting varieties were crossed.

Babu and Thirumurugan (2000) reported that the maximum 12.4% heterosis was observed from the hybrid EP39 × Pusa Kranti. Prasath *et al.* (2000) informed that the heterotic effect for fruit length was extreme for the cross 202 × Co-2 among 30 hybrids over the better parent. Substantial positive heterosis for fruit length in eggplant was reported by Kakizaki (1931); Mishra (1961); Thakur *et al.* (1968); Viswanathan (1973); Lal *et al.* (1974); Singh *et al.* (1974a, 1978); Balamohan (1983); Dahiya *et al.* (1984); Rajput *et al.* (1984); Patil and Shinde (1984); Gopinath and Madalageri (1986).

2.1.3.5 Fruit diameter

Heterosis in fruit diameter is an important feature of F_1 hybrids. In a diallel analysis of ten parents excluding reciprocals Ingale and Patil (1997a) stated that a predominance of additive gene action was studied for diameter of fruit. Additive genetic variance for the control of fruit diameter in eggplant was also observed by Peter and Singh (1973, 1976); Lal and Pathak (1974); Kumar and Ram (1987); Rashid *et al.* (1988) and Chadha and Hegde (1989). In other experiment, Singh *et al.* (1974b) illustrated non-additive gene effects in both F_1 and F_2 generation. Patil and Shinde (1985) and Shaha (1989) reported both additive and non-additive effects.

Partial dominance effect is revealed by Rajput *et al.* (1984) while Singh *et al.* (1982); Patil and Shinde (1984) and Prasath *et al.* (2000) noticed the presence of overdominance in the manifestation of heterosis for fruit diameter. Additive, dominance and epistatic gene effects were stated by Gopinath and Madalageri (1986). Cheah *et al.* (1981) reported that the number of loci controlling fruit diameter was estimated to be six. Singh *et al.* (1981) observed good general combiners for fruit width among female parents when crossed four testers with 15 lines. Prakash *et al.* (1994a) reported a good specific combination for fruit diameter in the crosses SM6 × Erengere and WCGR × J1. Dahiya *et al.* (1985) reported that variance owing to GCA of the parents and SCA of the hybrids were important for fruit Diameter.

Several workers reported heterotic effect of fruit diameter of the hybrids in eggplant. Prasath *et al.* (2000) observed the maximum heterotic effect over better parent for fruit diameter from the cross H-9 × MDU-1 among 30 hybrids. Heterotic effect for fruit diameter was also presented by Viswanathan (1973); Singh *et al.* (1974a) and Gopinath and Madalageri (1986).

2.1.3.6 Fruit weight

Fruit weight is one of the vital features of heterosis and has been studied by many workers. Various authors have presented the prevalence of additive, non-additive and/or both genetic variances. Tomar *et al.* (1997) evaluated 44 F_1 hybrids of eggplant, derived from the cross of 11 lines and 4 testers reported that fruit weight showed high heritability and genetic advance, indication of the role of additive genetic effects. Peter and Singh (1973, 1976) found additive gene action as did Kumar and Ram (1987); Singh *et al.* (1982); and Salehuzzaman and Alam (1983). In contrasts, non-additive genetic control was analyzed by Singh *et al.* (1979) and Ingale and Patil (1997a). Dharmegowda (1977); Dahiya *et al.* (1985); Patil and Shinde (1985) and Verma (1986) provided detail investigation on additive and non-additive variances.

Rajput *et al.* (1984) observed 56% heterosis over the better parent for mean fruit weight. Prasath *et al.* (2000) observed maximum heterosis over better parent for the cross 180 × ANI revealing the presence of overdominance. Heterosis for fruit weight was also reported by Viswanathan (1973); Joarder *et al.* (1981); Salehuzzaman (1981); Dixit *et al.* (1982); Singh *et al.* (1984); Patil and Shinde (1984); Dahiya *et al.* (1984) and Babu and Thrumugrgan (2000).

Singh *et al.* (1981) reported good general combiners of female parent for fruit weight from crosses of four testers with 15 lines. Ingale and Patil (1997a) reported significant SCA effects for fruit weight for the hybrid Surya × Gokak Local from 10 × 10 half diallel cross combinations.

2.1.3.7 Number of fruits

Many researchers have reported the heterotic effect and nature of gene action for number of fruits per plant in eggplant. A positive correlation of yield with fruit number was demonstrated by Odland and Noll (1948), Mishra (1962), Singh and Swarup (1971) and Balamohan *et al.* (1983). Singh *et al.* (1982) found that overdominance played a vital role in controlling the number of fruits per plant with parallel outcomes being analyzed by Singh (1984); Gopinath and Madalageri (1986); Ingale and Patil (1997b) and Prasath *et al.* (2000).

Singh *et al.* (1981) observed non-additive control for this and non-additive genetic control with significant reciprocal differences. Similar result was presented by Gopinath and Madalageri (1986). Padmanabham and Jagadish (1996) reported from an 8-parent half diallel cross.

Baha-Eldin *et al.* (1968b) from a study with parents, F_1, F_2 and backcrosses of a cross between Black Beauty and PI16965 found distinct heterosis. Viswanathan (1973) observed 1.57 to 23.43% heterosis over the better parents. Alike outcomes were also presented by Lal *et al.* (1974); Dharmegowda (1977); Hani *et al.* (1977); Joarder *et al.* (1981); Balamohan *et al.* (1983); Dahiya *et al.* (1984); Patil and Shinde (1984); Rajput *et al.* (1984); Singh (1984); Sanguineti *et al.* (1985); Gopinath and Madalageri (1986); Nualsei *et al.* (1986); Dixit and Gautam (1987); Sawant *et al.* (1992); Ingale and Patil (1997b) and Babu and Thirumurugan (2000).

Kumar *et al.* (1996) reported from 7 brinjal lines and their F_1 hybrids that the hybrids differed significantly for number of fruits per plant and the line SM6 was a good general combiner for that character. Dharmegowda *et al.* (1979) reported from a 9 × 9 half diallel cross that the variety Arka Kusumakar had the highest number of fruits per plant and good GCA for this character, similar result was also presented by Sawant *et al.* (1992) for Arka Kusumarkar.

Dixit *et al.* (1982) reported from an 8 × 8 half diallel cross that extremely important variances for GCA and SCA were found for number of fruits per plant and the best specific combinations for fruits per plant were Pusa Purple Long × R34 and Pusa Kranti × Aushey.

2.1.3.8 Fruit yield

Fruit yield is commonly referred as a complex character in eggplant or brinjal conditioned by several components - fruit weight, number of fruits, earliness, number of branches and plant size. Experimental results suggest any or all the components may be important in determining yield heterosis. Odland and Noll (1948); Baha-Eldin *et al.* (1968a, b) and Sanguineti *et al.* (1985) presented important positive correlation of yield with fruits per plant.

Mishra (1962) and Dharmegowda (1977) described that the fruit number and weight are the main reasons to enhancement in yields of hybrids. While Singh and Swarup (1971) and Balamohan *et al.* (1983) stated that heterosis in yield was influenced to rise in number of branches, fruit number and length. Similar complexity in yield has also been reported in tomato and wheat by Singh *et al.* (1978).

The inheritance of fruit yield in eggplant has been studied by many other workers. Additive, non-additive and additive dominance including epistatic effects were found vital for controlling this complex character. Lal and Pathak (1974) reported that additive gene action was involved in governing fruit yield per plant in a 7 × 7 diallel cross. Additive variance for yield was also reported by Gill *et al.* (1976); Dixit *et al.* (1982); Sharma (1985); Verma (1986); Chadha and Sharma (1989) and Saha (1989).

Non-additive genetic variances for fruit yield in eggplant were also described by numerous workers. From a study of a diallel mating of 7 varieties, Singh *et al.* (1974b) analyzed that non-additive gene action in the F_1 and F_2 generations controlled the yield per plant. Peter and Singh (1976) in 5 × 5 diallel cross observed that fruit yield per plant was controlled by both additive and non-additive gene action. Hani *et al.* (1977) ; Vijay *et al.* (1978) ; Bhutani *et al.* (1980) ; Dixit *et al.* (1984) and Dahiya *et al.* (1985) also reported the importance of both additive and non-additive genetic effects for fruit yield.

Overdominance and partial dominance affecting the manifestation of hybrid vigor for yield has also been reported. Singh *et al.* (1982) examined yield per plant and five yield components involving 20 parents in a fractional diallel design. Dominance was assessed based on mean values for hybrids compared with mean parental values. They found that the top five high yielding crosses showed overdominance for fruit yield per plant. Dahiya *et al.* (1984); Patil and Shinde (1984); Rajput *et al.* (1984) and Gopinath and Madalageri (1986) also verified overdominance for fruit yield while Singh (1984) stated partial dominance. The importance of epistatic effects for fruit yield was reported by Sidhu and Chada (1985); Borikar *et al.* (1981); Salehuzzaman and Alam (1983) and Chaudhary and Malhotra (2000).

Sanguineti *et al.* (1985) presented that the mean fruit yield of hybrids from crosses among 7 purple-fruited varieties was 38.1% higher than the parental mean owing largely to a higher number of fruits per plant. Babu and Thirumurugan (2000) reported 35.6% heterosis from crosses of 4 lines and 2 testers, Vijay and Nath (1974) reported 81.9% heterosis, Verma *et al.* (1986) presented 13.0% heterosis in Punjab Bahar x Pusa Purple Long over the best parental line and Singh *et al.* (1982) presented 140.19% heterosis over the better parent for yield in eggplant. Sing and Kumar (1988) reported that the cross Pusa Purple Cluster × Sel-5 was the finest specific combination for yield and the highest heterosis over better parent was observed 162.5%. Heterosis for yield in eggplant was also showed by Genchev and Popova (1973); Viswanathan (1973); Singh *et al.* (1974a); Hani *et al.* (1977); Singh *et al.* (1978); Singh *et al.* (1979); Bhutani *et al.* (1980); Cheah *et al.* (1981); Joarder *et al.* (1981); Ram *et al.* (1981); Dixit *et al.* (1982); Balamohan *et al.* (1983); Kandaswamy *et al.* (1983); Rajput *et al.* (1984); Singh (1984); Sanguineti *et al.* (1985); Gopinath and Madalageri (1986) and Nualsri *et al.* (1986).

CHAPTER III

MATERIALS AND METHODS

3.1 Experimental Site

The experiment was carried out at the experimental farm of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur from the month of march to September 2019. The location of the site is at 24-00^{0}N latitude and 90.25^{0}E longitude at an elevation of 8.4 meters from the sea level.

