HETEROSIS AND COMBINING ABILITY STUDIES IN PHOMOPSIS BLIGHT RESISTANT GENOTYPES OF BRINJAL (*SOLANUM MELONGENA* L.)

Thesis Submitted for the Award of the Degree of

DOCTOR OF PHILOSOPHY

in

Vegetable Science

By

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DECLARATION

I, hereby declared that the presented work in the thesis entitled "Heterosis and Combining Ability Studies in Phomopsis Blight Resistant Genotypes of Brinjal (*Solanum melongena* L.)" in partial fulfilment of degree of **Doctor of Philosophy (Ph.D.)** is outcome of research work carried out by me under the supervision of Dr. Vishal Tripathi, working as Assistant Professor, in the Department of Horticulture, School of Agriculture of Lovely Professional University, Phagwara, Punjab, India. In keeping with general practice of reporting scientific observations, due acknowledgements have been made whenever work described here has been based on findings of other investigator. This work has not been submitted in part or full to any other University or Institute for the award of any degree.

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Heterosis and Combining Ability Studies in Phomopsis Blight Resistant Genotypes of Brinjal (*Solanum melongena* L.)

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Abstract

The current work entitled "Heterosis and Combining Ability Studies in Phomopsis Blight Resistant Genotypes of Brinjal (*Solanum melongena* L.)" was conducted at the 'Vegetable Research Farm' of Department of Horticulture, Lovely Professional University, Phagwara, Punjab, India. The presented work was accomplished through two interconnected studies. In the first study, 33 genotypes were evaluated for diverse 47 traits against phomopsis blight in a randomized block fashion in triplicates during the spring-summer and *kharif* seasons of 2022. The mean sum of squares of genotypes revealed highly significant differences for all the traits studied. The obtained pooled analysis results revealed identification of five diverse lines, IC090146, IC090781, IC090810 and IC090828 based on disease resistance and improved biochemical level, and one susceptible line *i.e.*, IC090887, found good in overall horticultural traits. These five identified lines, along with two testers (Pusa Bhairav and Pant Samrat) and their ten derivative crosses obtained through line × tester mating and along with one susceptible check (Pant Rituraj), were evaluated during the spring-summer and *kharif* seasons of 2023. The line × tester ANOVA revealed significant differences among 17 genotypes for 47 traits, with no replication effects. Significant variation was observed among parents and crosses for most traits. Among the parents, Pant Samrat consistently recorded with the lowest disease incidence, superior growth & yield performance and highest nutrition and defense-related metabolites. Among the crosses, IC090146 × Pant Samrat demonstrated a strong balance of disease resistance, vigorous growth, superior yield performance and improved biochemical composition. The combining ability analysis highlighted IC090146 and Pant Samrat as the strongest general combiners in the desired GCA effect for wide range of traits. The crosses like IC090146 × Pant Samrat and IC090781 × Pant Samrat emerged as promising crosses due to their significant negative SCA values across multiple disease parameters and stood out with significant positive SCA values for key yield and biochemical parameters. The heterosis results revealed that crosses like IC090146 × Pant Samrat, IC090781 × Pant Samrat, and IC090810 × Pant Samrat, consistently exhibited superior resistance, vigorous growth, improved yield potential and superior nutritional quality. Conclusively, IC090146 and IC090781 identified as the best lines, Pant Samrat as the superior tester and IC090146 × Pant Samrat, IC090781 × Pant Samrat, and IC090810 × Pant Samrat were the top performing crosses with reference to combining resistance, earliness traits, vigorous growth, high yield potential, and improved nutritional quality. Hence, it is suggested that these genotypes serve as valuable genetic material for the development of disease-resistant, high-yielding, and nutritionally enriched brinjal cultivars.

Dr. Vishal Tripathi	Dr. Adesh Kumar	Etalesh Goutam
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GUIDED BY FAITH TO EMBRACE THE HARDER TRUTH OVER THE COMFORTING WRONG

Dedicated to

My loving Parents

Mrs. & Mr. Om Prakash Goutam

AUTHORED BY: ETALESH GOUTAM

ACKNOWLEDGEMENT

A successful venture is not only the efforts of an individual but also it is an artistic creation with the help of eminent persons. During my career and the completion of this work I have faced both weal and woe, but inspiration and guidance given by my teachers, parents and friends has helped me to make the work into reality. Words would probably be insufficient to express my gratitude, but words are all have as a medium of my expression. At the onset of the acknowledgement, I ascribe all glory to the Gracious "GOD" from all whom all good things come, who has showered his choicest blessings and benevolent graces up on me in life and bestowing me with the blessing to see this day.

I have immense pleasure in expressing my whole-hearted sense of gratitude and indebtedness towards my Research Guides ***Dr. Vishal Tripathi (Assistant Professor)****, Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India and* ***Dr. Adesh Kumar (Associate Professor)****, Department of Plant Pathology, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India for their inspiring guidance, keen interest, activeness and sharpness. I take this opportunity to express my deep and sincere feeling of gratitude to them for suggesting such a novel research topic, valuable guidance, constant inspiration, constructive criticism, talented versatile advice and untiring efforts in preparation of the manuscript of my Ph.D. thesis.*

I express my sincere regard and heartfelt gratitude to ***Dr. Pardeep Kumar Chhuneja (Professor & Dean)****, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India and* ***Dr. Anis Ahmed Mirza (Associate Professor & Head)****, Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India for their precious suggestions untiring help and moral support throughout the entire course of study.*

I would be failing in my duties if, I do not mention the help, guidance and constructive criticism rendered by my dear friend ***Dr. Bharti****.*

I express my sincere and special thanks to my heartiest friends ***Abhishek Thakur, Priyam Sharma, Ramswaroop Choudhary, Lokesh Kumar*** *&*

my cousins **Chirag Gautam**, **Ashvani Gautam** and **Bhuvnesh Gautam** for their liberal assistance, moral encouragement, co-operation & help during the entire study.

I am highly indebted to my senior **Mr. Harendra Kumar (Senior Research Fellow)**, Defence Research and Development Organisation, Haldwani, Nainital, India who always provided me an inner strength and guiding me during all my academic career so as to steer up my ambitions in a proper way.

I also give my convivial thanks to my lovely junior's **Amit Raj**, **Yaman Kumar**, **Dinesh Chilawariya** and all juniors for their supporting nature.

Everything in my life is nothing without the selfless care, boundless love and treatment moral support of the members of my family. No words are enough to express the great sacrifice, devotion, and constant encouragement of my respected grandfather **Late Hariballabh Sharma** & grandmother **Late Badri Bai** and my loving parents **Mrs. & Mr. Om Prakash Goutam**, younger brother **Sahil Gautam** for their love, care and moral support throughout my life.

Many more people helped me directly or indirectly during course of studies, if I do not list them all, it is not for lack of gratitude, it is lack of space. To them all, I convey my best compliments and lots of thanks.