3.1.1 Climate and Soil

The experimental site is situated in the sub-tropical climatic zone and characterized by heavy rainfall during the months of May to September and scanty rainfall during the rest of the year. The average minimum and maximum temperature during the crop period were 17.83^{0}C and 28.07^{0}C, respectively. The mean minimum and maximum relative humidity were 71.50% and 94.67%, respectively. The weather data (air temperature and humidity) are presented during the study period in Appendix 1. The soil of the experimental field was sandy clay loam in texture having a pH around 6.0. The soil belongs to the Chita soil series of red brown terrace. The soil was later developed for vegetable research purpose by riverbed silt.

3.1.2 Plant materials

In this study, seven parents and 21 cross combination of eggplant (28 treatments) were used as experimental materials.

P1	=	SM004
P2	=	SM005
P3	=	SM001
P4	=	SM217
P5	=	SM012
P6	=	SM0018
P7	=	SM014

3.1.3 Treatment of the experiment

The experiment consisted of one factor:

Factor: Different varieties (7 parents, 21 Hybrids) of Eggplant

P1	P1 x P2	P2 x P4	P3 x P7
P2	P1 x P3	P2 x P5	P4 x P5
P3	P1 x P4	P2 x P6	P4 x P6
P4	P1 x P5	P2 x P7	P4 x P7
P5	P1 x P6	P3 x P4	P5 x P6
P6	P1 x P7	P3 x P5	P5 x P7
P7	P2 x P3	P3 x P6	P6 x P7

The parents were selected on the basis of genetic diversity. The basic seeds of 7 x 7 half-diallel mating were produced in the research farm of Olericulture Division, HRC, BARI, during march to September 2019.

3.1.4 Growing plants

Seeds of the seven selfed parents and their 21 hybrids were sown densely in the primary seed bed on 15 February 2019. Nine days after sowing, the young seedlings at the cotyledon stage were transplanted the polypot (10x 12cm). Then at the age of 30 days, seedlings were transplanted in the main experimental plots.

3.1.5 Design and lay-out of experiment

The experiment was set up in a randomized complete block design (RCBD) with three replications. Twenty-eight genotypes (21 F1's + 7 parents) of brinjal were considered as the 28 treatments of the experiment. The experiment was laid out in RCBD design with three replications. The unit plot size was 7.0 x 0.70 m and 10 plants were accommodated in a plot with a plant spacing of 70 cm apart in single row maintaining a row-to-row distance of 1.2 m with 50 cm drain. Each unit plot contained single row accommodating 10 plants where data were collected from randomly selected 5 plants leaving 2 border plants.

3.1.6 Manure and Fertilizer application

The land was fertilized with cow dung, N, P, K, S, Zn and B @ 10,000 100, 30, 75, 13, 1.5 and 0.8 kg/ha, respectively. One third of the cow-dung and half of P and full of S, Zn and B were applied during final land preparation. Rest of cow-dung and P and 1/3 of K were applied as basal in pit. Entire amount of N and rest of K will be applied in four equal installments starting from 20 days after transplanting. Rest three installments will be applied at vegetative, flowering, and initial fruiting stage.

3.1.7 Intercultural Operations

Weeding and mulching were done followed by top-dressing and irrigation was applied at 15 days interval. The insecticide Ripcord (a.i. Cypermethrine) was sprayed four times at 15 days interval from first flowering stage.

3.1.8 Collection of data

Five plants were selected randomly from each unit plot. Data on the following parameters were recorded:

1. **Days to 50% flowering:** Number of days required from sowing to first flower opening of the 50 % plants of each replication.

2. **Days to first harvest:** Number of days required from sowing to first harvest of fruits in each replication.

3. **Plant height at first and last harvest (cm):** Measured from the soil surface to the tip of the tallest branch at first harvest.

4. **Number of primary and secondary branches at last:** All the primary and secondary branches were counted at final harvesting stage in each of the five selected plants and their average value was taken as number of branches per plant

5. **Length of fruit (cm):** Fruit length was measured with a slide caliper from the neck of the fruit to the bottom of the same from ten representative fruits and their average was taken as the length of the fruit.

6. **Fruit diameter (cm):** Fruit diameter was measured through the equatorial part of the same ten representative fruits by slide calipers and their average was taken as the diameter of the fruit.

7. **Number of fruits per plant:** Total number of fruits harvested at different dates from the five selected plants was counted.

8. **Individual fruit weight (g):** Individual fruit weight in gram was calculated from the ten representative fruits.

9. **Yield per plant (kg):** Total weight of fruits (kg) per plant was recorded in each of five plants and the value yield per plant is the average of five harvests in total.

10. **Yield (t/ha):** Calculated from the total yield of a single plot divided by the area of the plot in each replication and expressed in t/ha.

Fruit infestation: Fruit infestation was calculated using the following formula:

$$\text{Fruit infestation (by weight)} = \frac{\text{Weight of infested fruits}}{\text{Total weight of fruits}} x100$$

The cumulative plot yield of healthy and infested fruits of 10 harvests transformed into healthy yield and total yield per hectare in tons.

3.1.9 Statistical Analysis

3.1.9.1 Analysis of Variance (ANOVA)

Data were analyzed by MSTAT software for analysis of mean performances and standard error. All the measurable data occupied were subjected to ANOVA. The total variances of each character were partitioned into block, genotype and error differences. The differences within the classes of effects were tested by F-test.

3.1.9.2 Heterosis

For estimation of heterosis in each character the mean values of the 15 F_1' s have been compared with better parent (BP) for heterobeltiosis and with mid parent (MP) for heterosis over mid parental value. Percent heterosis was calculated as;

$$H(BP) = \frac{\overline{F_1} - \overline{BP}}{\overline{BP}} x100$$

$$H(MP) = \frac{\overline{F_1} - \overline{MP}}{\overline{MP}} x100$$

Where, F_1=Mean of F_1 generation, BP= Mean of better parent,

MP= Mean of mid parent

The significant test for heterosis was done by using standard error of the value of better parent and mid parent as.

$$SE\ (BP) = \sqrt{3/2\ x\ MSE/r}$$

$$SE\ (MP) = \sqrt{3/2\ x\ MSE/r}$$

Where, MSE = Error mean square, r = Number of replications

Plate 1. A. Seed raising in the pot.

CHAPTER IV

RESULTS AND DISCUSSION

The experiment was conducted to evaluate the performance of newly crossed hybrid materials (21 combinations) along with their parents (7 parents) of yield contributing traits using mean performances This chapter comprises the presentation and discussion of the findings obtained from the experiment. The fruits were harvested when it was time to edible. The data pertaining to eleven characters have been presented and statistically analyzed with the possible interpretations.

4.1. PERFORMANCE OF 21 HYBRIDS AND 7 PARENTS OF EGGPLANT

4.1.1 Days to 50% Flowering

Days to 50% flowering showed highly significant variation which indicates the presence of large variations among the tested genotypes (Appendix II). P4 x P6 (73.67days) took shortest time for 50% flowering followed by P1 x P6 (74.67days) whereas P2 took longest time (95 days) for 50% flowering followed by P1 x P2 (90.67days).

4.1.2 Days to First Harvest

Days to first harvest showed highly significant variation which indicates the presence of large variations among the tested genotypes (Appendix II). P1 took shortest time for first harvest (46.67days) followed by P1 x P7 (57.67 days) whereas P2 x P3 took longest time (87.67 days) for first harvest followed by P2xP5(78.67days).

4.1.3 Number of Primary Branches at Last Harvest

Number of primary branches at last harvest showed highly significant variation which indicates the presence of large variations among the tested genotypes (Appendix II). P4 showed highest number of primary branches at last harvest (6.67) followed by P3 x P4 (6.07) and P1x P7 (6.03) whereas P5 showed lowest number of primary branches at last harvest (3.47).

4.1.4 Number of Flowers Per Cluster

Number of flower/ clusters showed highly significant variation which indicates the presence of large variations among the tested genotypes (Appendix II). P1 and P7 showed highest no. of flowers/ cluster (5.33) followed by P1 x P5 (4.33), P4 x P6 (4.33) and P3 (4.33) whereas P2 x P6 showed lowest no. of flowers/ cluster (1.33) followed by P3 x P5 (1.67) and P5 x P6 (1.67).

4.1.5 Number of Fruits Per Cluster

Number of fruits/ clusters showed highly significant variation which indicates the presence of large variations among the tested genotypes (Table 1). P7 showed highest number of fruits per cluster (4.00) followed by P1 x P7 (3.33), P1 (3.33) whereas P1 x P2, P2 x P4, P3 x P6, P4 x P5, P5 x P6 showed lowest no. of fruits/ cluster (1.33) followed by P1 x P3 (1.67), P1 x P5(1.67), P1 x P6(1.67), P2 x P3(1.67), P2 x P5(1.67), P2 x P6(1.67), P6 x P7(1.67) and P3 x P7(1.67).

Table 1: Average performance of different characters of 21 hybrids and 7 parents of eggplant

F1/ Parents	Days to 50% flowering	Days to first harvest	Number of primary branches at last harvest	Number of flowers per cluster	Number of fruits per cluster
P1 x P2	90.67	64.67	4.37	2.33	1.33
P1 x P3	76.67	65.33	5.37	3.33	1.67
P1 x P4	76.33	73.67	5.03	2.67	2.33
P1 x P5	76.00	69.00	4.07	4.33	1.67
P1 x P6	74.67	65.67	5.17	3.33	1.67
P1 x P7	84.67	57.67	6.03	3.33	3.33
P2 x P3	88.67	87.67	4.97	2.67	1.67
P2 x P4	87.67	73.00	5.03	2.33	1.33
P2 x P5	89.67	78.67	3.87	2.33	1.67
P2 x P6	88.33	58.67	4.43	1.33	1.67
P2 x P7	85.67	70.67	5.57	3.33	3.00
P3 x P4	75.67	67.67	6.07	3.33	2.33
P3 x P5	77.67	73.67	4.67	1.67	2.00
P3 x P6	76.33	71.67	5.17	3.33	1.33
P3 x P7	76.67	66.67	4.77	3.33	1.67
P4 x P5	77.33	67.67	5.10	2.33	1.33
P4 x P6	73.67	66.67	5.27	4.33	2.33
P4 x P7	77.33	64.67	4.50	2.67	2.33
P5 x P6	76.67	64.67	4.67	1.67	1.33
P5 x P7	76.67	66.33	5.03	2.33	2.33
P6 x P7	75.67	60.33	4.13	2.67	1.67
P1	87.67	46.67	5.53	5.33	3.33
P2	95.00	66.67	4.47	3.33	3.00
P3	84.33	67.00	5.47	4.33	2.67
P4	75.67	65.33	6.67	3.00	2.67
P5	76.67	64.00	3.47	3.33	3.00
P6	77.67	67.00	5.40	3.33	2.33
P7	78.33	64.33	4.67	5.33	4.00
SE	**1.056**	**1.23**	**0.197**	**0.328**	**0.263**

4.1.6 Fruit Set (%)

% Fruit set showed highly significant variation which indicates the presence of large variations among the tested genotypes (Appendix II). P2 x P4 showed highest % fruit set (97.67) followed by P2 x P5 (81.00) whereas P4 x P5 showed lowest % fruit set (20.33) followed by P3 x P5 (25.00), P3 x P6 (25.00), P1 x P3 (25.33), P1 x P4 (25.33), P5 x P6 (25.33).

4.1.7 Individual fruit weight (g)

Individual fruit weight showed highly significant variation which indicates the presence of large variations among the tested genotypes (Appendix II). P2 showed highest individual fruit weight (445.00) followed by P2 x P6 (401.33) whereas P3 showed lowest individual fruit weight (65.33) followed by P1 x P3 (75.33), P3 x P7 (77.67).

4.1.8 Fruit Length (cm)

Fruit length showed highly significant variation which indicates the presence of large variations among the tested genotypes (Appendix II). P3 x P4 showed longest fruit length (26.67) followed by P4 (24.33), P3 (23.00) and P7 (23.00) whereas P5 showed shortest fruit length (7.33) followed by P6 (7.67).

4.1.9 Fruit Diameter (cm)

Fruit diameter showed highly significant variation which indicates the presence of large variations among the tested genotypes (Appendix II). P2 showed longest fruit diameter (11.67) followed by P2 x P6 (9.73) whereas P3 showed shortest fruit diameter (2.70) followed by P3x P4 (2.73).

4.1.10 Number of Fruits Per Plant

Number of fruits per plant showed highly significant variation which indicates the presence of large variations among the tested genotypes (Appendix II). P3 x P7 showed highest number of fruits per plant (39.67) followed by P1x P7 (38.30) and P1x P3 (37.67) whereas P2 showed lowest no. of fruits per plant (6.40) followed by P2 x P6 (7.37).

4.1.11 Yield Per Plant

Yield/plant showed highly significant variation which indicates the presence of large variations among the tested genotypes (Appendix II). P1 x P6 showed highest yield/plant (4.10) followed by P4 x P5 (4.03), P2 x P5 (4.02), P5 x P6 (3.77) and P4 x P6 (3.74) whereas P3 showed lowest yield per plant (1.93) followed by P2 (2.44) and P1 (2.47).

Table 1 (cont'd).

F1/ Parents	% Fruit set	Individual fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	No. of fruits per plant	Yield/ plant (kg)
P1 x P2	32.67	169.67	15.33	6.67	22.03	3.67
P1 x P3	25.33	75.33	18.67	3.10	37.67	2.87
P1 x P4	25.33	104.67	20.67	3.73	33.93	3.57
P1 x P5	49.67	127.33	14.00	5.27	27.83	3.54
P1 x P6	25.67	145.33	13.33	6.07	29.10	4.10
P1 x P7	80.67	99.33	19.67	3.67	38.30	3.67
P2 x P3	32.67	191.67	17.67	5.53	17.33	3.27
P2 x P4	97.67	225.67	18.33	6.10	15.77	3.44
P2 x P5	81.00	287.00	9.67	8.73	14.73	4.02
P2 x P6	26.00	401.33	10.00	9.73	7.37	2.83
P2 x P7	25.67	203.00	14.67	6.97	18.17	3.73
P3 x P4	50.33	80.67	26.67	2.73	33.13	2.70
P3 x P5	25.00	101.33	16.33	4.03	30.27	3.08
P3 x P6	25.00	120.67	15.33	4.57	27.67	3.40
P3 x P7	33.33	77.67	20.67	2.87	39.67	3.06
P4 x P5	20.33	150.00	17.67	4.97	26.33	4.03
P4 x P6	40.67	174.67	15.67	5.47	20.87	3.74
P4 x P7	50.33	91.67	20.67	3.23	31.27	2.87
P5 x P6	25.33	200.67	10.67	7.47	18.33	3.77
P5 x P7	33.33	99.33	19.33	3.83	27.27	3.67
P6 x P7	60.33	140.33	13.67	5.13	26.33	3.66
P1	77.67	87.67	13.67	4.33	25.57	2.47
P2	78.67	445.00	9.00	11.67	6.40	2.44
P3	52.33	65.33	23.00	2.70	30.73	1.93
P4	64.33	93.67	24.33	4.67	26.43	2.57
P5	52.33	215.67	7.33	7.00	13.50	2.84
P6	34.33	215.00	7.67	8.33	13.33	2.87
P7	77.67	90.33	23.00	3.80	31.33	2.76
SE	**1.557**	**1.26**	**0.863**	**0.304**	**0.703**	**0.054**

	
P1×P2	P1×P3
	
P1×P4	P1×P6
	
P1×P7	P2×P3

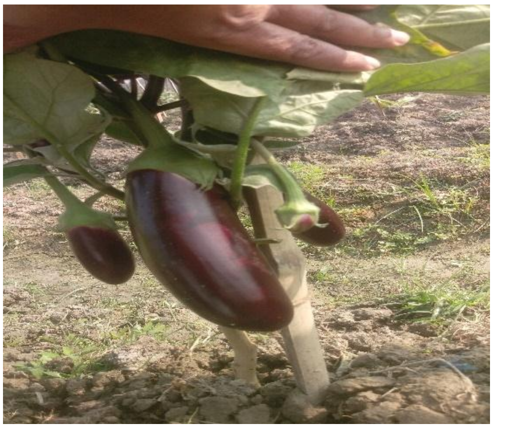
Plate 2a: performance of different hybrids of eggplant

P2×P4

P2×P5

P2×P6

P2×P7



P3×P4

P3×P6

Plate 2b: performance of different hybrids of eggplant

P3×P7

P4×P6

P4×P7

P5×P7

P6×P7

Plate 2c: performance of different hybrids of eggplant

4.2 STUDY OF HETEROSIS OF 21 CROSS COMBINATION OF EGGPLANT

The analysis of variance for genotypes i.e., parents and crosses showed significant difference for all the characters studied. The estimates of percent heterosis observed in F_1 high generation over better parents and mid parents are presented through Table 2.

4.2.1 Days to 50% Flowering

Out of 21 cross combinations, negative mid parent heterosis was found in 15 crosses. Among them, 9 showed significant and negative mid parent heterosis for the character expressing days to 50% flowering. The estimates of mid parent heterosis ranged from -10.85 to 4.47 percent. The highest significant positive heterotic response was discovered in the hybrid P2 x P5 (4.47 %) followed by P2 x P4 (2.73 %) while the lowest significant negative heterotic response was observed in the hybrid P1x P3 (-10.85 %) followed by P1 x P6 (-9.68%) for days to 50% flowering.

Among the 21 cross combinations, negative better parent heterosis was found in 7 crosses. Among them, only 2 showed significant negative better parent heterosis. The estimates of better parent heterosis ranged from -9.09 to 16.96 percent. The highest significant positive heterotic response was observed in the hybrid P2 x P5 (16.96%) while the lowest significant heterotic response was observed in the hybrid P1x P3 (-9.09%) followed by P1 x P6 (-3.86%) for days to 50% flowering.

4.2.2 Days to first harvest

Among 21 cross combinations, negative mid parent heterosis was found in 4 crosses. Among them, 2 showed highly significant negative mid parent heterosis for the character expressing days to first harvest. The estimates of mid parent heterosis ranged from -12.22 to 31.55 percent. The highest significant positive heterotic response was observed in the hybrid P1 x P4 (31.55 %) followed by P2xP3 (31.17%) while the lowest significant negative heterotic response was observed in the hybrid P2x P6 (-12.22 %) followed by P6 x P7 (-8.12%) for days to first harvest. Out of 21 cross combinations, negative better parent heterosis was observed in 2 crosses. Among them, only 1 showed highly significant negative better parent heterosis. The estimates of better parent heterosis ranged from -12.00 to 57.86 percent. The highest significant positive heterotic response was observed in the hybrid P1 x P4 (57.86 %) followed by P1 x P5 (47.86 %) while the lowest significant heterotic response was observed in the hybrid P2x P6 (-12.00%) for days to first harvest.

4.2.3 Number of Primary Branches at Last Harvest

Out of 21 cross combinations, highly significant negative mid parent heterosis was observed in 13 crosses for the character expressing primary branches at last harvest. The estimates of mid parent heterosis ranged from -20.59 to 23.77 percent. The highest significant positive heterotic response for no. of primary branches at last harvest was observed in the hybrid P5 x P7 (23.77 %) followed by P2x P7 (21.90%) while the lowest significant negative heterotic response was found in the hybrid P4X P7 (-20.59 %) followed by P6 X P7 (-17.88%) for no. of primary branches at last harvest. Choudhary and Mishra (1988) reported negative to positive range of heterobeltiosis for this character while Singh *et al*. (1988), Chadha and Sidhu (1982), Patil and Shinde (1994) and Sidhu and Chadha (1985) showed it in positive direction for this trait.

Among the 21 cross combinations, highly significant negative better parent heterosis was observed in 18 crosses. The estimates of better parent heterosis ranged from -32.50 to 19.29 percent. The highest significant positive heterotic response for no. of primary branches at last harvest was observed in the hybrid P2 x P7 (19.29 %)

followed by P1x P7 (9.04%) while the lowest significant negative heterotic response was observed in the hybrid P4X P7 (-32.50 %) followed by P1 X P5 (-26.51%) for no. of primary branches at last harvest.