Place: Phagwara, Punjab, India

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Symbols and Abbreviations	Full Form
°C	Degree centigrade
%	Percentage
$^{-1}$	Per
×	Multiplication
&	And
Σ	Summation
ANOVA	Analysis of variance
rpm	Revolutions per minute
cm	Centimeter
cm^2	Centimeter square
CD	Critical difference
CV	Critical value
MPH	Mid parent heterosis
BPH	Better parent heterosis
HSC	Heterosis over susceptible check
GAE	Gallic acid equivalents
DUS	Distinctiveness, uniformity and stability
DAS	Days after sowing
DAT	Days after transplanting
DAI	Days after inoculation
d.f.	Degree of freedom
et al.	et alia (and other)
etc.	Etcetera
FYM	Farm yard manure
g	Gram
mg	Milli gram
ha	Hectare
kg	Kilo gram
MSL	Mean sea level
m	Meter
m^2	Meter square
mm	Milli meter
ml	Milli litre
MOP	Muriate of potash
N	Nitrogen
P	Phosphorus
K	Potassium

SCs	Standard checks
L.	Linnaeus
L	Line
T	Tester
IC	Indigenous Collection
NBPGR	National Bureau of Plant Genetics Resources
IARI	Indian Agricultural Research Institute
GBPUA&T	Govind Ballabh Pant University of Agriculture & Technology
ITCC	Indian Type Culture Collection
PDA	Potato dextrose agar
PDB	Potato dextrose broth
PDI	Percent disease index
PLAD	Percent leaf area diseased
PLI	Percent leaf incidence
PFAD	Percent fruit area diseased
PFI	Percent fruit incidence
HR	Highly resistant
R	Resistant
MR	Moderately resistant
MT	Moderately tolerant
T	Tolerant
S	Susceptible
HS	Highly susceptible
pH	Puissance de hydrogen
q	Quintal
RBD	Randomized block design
S. No.	Serial number
SSP	Single super phosphate
SEm	Standard error of mean
M.S.S.	Mean sum of square
i.e.	That is
T.S.S.	Total soluble solids
viz.	Like, namely
DW	Dry weight
FW	Fresh weight
IU	International unit

Vegetables are referred to as protective foods due to their abundance of several physiologically active substances (Kumar *et al.,* 2023). The Solanaceae family comprises of about 2700 plant species in which the genus, *Solanum* approximately involves 1500 species, including three staple crops, *Solanum melongena*, *S. lycopersicum* and *S. tuberosum* (Barchi *et al.,* 2019). *S. melongena* L. (2n=2x=24) is a popular Solanaceous member that belongs to Old World and originated from *S. insanum* (Vavilov, 1951; Knapp *et al.,* 2013; Cericola *et al.,* 2013; Särkinen *et al.,* 2013). It is commonly known as brinjal, eggplant, aubergine, baingan, *etc.* It is recognized as the "vegetable of the masses" and ‘poor man's crop’ (Patel and Sarnaik, 2003; Gargi and Kalita, 2012). This crop can be grown extensively all year long in India, with the exception of higher elevations (Pramanik *et al.,* 2012). Unripe eggplant fruits are used in numerous culinary dishes and eaten as vegetables (Goutam *et al.,* 2024). There are regional differences exist in consumer’s preferences for various shape, size, colour of brinjal fruits (Bhanushree *et al.,* 2022a). About 56 percent of total eggplant production corresponds to China, and 26 percent to India (Ahmed *et al.,* 2022). With a total of 37,424,976 tonnes, or over 65 percent of global production, China was by far the largest producer of eggplant (FAOSTAT, 2023). In India, the area under eggplant cultivation during 2024–2025 was 685 (‘000 Ha), producing 13074 (‘000 MT) with a productivity of around 19 metric tonnes per hectare (Khound *et al.,* 2025). Eggplant has a high nutritional value due to low-fat, rich in dietary fiber, proteins, vitamins like A and C, minerals (calcium, magnesium, phosphorus, *etc*.), and antioxidants (Kumar *et al.,* 2024). The bitterness of brinjal could be attributed to glycoalkaloids and saponins (Plazas *et al.,* 2013). It possesses chlorogenic acid, that has anti-obesity, anti-diabetic, anti-oxidant, and anti-carcinogenic properties (Plazas *et al.,* 2013; Naveed *et al.,* 2018). Nasunin is the most prevalent flavonoid (anthocyanin), found in brinjal peel (Bhanushree *et al.,* 2019; Sohani and Tawar, 2019; Nandi *et al.,* 2021; Alighadri *et al.,* 2024).

Of the various biotic (fungi, bacteria, nematodes, viroids and viruses) and abiotic (drought, cold, heat, heavy metals, and salinity) variables, the most destructive factor affecting brinjal yield, after bacterial wilt is *Phomopsis vexans* causing phomopsis blight disease (Akhtar, 2009; Saha *et al.,* 2016). It is both soil and seed-borne disease that spreads by rain showers and contaminated farming tools. The pathogen ideally needs 55 percent relative humidity and 28°C temperature for its infection (Pawar and Patel 1957; Bhanushree *et al.,* 2022; Goutam *et al.* 2024). This disease damages brinjal fruits badly, makes them unfit for human consumption and unsellable. Datar and Ashtaputre (1988) revealed that it is indigenous to South Asia and spreaded to several wild eggplant species. With the exception of Europe, *P. vexans* has been documented to exist in warmer regions of most continents (Akhtar *et al.,* 2008; Mahadevakumar *et al.,* 2017; CABI, 2021). Rangaswamy and Mahadevan (2002) documented that the first case of phomopsis fruit rot was found in 1914 in Gujarat, India. Now, it has been reported in the majority of Indian states, such as Uttar Pradesh, Karnataka, Madhya Pradesh, Odisha, Tamil Nadu, Punjab, Kerala, Maharashtra, West Bengal, Andhra Pradesh *etc*. (CABI, 2021; Das and Sarma, 2012; Panwar *et al.,* 1970; Sharma *et al.,* 2011). In terms of damage severity, *P. vexans* reportedly reducing eggplant yield by 10 to 20 percent in India (Murali *et al.,* 2006; Sharmin *et al.,* 2010; Gomes *et al.,* 2013; Goutam *et al.,* 2024). According to Jayaramaiah *et al.* (2013), *P. vexans* causes damage to eggplants at many phases of their growth and development, from damping off in the seedling stage to blight and rot signs on aerial plant parts (leaf, stem, and fruits) in the latter stages of development. Rapid and timely detection of pathogens is crucial for making an effective disease control strategy (Xu *et al.,* 2024). Various disease management strategies have been documented, including seed treatments, soil amendments, grafting, resistant cultivars, and chemicals to manage this disease (ferric chloride, fungicides like zinab and captan) *etc.* (Pradhanang *et al.,* 2005; Fujiwara *et al.,* 2011; Askora, 2012; Keatinge *et al.,* 2014; Kumar *et al.,* 2024a). However, chemical treatments are expensive, unaffordable, and adversely affect soil biota. The greatest approach for long-lasting and stable resistance is the identification of new genetic resources of resistance (Boshou, 2005; Denny, 2007; Huet, 2014; Namisy *et al.,* 2019). Although breeding for phomopsis blight resistance is recognized as essential, systematic heterosis and combining ability studies in resistant brinjal genotypes remain largely unexplored. Furthermore, current breeding efforts focus predominantly on single-stress management, with limited investigation into heterosis-based approaches that simultaneously confer multiple biotic and abiotic stress tolerances. Given the diversity of stresses across India's agro-climatic zones and the urgent need for regionally adapted, high-yielding cultivars, systematic heterosis and combining ability studies in *Phomopsis* resistant genotypes would provide a strategic pathway for developing superior hybrid cultivars.