Table 2: Parental heterosis over mid parent and better parent for different characters of 21 crosses in eggplant

Crosses	**Days to 50% flowering**		**Days to first harvest**		**Number of primary branches at last harvest**	
	Mid parent (%)	**Better parent (%)**	**Mid parent (%)**	**Better parent (%)**	**Mid parent (%)**	**Better parent (%)**
P1 x P2	-0.73	3.42*	14.12**	38.57**	-12.67**	-21.08**
P1 x P3	-10.85**	-9.09**	14.96**	40.00**	-2.42**	-3.01**
P1 x P4	-6.53**	0.88	31.55**	57.86**	-17.49**	-24.50**
P1 x P5	-7.51**	-0.87	24.70**	47.86**	-9.63**	-26.51**
P1 x P6	-9.68**	-3.86**	15.54**	40.71**	-5.49**	-6.63**
P1 x P7	2.01	8.09**	3.90*	23.57**	18.30**	9.04**
P2 x P3	-1.12	5.14**	31.17**	31.50**	0.00	-9.15**
P2 x P4	2.73	15.86**	10.61**	11.73**	-9.58**	-24.50**
P2 x P5	4.47**	16.96**	20.41**	22.92**	-2.52**	-13.43**
P2 x P6	2.32	13.73**	-12.22**	-12.00**	-10.14**	-17.90**
P2 x P7	-1.15	9.36**	7.89**	9.84**	21.90**	19.29**
P3 x P4	-5.42**	0.00	2.27	3.57*	0.00	-9.00**
P3 x P5	-3.52*	1.30	12.47**	15.10**	4.48**	-14.63**
P3 x P6	-5.76**	-1.72	6.97**	6.97**	-4.91**	-5.49**
P3 x P7	-5.74**	-2.13	1.52	3.63*	-5.92**	-12.80**
P4 x P5	1.53	2.20	4.64*	5.73**	0.66*	-23.50**
P4 x P6	-3.91*	-2.64	0.76	2.04	-12.71**	-21.00**
P4 x P7	0.43	2.20	-0.26	0.52	-20.59**	-32.50**
P5 x P6	-0.65	0.00	-1.27	1.04	5.26**	-13.58**
P5 x P7	-1.08	0.00	3.38	3.65*	23.77**	7.86**
P6 x P7	-2.99	-2.58	-8.12**	-6.22	-17.88**	-23.46**
SE	**1.494**	**1.294**	**1.740**	**1.507**	**0.279**	**0.242**
LSD (0.05)	**3.066**	**2.655**	**3.571**	**3.093**	**0.573**	**0.497**
LSD (0.01)	**4.140**	**3.586**	**4.822**	**4.176**	**0.774**	**0.670**

*** Significant at 5% level**
**** Significant at 1% level**

4.2.4 Number of Flowers Per Cluster

Among the 21 cross combinations, 19 showed highly significant negative mid parent heterosis for the character expressing no. of flowers/ cluster except two crosses. Non-significant better parent heterosis in the hybrid P1 x P5 (0.00 %) and highly significant positive better parent heterosis in the hybrid P4 x P6 (36.84) were found. The estimates of mid parent heterosis ranged from -60.00 to 36.84 percent. The highest significant positive heterotic response was found in the hybrid P4 x P6 (36.84 %) and lowest significant negative heterotic response was found in the hybrid P2 x P6 (-60.00 %) for number of flowers/ clusters.

Out of 21 cross combinations, 19 showed highly significant negative better parent heterosis except two crosses. Non-significant better parent heterosis in hybrid P2 x P7 (0.00 %) and highly significant positive better parent heterosis in hybrid P4 x P6 (30.00%) were observed. The estimates of better parent heterosis ranged from -61.54 to 30.00 percent. The highest significant positive heterotic response was observed in the hybrid P4 x P6 (30.00 %) and lowest significant negative heterotic response was observed in the hybrid P3 x P5 (-61.54 %) for number of flowers per cluster.

4.2.5 Number of fruits per cluster

Among the 21 cross combinations, highly significant negative mid parent heterosis was observed in all crosses for the character expressing no. of fruits/ cluster. The estimates of mid parent heterosis ranged from -57.89 to -6.67 percent. The highest significant negative heterotic response was found in the hybrid P4 x P6 (-6.67 %) followed by P1x P7 (-9.09 %) while the lowest significant negative heterotic response was observed in the hybrid P1 x P2 (-57.89 %) followed by P2x P4 (-52.94%) for number of fruits per cluster.

Out of 21 cross combinations, highly significant negative better parent heterosis was found in all crosses. The estimates of better parent heterosis ranged from -60.00 to -12.50 percent. The highest significant negative heterotic response for no. of fruits/ cluster was observed in the hybrid P3 x P4 (-12.50 %) and P4x P6 (-12.50 %) while the lowest significant negative heterotic response was observed in the hybrid P1 x P2 (-60.00 %) followed by P1x P3 (-50.00%) and P1x P5 (-50.00%) for number of fruits per cluster.

Table 2 (cont'd).

Crosses	**No. of flower/ cluster**		**No. of fruits/ cluster**	
	Mid Parent (%)	**Better Parent (%)**	**Mid Parent (%)**	**Better Parent (%)**
P1 x P2	-46.15**	-56.25**	-57.89**	-60.00**
P1 x P3	-31.03**	-37.50**	-44.44**	-50.00**
P1 x P4	-36.00**	-50.00**	-22.22**	-30.00**
P1 x P5	0.00	-18.75**	-47.37**	-50.00**
P1 x P6	-23.08**	-37.50**	-41.18**	-50.00**
P1 x P7	-37.50**	-37.50**	-9.09**	-16.67**
P2 x P3	-30.43**	-38.46**	-41.18**	-44.44**
P2 x P4	-26.32**	-30.00**	-52.94**	-55.56**
P2 x P5	-30.00**	-30.00**	-44.44**	-44.44**
P2 x P6	-60.00**	-60.00**	-37.50**	-44.44**
P2 x P7	-23.08**	0.00	-14.29**	-25.00**
P3 x P4	-9.09**	-23.08**	-12.50**	-12.50**
P3 x P5	-56.52**	-61.54**	-29.41**	-33.33**
P3 x P6	-13.04**	-23.08**	-46.67**	-42.86**
P3 x P7	-31.03**	-37.50**	-50.00**	-58.33**
P4 x P5	-26.32**	-30.00**	-52.94**	-55.56**
P4 x P6	36.84**	30.00**	-6.67**	-12.50**
P4 x P7	-36.00**	-50.00**	-30.00**	-41.67**
P5 x P6	-50.00**	-50.00**	-50.00**	-55.56**
P5 x P7	-46.15**	-56.25**	-33.33**	-41.67**
P6 x P7	-38.46**	-50.00**	-47.37**	-58.33**
SE	**0.464**	**0.402**	**0.373**	**0.323**
LSD (0.05)	**0.952**	**0.824**	**0.765**	**0.663**
LSD (0.01)	**1.285**	**1.113**	**1.033**	**0.895**

*** Significant at 5% level**
**** Significant at 1% level**

4.2.6 Fruit percent

Out of 21 cross combinations, 17 showed highly significant negative mid parent heterosis for the character indicating % fruit set. The estimates of mid parent heterosis ranged from -67.16 to 36.60 percent. The highest significant positive heterotic response was observed in the hybrid P2 x P4 (36.60%) followed by P2 x P5 (23.66%) and the lowest significant negative heterotic response was observed in the hybrid P2 x P7 (-67.16 %) followed by P4x P5 (-65.14) for % fruit set.

Among the 21 cross combinations, 18 showed highly significant negative better parent heterosis. The estimates of better parent heterosis ranged from -68.39 to 24.15 percent. The highest significant positive heterotic response was observed in the hybrid P2 x P4 (24.15%) and the lowest significant negative heterotic response was observed in the hybrid P4 x P5 (-68.39 %) followed by P1 x P3 (-67.38%) and P1 x P4 (-67.38 %) for % fruit set.

4.2.7 Individual Fruit Weight

Out of 21 cross combinations, 16 showed negative mid parent heterosis. Among them, 13 showed highly significant negative mid parent heterosis for the character expressing individual fruit weight (g). The estimates of mid parent heterosis ranged from -36.30 to 21.62 percent. The highest significant positive heterotic response was discovered in the hybrid P2 x P6 (21.62%) followed by P1 x P4 (15.44%) and lowest significant negative heterotic response was found in the hybrid P1 x P2 (-36.30 %) followed by P5 x P7 (-35.08 %) for individual fruit weight.

Out of 21 cross combinations, 19 showed negative better parent heterosis. Among them, 18 showed highly significant negative better parent heterosis. The estimates of better parent heterosis ranged from -61.87 to 11.74 percent. The highest significant positive heterotic response was observed in the hybrid P1 x P4 (11.74 %) followed by

P1 x P7 (9.96 %) and lowest significant negative heterotic response was observed in the hybrid P1 x P2 (-61.87 %) followed by P2 x P3 (-56.93 %) for individual fruit weight (g). Better parent heterosis for fruit weight (g)was also reported by Dahiya *et al*. (1984) and Patil and Shinde (1984).

Table 2 (cont'd).

Crosses	% Fruit set		Individual fruit weight	
	Mid Parent (%)	Better Parent (%)	Mid Parent (%)	Better Parent (%)
P1 x P2	-58.21**	-58.47**	-36.30**	-61.87**
P1 x P3	-61.03**	-67.38**	-1.53	-14.07**
P1 x P4	-64.32**	-67.38**	15.44**	11.74**
P1 x P5	-23.59**	-36.05**	-16.04**	-40.96**
P1 x P6	-54.17**	-66.95**	-3.96*	-32.40**
P1 x P7	3.86	3.86**	11.61**	9.96**
P2 x P3	-50.13**	-58.47**	-24.89**	-56.93**
P2 x P4	36.60**	24.15**	-16.21**	-49.29**
P2 x P5	23.66**	2.97	-13.12**	-35.51**
P2 x P6	-53.98**	-66.95**	21.62**	-9.81**
P2 x P7	-67.16**	-67.37**	-24.16**	-54.38**
P3 x P4	-13.71**	-21.76**	1.47	-13.88**
P3 x P5	-52.23**	-52.23**	-27.88**	-53.01**
P3 x P6	-42.31**	-52.23**	-13.91**	-43.88**
P3 x P7	-48.72**	-57.08**	-0.21	-14.02**
P4 x P5	-65.14**	-68.39**	-3.02	-30.45**
P4 x P6	-17.57**	-36.79**	13.17**	-18.76**
P4 x P7	-29.11**	-35.19**	-0.36	-2.14
P5 x P6	-41.54**	-51.59**	-6.81**	-6.96**
P5 x P7	-48.72**	-57.08**	-35.08**	-53.94**
P6 x P7	7.74**	-22.32**	-8.08**	-34.73**
SE	**2.203**	**1.908**	**1.789**	**1.549**
LSD (0.05)	**4.521**	**3.915**	**3.671**	**3.179**
LSD (0.01)	**6.105**	**5.287**	**4.957**	**4.293**

*** Significant at 5% level**
**** Significant at 1% level**

4.2.8 Fruit Length

Out of 21 cross combinations, negative mid parent heterosis is found in 5 crosses. Among them, 4 showed highly significant negative mid parent heterosis for the character indicating fruit length. The estimates of mid parent heterosis ranged from -12.68 to 42.22 percent. The highest significant positive heterotic response was observed in the hybrid P5 x P6 (42.22%) followed by P1 x P2 (35.29%) and lowest significant negative heterotic response was observed in the hybrid P4 x P7 (-12.68 %) followed by P6 x P7 (-10.87 %) for fruit length. Significant positive heterosis for fruit length in brinjal was observed by Kakizaki (1931); Mishra (1961); Thakur *et al*. (1968); Lal *et al*. (1974); Singh *et al*. (1974,1978); Dahiya *et al.* (1984); Patil and Shinde (1984); Rajput *et al*. (1984).

Out of 21 cross combinations, significant negative better parent heterosis was observed in 15 crosses. The estimates of better parent heterosis ranged from -40.58 to 39.13 percent. The highest significant positive heterotic response was found in the hybrid P5 x P6 (39.13%) followed by P1 x P2 (12.20%) and lowest significant negative heterotic response was observed in the hybrid P6 x P7 (-40.58 %) followed by P2 x P7 (-36.23 %) for fruit length.

4.2.9 Fruit Diameter

Out of 21 cross combinations, all showed highly significant negative mid parent heterosis for the character expressing fruit diameter. The estimates of mid parent heterosis ranged from -29.01 to -2.61 percent. The highest significant negative heterotic response was observed in the hybrid P5 x P6 (-2.61%) followed by P2 x P6 (-2.67%) and lowest significant negative heterotic response was discovered in the hybrid P5 x P7 (-29.01%) followed by P3 x P4 (-25.79 %) for fruit diameter.

Among the 21 cross combinations, all showed highly significant negative better parent heterosis. The estimates of better parent heterosis ranged from -52.57 to -10.40 percent. The highest significant negative heterotic response was observed in the hybrid P5 x P6 (-10.40%) followed by P1 x P7 (-15.38%) and lowest significant negative heterotic response was observed in the hybrid P2 x P3 (-52.57 %) followed by P2 x P4 (-47.71 %) for fruit diameter.

Table 2 (cont'd).

Crosses	Fruit length		Fruit diameter	
	Mid Parent (%)	Better parent (%)	Mid Parent (%)	Better parent (%)
P1 x P2	35.29**	12.20**	-16.67**	-42.86**
P1 x P3	1.82	-18.84**	-11.85**	-28.46**
P1 x P4	8.77**	-15.07**	-17.04**	-20.00**
P1 x P5	33.33**	2.44*	-7.06**	-24.76**
P1 x P6	25.00**	-2.44*	-4.21**	-27.20**
P1 x P7	7.27**	-14.49**	-9.84**	-15.38**
P2 x P3	10.42**	-23.19**	-22.97**	-52.57**
P2 x P4	10.00**	-24.66**	-25.31**	-47.71**
P2 x P5	18.37**	7.41**	-6.43**	-25.14**
P2 x P6	20.00**	11.11**	-2.67**	-16.57**
P2 x P7	-8.33**	-36.23**	-9.91**	-40.29**
P3 x P4	12.68**	9.59**	-25.79**	-41.43**
P3 x P5	7.69**	-28.99**	-16.84**	-42.38**
P3 x P6	0.00	-33.33**	-17.22**	-45.20**
P3 x P7	-10.14**	-10.14**	-11.79**	-24.56**
P4 x P5	11.58**	-27.40**	-14.86**	-29.05**
P4 x P6	-2.08	-35.62**	-15.90**	-34.40**
P4 x P7	-12.68**	-15.07**	-23.62**	-30.71**
P5 x P6	42.22**	39.13**	-2.61**	-10.40**
P5 x P7	27.47**	-15.94**	-29.01**	-45.24**
P6 x P7	-10.87**	-40.58**	-15.38**	-38.40**
SE	**1.221**	**1.057**	**0.431**	**0.373**
LSD (0.05)	**2.505**	**2.169**	**0.883**	**0.765**
LSD (0.01)	**3.382**	**2.929**	**1.193**	**1.033**

*** Significant at 5% level**
**** Significant at 1% level**

4.2.10 Number of Fruits Per Plant

Among the 21 cross combinations, 4 showed highly significant negative mid parent heterosis for the character expressing no. of fruits per plant. The estimates of mid parent heterosis ranged from-25.34 to 49.61 percent. The highest significant positive heterotic response was observed in the hybrid P1 x P6 (49.61%) followed by P2 x P5 (48.07%) and lowest significant negative heterotic response was observed in the hybrid P2 x P6 (-25.34 %) followed by P2 x P3 (-6.64 %) for no. of fruits per plant**.** Vijay and Nath, Bhutani *et al*., Patel, Kalloo *et al*., Kapadia, Ingale and Patil, Kumar *et al.*, Jha and Patel reported negative to positive range of heterobeltiosis for this trait.

Out of 21 cross combinations, 12 showed negative better parent heterosis. Among them, 9 showed highly significant negative better parent heterosis. The estimates of better parent heterosis ranged from -44.75 to 35.80 percent. The highest significant positive heterotic response was observed in the hybrid P5 x P6 (35.80%) followed by P1 x P4 (28.37%) and lowest significant negative heterotic response was observed in the hybrid P2 x P6 (-44.75%) followed by P2 x P3 (-43.60 %) for no. of fruits per plant.

4.2.11 Yield Per Plant

Yield is a complex character and is the last product of various basic yield components. Out of 21 cross combinations, highly significant positive mid parent heterosis was found in all crosses. The estimates of mid parent heterosis ranged from 6.72 to 53.75 percent. The highest significant positive heterotic response was discovered in the hybrid P1 x P6 (53.75%) followed by P2 x P5 (51.95%) and lowest significant positive heterotic response was found in the hybrid P2 x P6 (6.72 %) followed by P4 x P7 (7.70 %) for yield/plant**.** Bhakta *et al*. (2009) showed significant positive heterosis for fruit yield per plant.

Out of 21 cross combinations, highly significant positive better parent heterosis was found in all crosses except one. Highly significant negative better parent heterosis was found in hybrid P2 x P6. The estimates of better parent heterosis ranged from -1.16 to

48.65 percent. The highest significant positive heterotic response was observed in the hybrid P1 x P2 (48.65%) followed by P1 x P6 (43.02%) and lowest significant negative heterotic response was observed in the hybrid P2 x P6 (-1.16%) for yield/plant.

The higher magnitude of heterobeltiosis (better parent heterosis) and relative heterosis (mid parent heterosis) in almost all crosses indicated the presence of over-dominance, which suggested that exploitation of heterosis through heterosis breeding may prove to be effective for the improvement at a greater extent of the fruit yield per plant.

Table 2 (cont'd).

Crosses	No. of fruits per plant		Yield/plant	
	Mid parent (%)	Better parent (%)	Mid Parent (%)	Better parent (%)
P1 x P2	37.85**	-13.82**	49.36**	48.65**
P1 x P3	33.81**	22.56**	30.30**	16.22**
P1 x P4	30.51**	28.37**	41.72**	38.96**
P1 x P5	42.49**	8.87**	33.21**	24.38**
P1 x P6	49.61**	13.82**	53.75**	43.02**
P1 x P7	34.62**	22.23**	40.40**	33.01**
P2 x P3	-6.64**	-43.60**	49.28**	33.70**
P2 x P4	-3.96**	-40.35**	37.33**	34.03**
P2 x P5	48.07**	9.14**	51.95**	41.27**
P2 x P6	-25.34**	-44.75**	6.72**	-1.16**
P2 x P7	-3.71**	-42.02**	43.59**	35.43**
P3 x P4	15.92**	7.81**	20.00**	5.19**
P3 x P5	36.85**	-1.52	29.10**	8.44**
P3 x P6	25.57**	-9.98**	41.67**	18.60**
P3 x P7	27.82**	26.60**	30.35**	10.88**
P4 x P5	31.89**	-0.38	48.98**	41.74**
P4 x P6	4.95**	-21.06**	37.79**	30.58**
P4 x P7	8.25**	-0.21	7.70**	3.99**
P5 x P6	36.65**	35.80**	31.93**	31.40**
P5 x P7	21.64**	-12.98**	30.95**	28.96**
P6 x P7	17.91**	-15.96**	30.05**	27.56**
SE	**0.995**	**0.861**	**0.078**	**0.067**
LSD (0.05)	**2.041**	**1.768**	**0.159**	**0.138**
LSD (0.01)	**2.756**	**2.387**	**0.215**	**0.186**

*** Significant at 5% level**
**** Significant at 1% level**

CHAHTER V

SUMMARY AND CONCLUSION

The experiment was conducted to estimate the heterosis and performance of eggplant during the summer season of 2019 at the experimental field of Olericulture Division, Horticultural Research Center (HRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh. The field performance and heterotic effect for different parameters were exhibited in twenty-one eggplant cross combination involving seven parents.

Highly significant variations were observed among all the characters indicating that there were variations among all genotypes.

The hybrid P4 x P6 (73.67days) took shortest time for 50% flowering followed by P1 x P6 (74.67days). The parent P1 took shortest time for first harvest (46.67days) followed by P1 x P7 (57.67 days). The parent P4 showed highest no. of primary branches at last harvest (6.67) followed by P3 x P4 (6.07) and P1x P7 (6.03). The parents P1 and P7 showed highest no. of flowers/ cluster (5.33) followed by P1 x P5 (4.33), P4 x P6 (4.33) and P3 (4.33). The parent P7 showed highest no. of fruits / cluster (4.00) followed by P1 x P7 (3.33), P1 (3.33). The hybrid P2 x P4 showed highest % fruit set (97.67) followed by P2 x P5 (81.00). The parent P2 showed highest individual fruit weight (445.00g) followed by P2 x P6 (401.33g). The hybrid P3 x P4 showed longest fruit length (26.67cm) followed by P4 (24.33cm), P3 (23.00cm) and P7 (23.00cm). The parent P2 showed longest fruit diameter (11.67cm) followed by P2 x P6 (9.73cm) whereas P3 showed shortest fruit diameter (2.70cm) followed by P3x P4 (2.73cm). The hybrid P3 x P7 showed highest no. of fruits per plant (39.67) followed by P1x P7 (38.30) and P1x P3 (37.67). Thehybrid P1 x P6 showed highest yield/plant (4.10kg) followed by P4 x P5 (4.03kg), P2 x P5 (4.02kg), P5 x P6 (3.77kg) and P4 x P6 (3.74kg). These hybrids may be selected for further trial. The hybridization programme should be continued and more advanced lines should be incorporated in the programme to find out more promising hybrid.