In the light of these gaps, one of the most notable developments in vegetable breeding in recent years is the use of hybrid vigor. In 1926, Nagai and Kida were the first to report hybrid-vigour in crosses between different Japanese kinds of eggplant. F_1 hybrid development in brinjal is essential to meet the growing demand for cultivars possessing superior quality traits and substantial yields (Rajashree *et al.,* 2023). Hybridization is a significant source of creating variation that contributes to genetic variation. Heritability, genetic advance under selection, and PCV and GCV all evaluate the amount of variability in a population and aid plant breeders in choosing elite genotypes (Rajashree *et al.,* 2023). Heterosis breeding is an excellent method of improving crops and for selecting the most suitable parental lines is crucial for producing hybrids that may be commercialized (Aswani *et al.,* 2016). Insights detailing the combining ability, gene action and inheritance of significant traits may assist breeders in choosing good parentages (Sao and Mehta, 2010). It helps breeders understand the distribution and makeup of genetic variations that can be fixed and those that cannot (Desai *et al.*, 2017; Bhanushree *et al.*, 2019).

Therefore, in light of the circumstances mentioned above, the current research work entitled **"Heterosis and Combining Ability Studies in Phomopsis Blight Resistant Genotypes of Brinjal (*Solanum melongena* L.)"** was conducted at the Vegetable Research Farm of Department of Horticulture, Lovely Professional University, Punjab, India with following prime objectives:

- To screen out and validate *Phomopsis* resistant genotypes of brinjal
- To assess the magnitude of genetic variability, inter-relationship among component traits and direct and indirect contribution on fruit yield
- To estimate heterosis, combining ability for yield and yield attributes involving phomopsis blight genotypes

A comprehensive literature review, adhering to different facets of the current research **"Heterosis and Combining Ability Studies in Phomopsis Blight Resistant Genotypes of Brinjal (*Solanum melongena* L.)"**, is discussed in this chapter under the following sections:

Study-1: Screening of brinjal genotypes against phomopsis blight and validation of resistant genotypes

2.1 Disease parameters

Pande and Singh (2015) evaluated the pathogenicity of *Phomopsis vexans* using four artificial inoculation methods (knife injury, cork-borer injury, carborundum powder injury and pin-prick injury) and subsequently screened five brinjal varieties (Surati Ravaiya, Bilimora Bhadtha, GBL-2, NSRP-1 and AB-08-5) for fruit rot under laboratory conditions. The obtained results inferred that None of the varieties were free from infection under artificial inoculation, with fruit rot incidence ranging from 36.62% to 79.83%. Surati Ravaiya and Bilimora Bhadtha were classified as highly susceptible, whereas NSRP-1 was rated as susceptible.

These findings highlight the critical need for identifying and developing resistant genotypes.

Jakatimath *et al.* (2017) conducted a roving survey during September–November of the year 2014 to assess the prevalence of brinjal fruit rot in Bagalkot district, Northern dry zone of Karnataka. The survey revealed disease presence across all five talukas (Bagalkot, Badami, Hunagunda, Jamakandi, Mudhol), with PDI ranging from 13% to 54.66%. The highest PDI was recorded in Bagalkot taluk, followed by Badami and Jamakandi. Village-level analysis identified Belur (54.66%) and Sulikieri (44%) as highly disease-prone areas. Subsequent screening of 60 brinjal genotypes under field conditions demonstrated that no genotypes were immune. However, two genotypes exhibited resistant reaction, 31 were moderately resistant and 27 were moderately susceptible. **Karmakar and Singh (2017)** evaluated resistance to phomopsis blight in 20 brinjal genotypes comprising two commercial cultivars (Pant Rituraj, Pant Samrat) and three wild relatives (*Solanum gilo*, *S. aethiopicum*, *S. khasianum*) and their interspecific hybrids. Both *S. gilo* and *S. khasianum* were rated highly resistant across all infestation parameters. Among the F_1 hybrids, *S. aethiopicum* × Pant Samrat, Pant Rituraj × *S. gilo*, *S. gilo* × *S. melongena*, *S. gilo* × Pant Samrat and *S. aethiopicum* × *S. gilo* were identified as highly resistant. Crosses involving *S. gilo* as a parent consistently showed high resistance levels. **Mahadevakumar *et al.* (2017)** investigated the distribution and prevalence of *Phomopsis vexans* across six major brinjal-growing agro-climatic zones of southwest India. The pathogen was isolated from diseased leaf and fruit samples, and 24 isolates were characterized for morpho-cultural traits and molecular phylogeny. Pathogenicity assays on 30-day-old seedlings demonstrated that the 18 G-type isolates induced leaf blight symptoms at 25–28 days post-inoculation and fruit rot symptoms at 45–55 days post-inoculation. Disease incidence varied by zone: the northern transition zone (NTZ) exhibited the highest severity (leaf blight: 10.6–25.3%; fruit rot: 21–33.3%), followed by the southern dry zone (SDZ: leaf blight 8.3–18%, fruit rot 22.3–62%) and the central dry zone (CDZ: leaf blight 10–17%, fruit rot 29–39%). **Kumar *et al.* (2020)** conducted a field experiment during the autumn-winter season to evaluate eighteen brinjal cultivars against phomopsis blight. Analysis of seventeen characters revealed significant genotypic variation, with mean sum of squares ranging from 433.79 to 1974.53, indicating considerable genetic diversity among the tested genotypes. At higher inoculum levels, fruit rotting commenced on the 4^{th} day post-inoculation and reached maximum severity by the 9^{th} day. With reduced inoculum loads of 64 and 34 spores per ml, disease symptoms appeared after 6 and 8 days, respectively. **Bhanushree *et al.* (2022b)** screened 18 brinjal cultivars against *Phomopsis vexans* and artificial inoculation via pin-prick method revealed significant variability among cultivars. PDI ranged from 0% to 100%, with six cultivars (Pusa Shyamla, Pusa Kranti, DBL-186, DBL-187, Muktokeshi, DBSR-52) exhibiting maximum PDI (80–100%) and classified as highly susceptible. Five cultivars (NDB-25, Kashi Sandesh, Kalo Solia, DBL-175, Debjhuri Hazari) were susceptible (PDI 60%). Notably, four cultivars (BR 112, Swarna Mani, BR 40-7, IC-112992) were identified as highly resistant with 0% PDI, representing novel resistance sources.

Collectively, these studies highlighting the critical need to develop commercially viable, disease-resistant brinjal varieties through systematic introgression of resistance genes from identified sources.

2.2 Growth, yield and biochemical parameters

Kumar and Arumugam (2013) evaluated 33 local brinjal genotypes collected from in and around the Tamil Nadu state under Madurai (Southern India) conditions to identify suitable varieties for cultivation and reported highly significant differences for most traits. They reported genotype SM 3 recorded the maximum number of primary branches (10.94), followed by Ramakkai Blue (10.90). While, Kariapatty Local exhibited the minimum internodal length (5.53 cm). Traits like days to first flowering exhibited substantial variability, ranging from 75.00 to 85.00 days and the highest (1.93 kg) fruit yield plant^{-1} in EP 27, followed by EP 3 with 1.83 kg fruit yield. Whereas, the maximum (13.87 mg 100 g^{-1}) level of ascorbic acid was measured in Keerikai indigenous brinjal genotype. **Das *et al.* (2017)** characterized 21 brinjal genotypes across two consecutive autumn-winter seasons using 47 characters encompassing growth, yield and morphological traits. Significant variation was observed among genotypes for most characters evaluated. BCB-27 exhibited the highest fruit yield plant^{-1} across both seasons, followed by BCB-8. However, BCB-8 demonstrated superior performance relative to other genotypes in total fruiting period, fruit length and number of fruits plant^{-1}. BCB-15 recorded the maximum peduncle length (6.59 cm), followed by BCB-8 (6.54 cm), while BCB-8 also exhibited the maximum petiole length (5.57 cm) with BCB-9 ranking second (5.50 cm). The earliest fruit initiation was observed in BCB-27 (46.83 DAT), succeeded by BCB-22 (49.33 DAT). **Kumari *et al.* (2023)** evaluated 31 brinjal genotypes collected from eight Indian states for genetic diversity using 19 morphological (10 qualitative and 9 quantitative) and seven biochemical traits. Significant variation was observed for earliness parameters, with days to 50% flowering ranging from 46 to 69 days and days to first harvest ranging from 73 to 94.67 days across the genotypes. The BRBL-1, IC-89888 and IC-89933 were the best performing genotypes of eggplant for the trait yield plant^{-1} (2.58, 2.16 and 1.98 kg, respectively). They also noticed a wide variation in weight of fruit (54.42-169.18 g). While the fruits plant^{-1} observed in the range of 7.96-31.39. However, different biochemical parameters were measured with their different ranges *viz.*, total chlorophyll content (0.15 to 2.35 mg 100 g^{-1}), anthocyanin (0.63-28.86 mg 100 g^{-1}), ascorbic acid (1.04-3.75 mg 100 g^{-1}) and phenols (7.28-12.03 mg 100 g^{-1}) in diverse brinjal genotypes. **Koley *et al.* (2019)** evaluated 26 eggplant genotypes of different colours for total phenolics, total flavonoids, total monomeric anthocyanin and antioxidant activity using two in vitro assays (cupric ion reducing antioxidant capacity and DPPH). Significant differences ($p < 0.05$) were observed for antioxidant composition and activity across genotypes. Total phenolics ranged from 13.00 to 49.29 mg/100 g fresh weight (FW), while flavonoids ranged from 5.30 to 28.70 mg/100 g FW. White-coloured genotypes demonstrated the highest phenolic and flavonoid content with superior antioxidant activity. **Mohamed *et al.* (2019)** analyzed the proximate chemical composition, mineral content, amino acids and bioactive compounds in Black Beauty eggplant flour prepared from pulp, peel and whole fruit. They reported that peel contained significantly higher total dietary fiber (43.31%), insoluble dietary fiber (29.31%), ash (6.20%), minerals (K, Mg, Fe, Zn), phenolics (chlorogenic acid 89.9%), flavonoids, anthocyanins, ascorbic acid (17 mg/100 g) and β-carotene (28 mg/100 g) compared to pulp and whole fruit, establishing its potential as a dietary supplement. **Parida *et al.* (2020)** evaluated 35 brinjal genotypes under Red and Laterite Zone conditions of West Bengal and observed considerable variation for growth, flowering, harvesting and yield attributes. Plant height ranged from 66.7–113 cm, branches per plant 7.3–12.8, days to 50% flowering 37.3–67.7, days to first fruit harvest 57.7–84.7, fruit length 7.8–20.7 cm and average fruit weight 19.9–255.3 g. Utkal Anushree and Teispur Long were identified as high-yielding genotypes, while Pusa Purple Long, Pusa Ankur, Pusa Upkar, Pusa Anupam and Local-2 were classified as early types recommended for breeding programs. **Nandi *et al.* (2021)** evaluated 30 diverse accessions of eggplant with having land races, wild accessions and commercial varieties for 13 parameters related to fruit quality. They observed high magnitude of variability among the eggplant accessions. The recorded range of variation for various traits like total anthocyanin was from 0.00–945.34 mg 100 g^{-1} FW, total phenolics with range of 30.98–313.02 mg GAE 100 g^{-1} FW and ascorbic-acid varied from 1.23–4.27 mg 100 g^{-1} FW in different cultivars of brinjal. **Saikia *et al.* (2021)** evaluated 30 brinjal genotypes during *kharif* 2017-2018 for 15 morphological and 6 biochemical characters. Significant genotypic variation was observed across traits. Eighteen superior genotypes *viz.*, Brinjal-6, Kuchia, Koni Bengena, Brinjal-3, Khoruah-1, Brinjal-4, Brinjal-1, Kajala, Brinjal-7, Brinjal-8, Brinjal-2, Boga Bengena, Brinjal Long, Green Long, Sagolishingia, Long Khoruah, Seujia Bengena and Brinjal-9 demonstrated best performance for days to first flowering, days to 50% flowering, primary branches plant^{-1}, fruits per plant and fruit yield plant^{-1}. **Attia *et al.* (2022)** performed a pot experiment on three weeks-old eggplant seedlings (Balady cultivar) to check the early blight (caused by *Alternaria solani*) infection by using endophytic *Aspergillus terreus*, improving plant immunological, physiological and antifungal activities. *Aspergillus terreus* treated plants showed a significant increase in the content of chlorophyll a and b and carotenoids, the total phenols, free proline, total soluble proteins, peroxidase (POD) and polyphenol oxidase (PPO) compared to the nontreated infected plant. **Harisha *et al.* (2023)** evaluated 17 brinjal lines for peel anthocyanin content at edible maturity. Purple-fruited genotypes exhibited significantly higher anthocyanin levels than green- and white-fruited types. Pusa Shyamla recorded the maximum total anthocyanin content (139.04 mg/100 g), followed by Pusa Purple Round (51.33 mg/100 g). High-performance liquid chromatography identified cyanidin-3-O-glucoside, delphinidin-3-O-glucoside and delphinidin-3-rutinoside as primary anthocyanins. These anthocyanin-rich lines represent valuable genetic resources for breeding nutritionally enhanced brinjal varieties.