The highest significant positive heterobeltiosis for days to 50% flowering was observed in the hybrid P2 x P5 (16.96%), days to first harvest was observed in the hybrid P1 x P4 (57.86 %) followed by P1 x P5 (47.86 %), no. of primary branches at last harvest was observed in the hybrid P2 x P7 (19.29 %) followed by P1x P7 (9.04%), no. of flowers/cluster was observed in the hybrid P4 x P6 (30.00 %),

The highest significant positive heterobeltiosis for %fruit set was observed in the hybrid P2 x P4 (24.15%), individual fruit weight was observed in the hybrid P1 x P4 (11.74 %) followed by P1 x P7 (9.96 %), fruit length was found in the hybrid P5 x P6 (39.13%) followed by P1 x P2 (12.20%), no. of fruits/plant was observed in the hybrid P5 x P6 (35.80%) followed by P1 x P4 (28.37%) and yield per plant was observed in the hybrid P1 x P2 (48.65%) followed by P1 x P6 (43.02%).The highest significant positive relative heterosis for days to 50% flowering was discovered in the hybrid P2 x P5 (4.47 %) followed by P2 x P4 (2.73 %), days to first harvest was observed in the hybrid P1 x P4 (31.55 %) followed by P2xP3 (31.17%), no. of primary branches at last harvest was observed in the hybrid P5 x P7 (23.77 %) followed by P2x P7 (21.90%), no. of flowers/cluster was found in the hybrid P4 x P6 (36.84 %), %fruit set was observed in the hybrid P2 x P4 (36.60%) followed by P2 x P5 (23.66%), fruit weight was discovered in the hybrid P2 x P6 (21.62%) followed by P1 x P4 (15.44%), fruit length was observed in the hybrid P5 x P6 (42.22%) followed by P1 x P2 (35.29%), no. of fruits/plant was observed in the hybrid P1 x P6 (49.61%) followed by P2 x P5 (48.07%), yield/plant was discovered in the hybrid P1 x P6 (53.75%) followed by P2 x P5 (51.95%).

Above the discussion we concluded that the crosses P1 x P6, P4 x P5, P2 x P5, P5 x P6 exhibited highest yield/plant. The crosses P1 x P6, P2 x P5, P1 x P4 exhibited significant positive heterosis.

These finding along with other information on heterosis in eggplant are expected to help a plant breeder to plan an effective hybrid variety development programmed of eggplant in Bangladesh condition. The information may also help a plant breeder of the similar tropical environment in the others parts of the world.

REFERENCES

Anonymous. (2019). Year Book of Agricultural Statistics of Bangladesh 1971 Bangladesh Bureau of Statistics, Ministry of Planning, Government of the Peoples Republic of Bangladesh, Dhaka, Bangladesh. pp. 37-38.

Babu, S. and Thirumurugan, T. (2000). Effect of heterosis in brinjal (*Solanum melongena* L*.). J. Ecotoxic. and Environ. Monitoring.,* **10**(1): 63-66.

Baha-Eldin, S.A., Blackhurst, H.T. and Perry, B.A. (1968a). The inheritance of certain quantitative characters in eggplant. I. Inheritance of plant height, flowering date and fruit shape. *Proc. Amer. Soc. Hort. Sci.,* **92**: 480-489.

Baha-Eldin, S.A. Blackhurst, H.T. and Perry, B.A. (1968b). Inheritance of certain quantitative characters in eggplant. II. The inheritance of yield, fruit number and fruit weight. *Proc. Amer. Soc. Hort. Sci.,* **92**: 490-497.

Balamohan, T.N., Subbiah, R. and Shanmugavelu, K.G. (1983). Studies on heterosis in brinjal (*Solanum melongena* L.) Proc. on scientific meeting on genetics and improvement of heterotic systems. School of genetics. Tamil Nadu Agricultural University, Coimbatore, India. pp.23-24.

Bhakta R.S., Patel, D.U., Patel, S.J., Patel, N.K.,and Kodappully, V.C. (2009). Hybrid vigour in eggplant (*Solanum melongena L*.). *Research on Crops.* 2009; **10**(2):357-361.

Bhutani, R.D., Kalloo, H.C., Singh, G.P. and Sidhu, A.S. (1980). Heterosis and combining ability in brinjal (*Solanum melongena* L.). *Haryana Agric. Univ. J. Res.,* 10(4): 476-484.

Borikar, S.T., Makne, V.G. and U.G. Kulkarni. (1981). A note on diallel analysis in brinjal (*Solanum melongena* L.) *Indian J. Agril. Sci.,* **51**(1): 51-52.

Bose, T.K. and Som, M.G. (1986). Vegetable Crops in India. Nayaprakash, 206, Bidhan Sarani, Calcutta 700006. India. pp. 775.

Boswell, V.R. (1937). Improvement and genetics of tomatoes, peppers and eggplant. US Dep. Agric. Year Book Agric. pp. 176-206.

Chadha, M.L. and Sharma, C.M. (1989). Inheritance of yield in brinjal. *Indian J. Hort*., **46**(4): 485-489.

Chadha, M.L. and Sidhu, A.S. (1982). Studies on hybrid vigour in brinjal, *Indian J. Hort*. **39**: 233-238

Chadha, M.L. and Hegde, R.K. (1989). Combining ability studies in brinjal. *Indian J. Hort.*, **46**(1): 44-52.

Chadha, M.L., Joshi, A.K. and Ghai, T.R. (1990). Heterosis breeding in brinjal. *Indian J. Hort.,* **47**(4): 417-423.

Chaudhary, D.R. and Malhotra, S.K. (2000). Combining ability of physiological growth parameters in brinjal (*Solanum melongena* L.). *Indian J. Agric. Res.,* **34**(1): 55-58.

Choudhary, D.R. and Mishra, G.M. (1988), Heterosis for morphological characters in inter-varietal crosses of brinjal, *Haryana J. Hort. Sci*. 17221-227.

Cheah, C.H., Kwan, K.H. and Nurmala, M.N. (1981). Genetics of brinjal (*Solanum melongena* L.). Fourth international SABRAO congress, 4-8 May 1981, Universiti Kebangsaan Malaysia and Federal Hotel, Kuala Lumpur.

Dahiya, M.S., Dhankar, B.S. and Kallo, H.C. (1984). Hybrid performance in eggplant (*Solanum melongena* L.) *Haryana J. Hort. Sci*., **13**(3/4): 147-149.

Dahiya, M.S., Dhankhar, B.S., Kalloo, H.C. and Pandita, M.L. (1985). Line × tester analysis for the study of combining ability in brinjal (*Solanum melongena* L.). *Haryana J. Hort. Sci.,* **14**(1 & 2): 102-107.

Daskaloff, C.H. (1937). Contribution to the study of heterosis in eggplant (*Solanum melongena* L.) and the posibility of its practical utilization in horticulture. *Rev. Inst. Res. Agron., Bulgaria***.** **7**(4): 56-76.

Dharmegowda, M.V. (1977). Genic analysis of yield and yield components in brinjal (*Solanum melongena* L.). *Mysore J. Agric. Sci.,* **11**(3): 426.

Dharmegowda, M.V., Hiremath, K.G. and Goud, J.V. (1979). Combining ability studies in *Solanum melongena* L. *Mysore J. Agric. Sci.,* **13**(1): 10-14.

Dixit, J. and Gautam, N.C. (1987). Studies on hybrid vigour in eggplant (*Solanum melongena* L.). *Indian J. Hort.,* **44**(1/2): 74-77.

Dixit, J., Bhutani, R.D. and Dudi, B.S. (1982). Heterosis and combining ability in eggplant. *Indian J. Agril. Sci.,* **52**(7): 444-447.

Dubey, R.; Das, A.; Ojha, M.D.; Saha, B.; Ranjan, A.; Singh, P.K. Heterosis and combining ability studies for yield and yield attributing traits in brinjal (*solanum melongena l.*). 6.

Genchev, S. and Popova, D. (1973). A study on plastid pigments content in connection with the manifestation of heterosis effect in eggplant (*Solanum melongena* L.). *Competes Rendus de l'Academie Agricole Georgi Dimitrov.,* **6**(3): 239-243.

Gill, H.S., Arora, R.S. and Pachauri, D.C. (1976). Inheritance of quantitative characters in eggplant (*Solanum melongena* L.). *Indian J. Agril. Sci.,* **46**(10): 484-490.

Gopinath, G. and Madalageri, B.B. (1986). Genetics of yield and its components in brinjal (*Solanum* melongena L.). *Haryana J. Hort. Sci.,* **15**(1 & 2): 103-109.

Hani, M.B., Allam, A.M.K., Shal, M.A.E., Kader, M.M.A. and Doos, M.K. (1977). Estimation of heterosis in eggplant (*Solanum melongena* L.). *Alexandria J. Agric. Res.,* ***25****(3): 465-471.*

Ingale, B.V. and Patil, S.J. (1997a). Diallel analysis of fruit characteristics in egg plant. *PKV Res. J.,* **21**(1): 30-34.

Ingale, B.V. and Patil, S.J. (1997b). Heterosis breeding in brinjal (*Solanum melongena* L.). *PKV Res. J.,* **21**(1): 25-29.

Ingale, B.V. and Patil, S.J. (1996). Heterosis for fruit characteristics in eggplant, *J. Maharashtra Agric. Uni.* **21**: 390-393.

Jha, N.K. (2003). Generation mean analysis in brinjal (*Solanum melongena* L.). M.Sc. (Agri.) Thesis, Gujarat Agricultural University, Sardarkrushinagar, (Gujarat) India.

Joarder, O.I., Islam, Q.N., Salehuzzaman, M. and Alam, M.S. (1981). Inheritance of some quantitative characters in eggplant (*Solanum melongena* L.). *Genetica Polonica.,* ***22****(1): 91-102.*

Kakizaki, Y. (1930). Breeding grossed eggplants in Japan. *J. Hered.,* **21**: 253-258.

Kakizaki, Y. (1931). Hybrid vigor in eggplant and its practical utilization. *J. Hered.*, **16**: 1-25.

Kandaswamy, P., Singh, N., Kalda, T.S., Sirohi, P.S. and Chaudari, B. (1983). Heterosis and combining ability in eggplant. *Indian J. Agri. Sci.* **53**(4): 201-206.

Kapadia, S. (1995). Generation mean analysis. M.Sc. (Agri.) Thesis, Gujarat Agricultural University, Sardarkrushinagar, (Gujarat) India.

Kalloo, G., Baswana, K.S. and Sharma, N.K. (1989). Performance of various hybrids of brinjal (*Solanum melongena* L.). *H.A.U. J. Res.* **19**:328- 335.

Kumar, N. and Ram, H.H. (1987). Combining ability and gene effect analysis of quantitative characters in eggplant. *Indian J. Agril. Sci.*, **57**(2): 89-102.

Kumar, R., Singh, D.N., Prasad, K.K. and Kumar, R. (1996). Combining ability analysis in brinjal (*Solanum melongena* L.). *J. Res. Birsa Agril. Univ*., **8**(1): 45-49.

Kumar, R., Singh, D.N., Prasad, K.K. and Kumar, R. (1999). Heterosis in brinjal (*Solanum melongena* L.), *J. Res.* **11**:217-221.

Kumar, S.R.; Arumugam, T.; Anandakumar, C.R.; Rajavel, D.S. Estimation of Heterosis and Specific Combining Ability for Yield, Quality, Pest and Disease Incidence in Eggplant (Solanum Melongena L.). 2012, 2, 13.

Lal, S. and Pathak, M.M. (1974). Combining ability in brinjal. *Indian. J. Gen.,* **34**(3): 394-399.

Lal, S., Verma, G. and Pathak, M.M. (1974). Hybrid vigour for yield and yield components in brinjal (*Solanum melongena* L.). *Indian J. Hort.,* **31**(1): 52-55.

Lester, R.N. and Thitai, G.N.W. (1986). Inheritance in *Solanum aethiopicum,* the scarlet eggplant. VIth meeting on genetics and breeding on Capsicum and eggplant, October 21-24, 1986. Zaragoza, Spain. Servicio de Investigacion Agraria. pp. 31-38.

McDaniel, R.G. (1986). Biochemical and physiological basis of heterosis. *Critical Rev. Plant Sc.,* **4**(3): 227-246.

Mian, M.A.K. (1985). Heterosis, inbreeding depression and combining ability analysis in chickpea (*Cicer arientinim* L.). Ph.D. Thesis. Div. of Genet., IARI, New Delhi. p. 129.

Mishra, G.M. (1962). Investigation on manifestation and some physioligical aspects of heterosis in brinjal (*Solanum melongena* L.). Ph.D. Thesis. I.A.R.I., New Delhi, India.

Mishra, G.M. (1961). Investigation on hybrid vigor in brinjal (*Solanum melongena* L.). *Indian J. Hort.*, **19**:305-317.

Nagi, X. and Kida, M. (1926). An experiment with some varietal crosses of eggplant.*Japan. J. Gen., **4**: 10-30.*

Nualsri, C., Dhanasobhon, C. and Srinives, A. (1986). A study on the inheritance of some economically important characters in 4 cultivars of eggplant (*Solanum melongena* var. esculenta Nees.) I. Heterosis in the F1 hybrids. *Kasetsart J.,* **20**(2): 117-123.

Odland, M.L. and Noll, C.J. (1948). Hybrid vigor and combining ability in eggplants.Proceedings of Amer. Soc. *Hort. Sci.,* **46**: 269-276, 51: 417-420.

Padmanabham, V. and Jagadish, C.A. (1996). Combining ability studies on yield potential of round fruited brinjal (*Solanum melongena* L.). *Indian J. Gen. Pl. Breed.,* **56**(2): 141-146.

Pal, B.P. and Singh, H.B. (1946). Studies in hybrid vigour. II. Notes on the manifestation of hybrid vigor in the brinjal and bitter gourd. *Indian J. Gen.,* **5**: 106-121, **6** (1): 19-23.

Pal, B.P. and Singh, H.B. (1949). Hybrid brinjal gives increased yields. *Indian Fmg.,* **10:** 378-380.

Pan, X.Q., Wang, H.C., Liu, J.S., Pan, X.Q., Wang, H.C. and Liu, J.S. (1996). New eggplant F1 hybrid 'Jiqie 2'. *China Vegetables.,* **6**: 1-3.

Patel, N.B. (2003). Diallel analysis for yield, its components and quality traits in round brinjal (*Solanum melongena* L.). M.Sc. (Agri.) Thesis, Gujarat Agricultural University, Sardarkrushinagar, (Gujarat) India

Patil, R.B. and Shinde, S.R. (1984). Heterosis in eggplant. *J. Maharashtra Agric. Univ.,* **9**(3): 289-292.

Patil, H.S. and Shinde, Y.M. (1985). Combining ability studies for different characters in eggplant. *J. Maharashtra Agric. Univ.,* **10**(2): 179-181.

Peter, K.V. and Singh, R.D. (1973). Diallel analysis of economic traits in brinjal (*Solanum melongena* L.). *Indian J. Agric. Sci.,* **43**: 452-455.

Peter, K.V. and Singh, R.D. (1976). Combining ability, heterosis and analysis of phenotypic variation in brinjal (*Solanum melongena* L.). *Indian J. Agril. Sci.,* **46**(6): 393-399.

Prakash, K.T., Shivashankar, A. and Gowda, P.H.R. (1994a). Line × tester analysis for combining ability in brinjal (*Solanum melongena* L.). *Crop Res. Hisar*., **8**(2): 296-301.

Prasath, D., Natarajan, S. and Thamburaj, S. (2000). Line × tester analysis for heterosis in brinjal (*Solanum melongena* L.). *Orissa J. Hort.,* **28**(1): 59-64.

Rajput, J.C., Palve, S.B., Jamadagni, B.M. and Salvi, M.J. (1984). Heterosis in brinjal (*Solanum melongena* L.). *Agricultural Science Digest, India,* **4**(4): 215-217.

Ram, D., Singh, S.N., Chauhan, Y.S. and Singh, N.D. (1981). Heterosis in brinjal.

Haryana J. Hort. Sci., **10**(3 & 4): 201-206.

Rashid, M.A., Mondal, S.N., Ahmed, M.S., Ahmad, S. and Sen, D.K. (1988). Genetic variability, combining ability estimates and hybrid vigour in eggplant (*Solanum melongena* L.). *Thai. J. Agric. Sci.,* **21**: 51-61.

Rood, S.B., Buzzel, R.I. and McDonald, M.D. (1988). Influence of temperature on heterosis for maize seedling growth. *Crop Sci.,* **28**: 283-286.

Saha, M.G. (1989). Combining ability estimates and hybrid vigour in eggplant (*Solanum melongena* L.). M.Sc. (Ag) Thesis. Bangaldesh Agric. Univ. Mynsingh.

Saha, M.G., Hossain, A.K.M.A., Hoque, K.R. and Bhowmik, A. (1991). Genetic analysis of plant height and number of branches in brinjal (*Solanum melongena* L.). *Ann. Bangladesh Agric.,* **1**(2): 91-97.

Salehuzzaman, M. (1981). Investigation on hybrid vigour in *Solanum melongena* L. *SABRAO J.*, **13**(1): 25-31.

Salehuzzzaman, M., and Alam, M.S. (1983). Genetic analysis of yield and its components in eggplant. *SABRAO J*., **15**: 11-15.

Sanguineti, M.C., Coltelli, C. and Conti, S. (1985). Heterosis and combining ability in eggplant (*Solanum melongena* L.). *Genetica Agraria.,* **39**(3): 345.

Sawant, S.V., Desai, U.T., Kale, P.N. and Joi, M.B. (1992). Heterosis studies in brinjal.J. *Maharashtra Agric. Univ.,***17**(3): 394-396.

Sharma, C.M. (1985). Inheritance of some biochemical traits with special reference to bitterness and discoloration in *Solanum melongena* L. M.Sc. Thesis, PAU, Ludhiana.

Sidhu, A.S. and. Chadha, M.L. (1985). Heterosis and per se performance studies in brinjal. *Indian J. Hort.* **42**:107-111.

Singh, B. and Kumar, N. (1988). Studies on hybrid vigour and combining ability in brinjal (*Solanum melongena* L.). *Veg. Sc.,* **15**(1): 72-78.

Singh, B., Joshi, S. and Kumar, N. (1978). Hybrid vigour in brinjal (*Solanum melongena* L.). *Haryana J. Hot. Sci.,* **7**: 95-99.

Singh, D.P., V.S.R.K. Prasad and R.P. Singh. (1991). Combining ability in egg plant. *Indian J. Hort.,* **48**(1): 52-57.

Singh, H. and Kalda, T.S. (1989). Heterosis and genetic architecture of leaf and yield characteristics in eggplant. *Indian J. Hort.,* **46**(1): 53-58.

Singh, H. and Swarup, V. (1971). Exploitation of hybrid vigour in vegetables. Tech. Bull. I.C.A.R., New Delhi, No. 33.

Singh, H.N., Singh,V.and Mittal.(1974a). Heterosis in brinjal. In: S. Ramanujam and R.D. Iyer (Eds.). Breeding researches in Asia and Oceania. Proceedings of the Second General Congress of the Society for the Advancement of Breeding Researches in Asia and Oceania. Session XVIII. Breeding vegetables, fruits and ornamentals. New Delhi, India. Indian Society of Genetics and Plant Breeding. 1245-1247.

Singh, H.N., Singh, S.N. Verma, H.P.S. Mital, R.K. and Singh, V. (1974b). Combining ability in brinjal (*Solanum melongena* L.). *Indian J. Agril. Sci.,* **44**(3): 151- 155.

Singh, S.N. (1984). The magnitude of G.C.A. in relation to heterosis and inbreeding depression in eggplant. *Haryana J. Hort. Sci.,* **13**(3 & 4): 175-181.

Singh, S.N. and Hazarika, M.H. (1982). Note on the relationship between performance per se and general combining ability of parents in eggplant. *Indian* J. *Agril. Sci.,* **52**(9): 614-615.

Singh, S.N., Singh, H.N. and Hazarika, M.H. (1979). Fractional diallel analysis of some quantitative characters in brinjal. *Acta Hort*.**,** **93**: 307-316.

Singh, S.N., Singh, H.N. Singh, N.D. and Jain, B.P. (1979). Hybrid performance in brinjal. *Haryana J. Hort. Sci.,* **7**(1 & 2): 74-77.

Singh, S.N., Chauhan, Y.S. and Singh, N.D. (1981). Combining ability analysis for some quantitative characters in egg-plant (*Solanum melongena* L.). *Haryana J. Hort. Sci.*, **10**(1 & 2): 95-101.

Singh, S.N., Singh, N.D. and Hazarika, G.N. (1982). A note on degree of dominance and parental mean performance in brinjal (*Solanum melongena* L.). *Haryana J. Hort. Sci.,* **11**(1/2): 146-148.

Sinha, S.K. and Khanna, R. (1975). Physiological, biochemical and genetic basis of heterosis. *Adv. Agron.,* **27**: 123-174.

Sprauge, G.F. 1983. Heterosis in maize. Thory and Practices. In: Hterosis, Reappraisal of Theory and Practices. Monograph on Theoretical and Applied Genetics. Vol. 6. Frnkel, R. (ed.). Springer - Verlag Berlin, Heidelberg.

Srivastava, O.P. and Bajpai, P.N. (1977). Combining ability in eggplant (*Solanum melongena* L.). *Indian J. Agril. Sci.,* **47**(4): 181-184.

Tan, T.M., Xu, C.C. Tan,T.M. and Xu, C.C. (1997). Breeding of Eqie No.1 eggplant - a new F1 hybrid with early maturity and long purple fruit. *China Vegetables.,* **2**: 25-27.