Collectively, these comprehensive studies, highlighting the fundamental importance of systematic germplasm evaluation in identifying superior genotypes for region-specific cultivation, nutritional enhancement, and disease tolerance breeding.

2.3 Genetic parameters

Kumar *et al.* (2012) evaluated 40 eggplant hybrids along with their parents to assess the nature and extent of various genetic parameters. They reported high genotypic and phenotypic coefficients of variation for yield per plant, internodal length, number of fruits per plant, number of primary branches plant^{-1}, and fruit weight, indicating substantial inherent variability for these traits. High heritability coupled with high genetic advance as per cent of mean was observed for fruit length, number of fruits plant^{-1}, number of primary branches plant^{-1}, ascorbic acid content, yield plant^{-1}, internodal length and fruit weight, suggesting the predominance of additive gene action and good prospects for improvement of these characters through selection. **Manna and Paul (2012)** evaluated 15 tomato genotypes over two years for fruit quality traits and yield components. They reported high to moderate genotypic and phenotypic coefficients of variation for number of locules per fruit, fruit weight, total acidity, number of fruits per plant, vitamin C content, fruit yield per plant, fruit length and pericarp thickness, indicating substantial variability for these traits. High to moderate heritability coupled with high to moderate genetic gain for number of locules per fruit, fruit weight, fruit length, number of fruits plant^{-1}, pericarp thickness, vitamin C and total acidity suggested predominance of additive gene action and effectiveness of selection for these characters. **Patel *et al.* (2015)** evaluated 35 brinjal genotypes during rabi 2012-13 for 21 characters and observed that phenotypic coefficient of variation (PCV) exceeded genotypic coefficient of variation (GCV) across all traits. The fruit length:diameter ratio exhibited the highest PCV (56.26%) and GCV (55.68%). High heritability coupled with substantial genetic advance was recorded for most yield and yield-contributing traits, indicating the effectiveness of phenotypic selection for genetic improvement. Fruit yield showed highly significant positive genotypic correlations with number of flowers per cluster (0.49), flowers per plant (0.61), fruits per cluster (0.41), fruits per plant (0.72) and branches per plant (0.48). Path coefficient analysis revealed the highest positive direct effects on fruit yield from fruit length:diameter ratio (2.4326), followed by fruits per plant (1.2644), fruit diameter (1.2539), fruit dry matter (0.9633), fruit moisture content (0.9238) and flowers per cluster (0.9098). **Sujin *et al.* (2017)** assessed genetic variability, heritability, correlation and path coefficient analysis in 60 brinjal genotypes. Maximum PCV and GCV were recorded for fruit yield plant^{-1}, followed by fruit weight, fruit girth, number of fruits plant^{-1} and shoot and fruit borer (*Leucinodes orbonalis*) incidence. High heritability coupled with elevated GCV, genetic advance and genetic gain was observed for fruit yield plant^{-1}, fruit weight, number of secondary branches plant^{-1} and shoot and fruit borer incidence, indicating strong potential for genetic improvement through selection. They also noticed that the genotypes had a favourable direct effect on the no. of days until first harvesting, the no. of short-styled flowers, fruits no. plant^{-1}, fruit weight, borer incidence and long-styled flowers plant^{-1}. Additionally, in a variety of brinjal genotypes, a substantial and favourable character connection was noted by fruit circumference, weight of fruit and fruits no. plant^{-1}. **Kasera *et al.* (2018)** evaluated 20 brinjal varieties at Horticulture Experiment Station, Allahabad, recording 13 quantitative and qualitative traits. The highest PCV and GCV were observed for average fruit weight (PCV 35.71%, GCV 34.80%), followed by yield per plant (PCV 28.60%, GCV 27.53%) and fruit circumference (PCV 26.19%, GCV 24.96%), while days to 50% flowering exhibited the lowest values (PCV 11.02%, GCV 7.82%). High heritability coupled with substantial genetic advance as per cent of mean (GAM) was recorded for fruit weight (94.95%, 69.85%), yield plant^{-1} (92.62%, 54.58%), fruit circumference (90.81%, 49.00%), primary branches plant^{-1} (90.08%, 45.77%) and fruits plant^{-1} (89.50%, 45.12%), indicating predominance of additive gene effects and reliable selection potential for these traits in breeding programs. **Anbarasi and Haripriya (2021)** evaluated 112 brinjal genotypes across two consecutive experiments for 10 growth and 9 yield attributes, revealing highly significant genotypic differences for all traits. High PCV and GCV were recorded for pseudo- and true short-styled flowers, fruit set percentage, fruit yield plant^{-1}, seeds per fruit, medium-styled flowers and fruit girth. High heritability coupled with substantial genetic advance was observed for fruit girth, seeds per fruit, fruit length, leaf area index, fruits plant^{-1}, fruit set percentage, average fruit weight, and pseudo- and true short-styled flowers, particularly indicating predominant additive gene action for pseudo- and true short-styled flowers, fruit set percentage and fruit yield plant^{-1}, suggesting excellent potential for parental selection in breeding programs.

Collectively, these comprehensive genetic analyses across diverse brinjal germplasm collections consistently emphasizes the role of genotypic variability for key yield and its contributing traits, to establish collectively the robust potential for effective phenotypic selection and strategic parental selection to achieve substantial genetic improvement in fruit yield, fruit quality, disease tolerance, and reproductive efficiency in brinjal breeding programs.

2.4 Correlation and path

Mangi *et al.* (2017) conducted character association and path analysis in 60 brinjal genotypes for 17 traits. At 90 DAT, total yield plant^{-1} exhibited significant positive genotypic and phenotypic correlations with plant height (0.385), plant spread (0.660), number of primary branches (0.545), stem girth (0.539), early yield plant^{-1} and number of fruits plant^{-1}. Conversely, yield showed significant negative correlations with days to first flowering (-0.302 genotypic, -0.230 phenotypic), days to 50 percent flowering (-0.272 genotypic, -0.229 phenotypic) and days to first fruit maturity (-0.164 genotypic, -0.168 phenotypic). Path analysis confirmed direct positive effects on yield from plant height (0.235), leaf area at 90 DAT (0.228), days to first fruit maturity (0.162), fruits per cluster (0.280) and early yield plant^{-1} (1.903), indicating these traits as reliable selection criteria for yield improvement. **Kumar *et al.* (2024a)** evaluated resistance-inducing chemicals against phomopsis blight in brinjal during the *kharif* season of 2019 at Lovely Professional University, Phagwara, Punjab. Seed treatment and foliar applications of sodium phosphate, sodium chloride, potassium phosphate, silicon dioxide (25 and 50 mM) and ferric chloride (5 and 10 mM) significantly improved growth parameters, elevated total protein and phenol levels, and reduced disease severity. Ferric chloride at 5 mM was most effective, reducing disease severity from 59.20 to 19.09 percent. Negative correlations were observed between disease severity and both total phenol content and soluble protein levels. Path analysis revealed positive direct effects on yield per plant (0.3723), fruits per plant (0.230), fruit weight (0.220) and plant height (0.173). **Kumar *et al.* (2024b)** evaluated 74 brinjal genotypes (14 lines, 4 testers, 56 F_1 hybrids, two checks) over summer seasons of 2022–2023 at Sunrise University, Alwar, Rajasthan. Phenotypic path coefficient analysis revealed highly positive direct effects on total fruit yield per plant from number of fruits plant^{-1} (0.2300), average fruit weight (0.2204), plant height (0.1734) and total fruit yield per plant itself (0.3723). Pooled genotypic path analysis indicated maximum direct effects from total fruit yield per plant (0.7791) and total sugars (0.3543). Significant negative correlations were recorded between total phenols and disease severity, and between total soluble protein and disease severity.

These findings revealed that path coefficient and correlation analyses collectively validate the strong genetic relationships between yield-determining traits and total fruit yield per plant, while confirming the negative impact of delayed flowering and disease severity on productivity.

Study-2: Estimation of heterosis, combining ability for yield and yield attributes in parents, their crosses and comparison with a susceptible check

2.5 Combining ability and heterosis

Shafeeq *et al.* (2013) conducted line × tester analysis using 6 lines and 4 testers to generate 24 brinjal hybrids, along with standard check Kalpataru, during 2004–05 at University of Agricultural Sciences, Dharwad. The results of analysis of variance revealed significant variability among genotypes for 15 of 17 traits studied. Notable standard heterosis for fruit yield was exhibited by six hybrids, with Arka Sheel × Green Round, Arka Sheel × Kudachi Local A, and Budihal Local × Green Round identified as superior cross combinations for yield and component traits. **Ansari and Singh (2014)** assessed general combining ability (GCA) and specific combining ability (SCA) effects in brinjal for Phomopsis blight resistance traits. Pant Rituraj exhibited superior GCA effects for number of infested fruits per plant, average fruit weight and fruit diameter. Pant Samrat demonstrated best GCA performance for yield per plant, number of healthy fruits per plant and total fruits plant^{-1}. BARI excelled as a general combiner for fruit length, average fruit weight, weight of healthy fruits per plant and yield per plant. The crosses BARI × Pant Rituraj, BARI × Pant Samrat and BARI × PB-66 recorded the highest SCA effects across most evaluated traits, indicating their potential as superior hybrid combinations for resistance breeding. **Sharma *et al.* (2016)** evaluated 22 brinjal entries (6 parental lines, 15 F_1 hybrids, and standard check PPL-74) during *kharif* season. Significant heterosis was observed across all quantitative traits studied. The cross Pusa Purple Cluster × Pant Samrat exhibited superior performance, demonstrating pronounced positive heterosis over better parent for fruit yield plant^{-1} (56.16%) and number of fruits plant^{-1} (40.56%), along with significant negative heterosis for earliness traits (days to first flowering, 50 percent flowering, and first harvest), establishing it as the most promising hybrid for commercial exploitation following stability assessment. **Desai *et al.* (2017)** conducted combining ability analysis using 37 brinjal genotypes (8 parents, 28 F_1 hybrids, 1 standard check) during rabi season at Regional Horticultural Research Station, Navsari Agricultural University, Gujarat. Both additive and non-additive gene effects were significant for all traits studied; however, variances due to SCA exceeded those of GCA for most economic traits, indicating predominance of non-additive gene action. Parents JBGR-1, NSR-1 and JBL-08-8 emerged as good general combiners across multiple traits. Hybrids AB-09-1 × AB-12-10, AB-09-1 × AB-08-5, AB-08-5 × JBL-08-8 and GJB-3 × AB-12-10 exhibited significant positive SCA effects coupled with superior per se performance for fruit yield and component traits. **James *et al.* (2017)** conducted a diallel analysis (without reciprocals) using five bacterial wilt-resistant chilli genotypes (Ujwala, Anugraha, VKC 2, VKC 11, VKC 76) to generate 10 F_1 hybrids at Department of Olericulture, College of Horticulture, Vellanikkara, in two seasons. The genotype Anugraha exhibited superior GCA for number of fruits plant^{-1} and yield plant^{-1}, while Ujwala and Anugraha showed high GCA for phosphorus, calcium, magnesium and β-carotene content. VKC 11 demonstrated strong GCA for fruit length, fruit girth, magnesium, iron, vitamin C and β-carotene. Among specific combining ability (SCA) effects, Ujwala × VKC 11 excelled for fruit width, fruit girth, average fruit weight, vitamin C and antioxidant activity, whereas Ujwala × Anugraha was superior for number of fruits per plant and green yield. Non-additive gene action predominated for most traits (plant height, branches, flowering/harvesting periods, fruit dimensions, yield, minerals, antioxidants), while additive gene action governed number of fruits per plant, capsaicin, vitamin C and β-carotene. All hybrids exhibited resistance to bacterial wilt under both field and artificial inoculation conditions. **Saurabh and Sarvanan (2020)** generated 30 F_1 hybrids using a line × tester mating design involving 10 diverse lines (Azad B-4, DBR-31, Green Long, Azad B-2, Punjab Shree, Utkal Anushri, Aruna, J.B. Round, VR-2, Punjab Barsati) and 3 testers (Arka Nidhi, DBR-8, Kashi Prakash) of eggplant during *kharif* season at Naini Agricultural Institute, Prayagraj. Combining ability analysis identified VR-2 × DBR-8 as the superior cross combination for fruit yield per plot based on high SCA effects, heterobeltiosis and standard heterosis, followed by J.B. Round × DBR-8, Utkal Anushri × Kashi Prakash and Punjab Barsati × Arka Nidhi. Non-additive gene action predominated for most yield-contributing traits except primary branches, fruit length, flowers per plant, dry matter and TSS. **Dhillon *et al.* (2021)** utilized diallel mating (including reciprocals) to develop 30 F_1 bell pepper hybrids from genetically diverse bacterial wilt-resistant parents and assessed combining ability effects. Variance analysis revealed significant genetic variability across traits, with GCA effects predominating over SCA effects. Parents DPBWRC-6-1, EC-464107, EC-464115 and DPBWRC-39 exhibited high positive GCA for fruit yield and yield-contributing traits. Non-additive genetic variance predominated for most characters except fruit width and pericarp thickness, while reciprocal effects influenced all parameters except fruit width, total soluble solids and lobes per fruit. Superior SCA combinations included DPBWRC-29 × EC-464107, DPBWRC-39 × DPBWRC-1 and EC-464115 × DPBWRC-29, recommended for hybrid development or superior segregant selection. **Soresa (2022)** conducted a half-diallel mating design using eight tomato varieties to generate 28 F_1 hybrids and evaluated late blight resistance under greenhouse conditions. Highly significant genotypic differences confirmed substantial genetic variability, with GCA and SCA mean squares significant ($P < 0.001$) for all disease parameters. GCA/SCA variance ratios <1 indicated predominance of non-additive gene action. Parental lines ARP tomato d2 and Metadel exhibited stable resistance with positive days to first disease appearance and negative GCA effects for disease severity index and AUDPC, establishing them as superior general combiners. Superior resistant hybrids identified included ARP tomato d2 × Metadel and Bishola × ARP tomato d2. **Mishra *et al.* (2023)** conducted half-diallel analysis of seven diverse brinjal landraces, generating 21 F_1 crosses to assess heterosis magnitude. Crosses BBSR-08-2 × Selection from BBSR-145-1, BBSR-08-2 × BBSR-10-25 and BBSR-08-2 × BBSR-10-26 exhibited significantly positive heterosis for vegetative growth, fruit yield attributes and fruit yield over mid-parent, better-parent and standard check. Combining ability analysis identified BBSR-08-2, BBSR-10-26 and BBSR-195-3 as good general combiners for plant height, primary branches plant^{-1}, fruit length, fruit girth, average fruit weight, fruits plant^{-1}, bacterial wilt incidence at 90 DAT and fruit yield per plant. Specific combining ability effects were highest in BBSR-08-2 × BBSR-10-25, BBSR-08-2 × BBSR-10-26, BBSR-08-2 × Selection from BBSR-145-1 and BBSR-10-26 × BBSR-195-3. Both additive and non-additive gene actions governed yield and component traits. **Rajan *et al.* (2023)** conducted molecular characterization of 14 brinjal genotypes using 20 SSR markers, revealing polymorphisms in eight markers and clustering parents into five groups via UPGMA analysis. Examination of yield and yield-related traits demonstrated significant heterosis over mid, better and standard parents, particularly for fruit yield plant^{-1}. The crosses RKML-26 × PPC and RKML-1 × PPC exhibited substantial heterosis over mid and better parents, respectively. Moderate genetic distance between parents was associated with optimal heterosis levels, beyond which heterotic response diminished. **Rajashree *et al.* (2023)** evaluated 36 F_1 brinjal hybrids generated from 12 lines × 3 testers in a line × tester mating design. The hybrid KRCCH-11 × GL exhibited superior performance, recording the highest yield of 73.34 t ha^{-1} coupled with desirable earliness traits, positioning it as the top-performing combination among all cross combinations for commercial heterosis exploitation. Crosses KRCCH-12 × GL and KRCCH-10 × GL also demonstrated high positive heterosis for yield parameters, while KRCCH-11 × BL and KRCCH-11 × GL excelled in quality attributes.