Thompson, H.C. (1951). Vegetable Crops. 4th Edn. MacGrew Hill Book Company Inc. London. p. 611.

Tiwari, R.R. (1966). Studies on hybrid vigour in *Solanum melongena* L. *J. Indian Bot. Soc.*, **45**: 138-149.

Thakur, M.R., Singh, K. and Singh, J. (1968). Hybrid vigour studies in brinjal. *Punjab Agric. Univ. J. Res.,* **5**:490-495.

Tomar, B.S., Kalda, T.S. Balakrishan, K.A.and Gupta, S.S. (1997). Genetic parameter studies in the F1 generation of a line × tester cross in brinjal. *South Indian Hort.*, **45**(3 & 4): 111-114.

Venkataramani, K.S. (1946). Breeding brinjals (*Solanum melongena*) in Madras. I. Hybrid vigor in brinjal. *Proc. Indian Aca. Sci.,* **23**(6): 266-273.

Verma, S. (1986). Combining ability studies in brinjal (*Solanum melongena* L.*). Prog. Hort.*, **18**(1 & 2): 111-113.

Vijay, O.P. and Nath, P. (1974). Studies on hybrid vigour in eggplant (*Solanum melongena* L.). In: R. Antoszewski, L. Harrison and C.C. Zych (Eds.): Proceedings of the XIX International Horticultural Congress. I. SectionVII. International Society for Horticultural Science. Warsaw, Poland. Vegetables. pp. 621-674.

Vijay, O.P. and Nath, P. (1978). Studies on heterosis and development of hybrid varieties in eggplant *(Solanum melongena* L.). *Indian J. Horti.* **35**:229−232

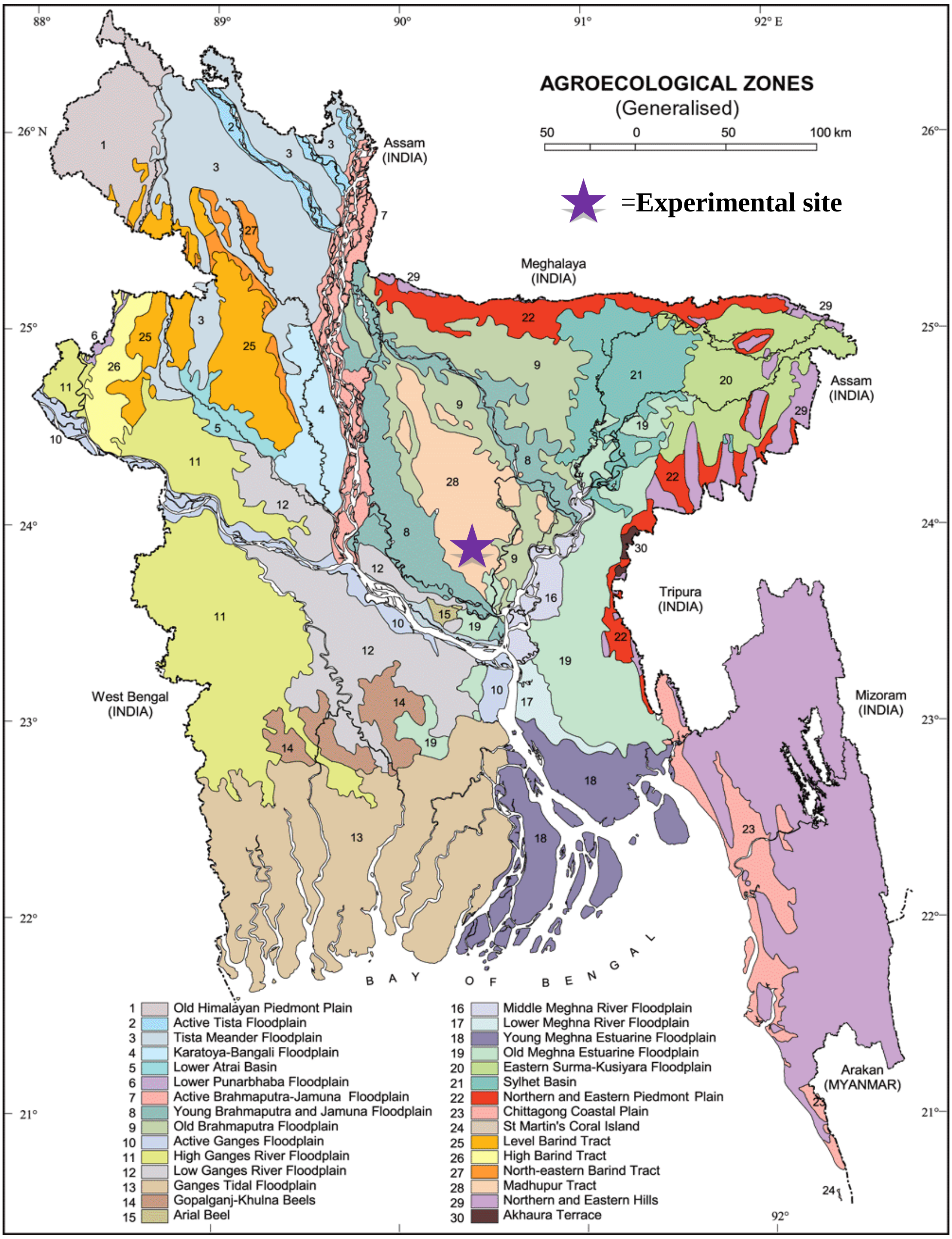
Vijay, O.P., Premnath and Jalikop. S.H. (1978). Combining ability in a diallel cross of brinjal (*Solanum melongena* L.). *Indian J. Hort*.,**35**(1): 55-58.

Viswanathan, T.V. (1973). Hybrid vigour in brinjal. *Proc. Indian Aca. Sci.,* **77(**4): 176-180.

Yamaguchi, M. (1983). Solanaceous Fruits. In: World Vegetables Principles, Production and Nutritive Values. AVI Publishing Company Inc. West Port, Connecticut, USA. pp. 298-304.

APPENDICES

Appendix I. Map showing the experimental site under study



Appendix II: Analysis of variance for genotypes (Parent and crosses) in eggplant

Source of variance	Df	Mean sum of Square					
		Days to 50% flowering	Days to first harvest (cm)	No. of primary branches at last harvest	No. of flower/ cluster	No. of fruits/ cluster	% Fruit set
Replication	2	180.25	83.01	0.65	1.29	2.04	270.51
Genotype	27	111.85**	153.69**	1.46**	2.89**	1.59**	1524.77**
Error	54	3.35	4.54	0.12	0.32	0.21	7.28
CV (%)		2.27	3.18	6.90	18.28	20.96	5.79

** Significant at 1% level**

Table 1 (cont'd).

Source of variance	Df	Mean sum of Square				
		Individual fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	No. of fruits per plant	Yield/plant (kg)
Replication	2	209.00	60.33	1.61	90.82	0.21
Genotype	27	26264.90**	78.84**	15.08**	241.11**	0.94**
Error	54	4.80	2.23	0.28	1.48	0.01
CV (%)		1.36	9.17	9.69	4.94	2.94

** Significant at 1% level**

Appendix III: Leaf colour, Stem colour, Spine on calys, of 21 hybrids and 7 parents in eggplant

F1/ Parents	Leaf colour	Stem colour	Spine on calys
P1 x P2	Deep green	Purple green	Few
P1 x P3	Deep green	Purple green	Intermediate
P1 x P4	Green	Purple green	Intermediate
P1 x P5	Deep green	Green	Few
P1 x P6	Deep green	Purple green	Intermediate
P1 x P7	Green	Green	Few
P2 x P3	Green	Green	Few
P2 x P4	Deep green	Green	Intermediate
P2 x P5	Deep green	Purple green	Few
P2 x P6	Green	Green	Few
P2 x P7	Green	Purple green	Intermediate
P3 x P4	Deep green	Green	Intermediate
P3 x P5	Green	Green	Intermediate
P3 x P6	Green	Purple green	Few
P3 x P7	Deep green	Purple green	Few
P4 x P5	Deep green	Green	Few
P4 x P6	Green	Green	Intermediate
P4 x P7	Deep green	Green	Few
P5 x P6	Green	Purple green	Intermediate
P5 x P7	Deep green	Green	Few
P6 x P7	Green	Purple green	Intermediate
P1	Deep green	Purple green	Intermediate
P2	Deep green	Green	Few
P3	Green	Green	Few
P4	Green	Purple green	Intermediate
P5	Deep green	Green	Intermediate
P6	Green	Purple green	Few
P7	Deep green	Purple green	Few

Appendix IV: Spine on leaf, Spine on stem and Fruit length/ diameter ratio, of 21 hybrids and 7 parents in eggplant

F1/ Parents	Spine on leaf	Spine on stem	Fruit length/ diameter ratio
P1 x P2	No	Very few	Twice as long as broad
P1 x P3	Very few	Very few	Several times as long as broad
P1 x P4	No	No	Three times as long as broad
P1 x P5	No	Very few	Singly longer than broad
P1 x P6	No	No	Singly longer than broad
P1 x P7	Very few	Very few	Three times as long as broad
P2 x P3	No	No	Three times as long as broad
P2 x P4	No	Very few	Three times as long as broad
P2 x P5	No	Very few	As long as broad
P2 x P6	No	No	Broader than long
P2 x P7	No	No	Twice as long as broad
P3 x P4	Very few	Very few	Several times as long as broad
P3 x P5	No	No	Twice as long as broad
P3 x P6	Very few	Very few	Twice as long as broad
P3 x P7	No	No	Several times as long as broad
P4 x P5	No	No	Three times as long as broad
P4 x P6	No	No	Three times as long as broad
P4 x P7	Very few	Very few	Several times as long as broad
P5 x P6	No	Very few	As long as broad
P5 x P7	No	No	Three times as long as broad
P6 x P7	No	No	Singly longer than broad
P1	No	No	Three times as long as broad
P2	No	No	Broader than long
P3	Very few	Very few	Several times as long as broad
P4	Very few	Very few	Several times as long as broad
P5	No	Very few	As long as broad
P6	No	No	As long as broad
P7	No	No	Three times as long as broad

Appendix V: Average weather conditions in Gazipur, Bangladesh in 2019

Month	Average Temperature (°C)	Average Precipitation(mm)	Average Humidity (%)
March	32.5	65.8	38
April	33.7	156.3	42
May	34.2	339.4	59
June	32.4	340.4	72
July	31.8	373.1	72
August	32.7	316.2	74
September	31.5	300.3	71

Source: Metrological Department of Bangladesh

Appendix VI: Layout of field experiment in summer season