Collectively, these combining ability and heterosis studies across diverse brinjal germplasm demonstrate the utility of these analysis to understand the genetic variability and gene effects governing yield and disease resistance traits. In addition, these studies also help to identify superior general combiners and promising specific hybrid combinations that exhibit significant heterosis for fruit yield, yield components, and resistance, collectively establishing robust genetic resources and strategic parental combinations for developing high-yielding, commercially viable brinjal hybrids.

The current research titled **"Heterosis and Combining Ability Studies in Phomopsis Blight Resistant Genotypes of Brinjal (*Solanum melongena* L.)"** was carried out at the Vegetable Research Farm, Department of Horticulture, Lovely Professional University Punjab, India. The work that is being presented is separated into two interrelated studies. The study 1 is related to the screening of brinjal genotypes against the phomopsis blight and validation of resistant genotypes. Whereas, the study-2 deals with estimation of combining ability and heterosis for yield and yield attributes in parents, their crosses and comparison with a susceptible check. Each study was sub-divided into two experiments, conducted in two successive cropping seasons *i.e.*, spring-summer and *kharif* of 2022 and 2023, respectively. In this chapter treatment details, adopted methodology, framework of the experiment, criteria for evaluation of treatments and statistical analysis during the research work are described in the subsequent heads and subheads:

3.1 Experimental site

The research experiments were performed at the 'Vegetable Research Farm', located within premises of Lovely Professional University, Phagwara, Punjab, India in two successive cropping seasons (spring-summer and *kharif*) of 2022 to 2023. The research farm is established near the Hardaspur village of the Kapurthala district of Punjab and it has a distance of around 400 kilometres from Delhi. Its geographical coordinates are N 31º15'19.45" latitude and E 75º42'20.73" longitude, with an average elevation of 252 meters above mean sea level (MSL).

3.2 Climate conditions

The experimental site falls within the Doaba region of Punjab that has a sub-tropical climate with scorching summers and hot winds during April to June, trailed by hot and humid rain showers and chilling winters from December to January. In fairly cold winters, the temperature sometimes goes as low as 6°C to 10°C in the month of December to January and up to 38°C to 48°C in the month of May to June. The South-West Monsoon, which typically begins in the second part of July and lasts until the end of September, is recognized to be responsible for around 80 percent of the total rainfall, with sporadic winter showers. The meteorological observatory located at LPU's Research Farm provided regular monthly temperature, rainfall and humidity readings throughout the period of investigation (February to October).

Below Table 3.1 presents the recorded mean temperature (°C), relative humidity (%) and rainfall (mm) for the years 2022 and 2023.

Table 3.1 Monthly meteorological data during the period of investigation in year 2022 and 2023

Factors	**Temperature (°C)**				**Relative humidity (%)**				**Rainfall (mm)**			
Year	**2022**		**2023**		**2022**		**2023**		**2022**		**2023**	
Month	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
February	7	22	5	29.6	48	86	33	96	0	16	0	0.01
March	9	34	11.6	33	38	62	31	94	0	0	0.02	25
April	22	44	11.85	39.51	20	53	21	98	0	0.5	0.02	9.3
May	24	43	19	47	18	44	21	91	0	11.2	0.2	23.3
June	27	48	29	46	34	62	30	69	0	65.4	0.05	5
July	24	45	29	49	55	86	42	86	0	142.6	0.08	20.2
August	24	39	27	42	60	79	62	89	0	8.3	0.09	16
September	20	39	22	40	60	78	58	80	0	2.6	0.04	9
October	18	35	17	34	55	64	58	67	0	0	0	0

3.3 Soil sampling and analysis

Before conducting every research experiment, several randomized soil samples were taken from the experimental site. To ensure an exact illustration, the top layer of the soil was carefully scraped off, and then V-shaped cuts were made down to a depth of 15 cm. From each incision, a piece of soil, about an inch thick, was gently removed on one side. Throughout the experimental plot, the sampling procedure was conducted in a zigzag manner, yielding the collection of eight to ten different samples. By using the quartering procedure, these separate soil samples were properly combined to create a homogenous composite that weighed about 500 g. These prepared and processed composite soil samples were examined at the Soil Testing Laboratory of the

Department of Geology of Punjab Agricultural University (PAU), Ludhiana, Punjab. The detailed description of analyzed soil samples with respect to each experiment are stated in Table 3.2.

Table 3.2 Experiment wise analyzed soil sample reports

Characteristics	Unit	Year and Experiment				Methodology
		2022		2023		
		I	II	I	II	
pH	-	6.7	6.6	6.8	6.7	Backman glass electrode pH meter (Jackson, 1973)
EC	(dsm^{-1})	0.28	0.31	0.26	0.25	Electrical conductivity method
Organic carbon	%	0.58	0.62	0.51	0.59	Rapid titration technique (Walkley and Black, 1934)
Available nitrogen (N)	kg ha^{-1}	142.07	151.38	131.82	148.82	Modified macro Kjeldahl method (Jackson,1967)
Available phosphorus (P)	kg ha^{-1}	37.21	30.42	36.68	34.38	Bray's no.1 method (Jackson,1967)
Available potassium (K)	kg ha^{-1}	192.13	194.74	198.34	196.02	Method of Flame photometer (Jackson,1973)

3.4 Experimental details

3.4.1 Study-1: Screening of brinjal genotypes against phomopsis blight and validation of resistant genotypes (Year 2022)

3.4.1.1 Experiment 1 and 2 of year 2022

In the spring-summer and *kharif* seasons of 2022, two field experiments were carried out. Under both these experiments a total of 33 brinjal genotypes were screened out against phomopsis blight and resistant genotypes were validated. Table 3.3 lists the experimental specifics pertaining to the two experiments. These experiments were conducted in triplicate using a randomized block design.

3.4.1.1.1 Line × tester crossing

During the both cropping seasons (spring-summer and *kharif*) of the year 2022, all possible crosses (between 30 IC and 2-testers, namely-Pusa Bhairav and Pant Samrat) were made following line × tester mating fashion (Kempthorne, 1957 and Arunachalam, 1974). Thus, from the obtained findings of study-1, only five lines (4-moderately resistant on the basis of disease and biochemical parameters and 1-susceptible line which was found good in horticultural traits) were identified among the screened-out genotypes. Hence, only 10-derivate crosses (as stated in Table 3.5), resultant of cross between five selected lines and two testers (Pusa Bhairav and Pant Samrat) from the study-1 were considered for further evaluation.

3.4.1.1.2 Experimental materials

3.4.1.1.2.1. Collection of genotypes

Thirty brinjal lines from the Indigenous Collection (IC) were brought from ‘National Bureau of Plant Genetics Resources (NBPGR)’, located in New Delhi. Three commercial cultivars were utilized as standard checks *viz.*, Pant Samrat and Pant Rituraj from Govind Ballabh Pant University of Agriculture & Technology (GBPUA&T), Uttarakhand and Pusa Bhairav from Indian Agricultural Research Institute (IARI), New Delhi. Table 3.4 displays all of the genotypes that were gathered.

3.4.1.1.2.2 Collection of fungal culture

A mother culture of a virulent isolate of *Phomopsis vexans* (Sacc. and Sydow) Harter (Fungal No., 7222) was collected from the Indian Type Culture Collection, Division of Plant Pathology, IARI, New Delhi for the screening of disease via artificial inoculation among brinjal genotypes.

3.4.1.1.2.3 Artificial inoculation

To prepare a 70-ml spore suspension (5×10^6 spores ml^{-1}), the obtained culture was subsequently sub-cultured/multiplied on potato dextrose agar medium (PDA) and potato dextrose broth (PDB), respectively (Islam *et al.*, 2020). The artificial inoculation was done twice on the 10 selected plants in which 5 were inoculated first at 15-days after transplanting (DAT) and rest five were at the time of fruiting stage with the slow pressure release of spore suspension using a hand sprayer. Thus, these genotypes were screened out against the disease and the validation resistance of different genotypes was done on the basis of disease and biochemical parameters as stated in Table 3.8.

Table 3.3 Experimental details for the experiment number 1 and 2 of year 2022

1.	Crop name	Brinjal (*Solanum melongena* L.)
2.	Experiment year	2022
3.	Sowing of seeds	For spring-summer season on 09th February, 2022 and for *kharif* season 21st June, 2022
4.	Transplanting	12th March, 2022 and 23rd July, 2022 for spring-summer and *kharif* season, respectively
5.	Design of experiment	Randomized Block Design
6.	Total genotypes	33
7.	Total lines	30 IC
8.	Standard checks (SCs)	3 (Pusa Bhairav, Pant Samrat and Pant Rituraj)
9.	Replications	3
10.	Total number of plots	99

11.	Spacing	60 × 45 cm
12.	Number of plants per treatment per replication (plot)	12
13.	Total number of plants	1188
14.	One plot size	3.24 m^2

Table 3.4 Genotype details for the experiment number 1 and 2 of year 2022

Genotypes	Particulars	Source
G_1	IC090121	NBPGR, New Delhi
G_2	IC090132	
G_3	IC090144	
G_4	IC090146	
G_5	IC090781	
G_6	IC090785	
G_7	IC090791	
G_8	IC090806	
G_9	IC090810	
G_{10}	IC090828	
G_{11}	IC090839	
G_{12}	IC090871	
G_{13}	IC090887	
G_{14}	IC090905	
G_{15}	IC090907	
G_{16}	IC090915	
G_{17}	IC090931	
G_{18}	IC090940	
G_{19}	IC090942	
G_{20}	IC090966	
G_{21}	IC099676	
G_{22}	IC099703	
G_{23}	IC099723	
G_{24}	IC099726	
G_{25}	IC099670	
G_{26}	IC099691	

G_{27}	IC099731	
G_{28}	IC104076	
G_{29}	IC104083	
G_{30}	IC104089	
G_{31}	Pusa Bhairav (SC_1)	IARI, New Delhi
G_{32}	Pant Samrat (SC_2)	GBPUA&T, Uttarakhand
G_{33}	Pant Rituraj (SC_3)	

Table 3.5 Identified lines and their derived crosses with testers obtained from the experiment number 1 and 2 of year 2022

Genotype	**Code**	**Specification**
IC090146	L1	**Lines**
IC090781	L2	
IC090810	L3	
IC090828	L4	
IC090887	L5	
Pusa Bhairav	T1	**Testers**
Pant Samrat	T2	
IC090146 × Pusa Bhairav	L1 × T1	**Crosses**
IC090146 × Pant Samrat	L1 × T2	
IC090781 × Pusa Bhairav	L2 × T1	
IC090781 × Pant Samrat	L2 × T2	
IC090810 × Pusa Bhairav	L3 × T1	
IC090810 × Pant Samrat	L3 × T2	
IC090828 × Pusa Bhairav	L4 × T1	
IC090828 × Pant Samrat	L4 × T2	
IC090887 × Pusa Bhairav	L5 × T1	
IC090887 × Pant Samrat	L5 × T2	

3.4.2 Study-2: Estimation of combining ability and heterosis for yield and yield attributes in parents, their crosses and comparison with susceptible check (Year 2023)

3.4.2.1 Experiment 1 and 2 of year 2023

These experiments were performed in spring-summer and *kharif* seasons of 2023.

3.4.2.1.1 Experimental materials

Five selected lines (from the study-1), two testers (Pusa Bhairav and Pant Samrat), their derivative crosses and one susceptible check (Pant Rituraj) were evaluated for their performance in the spring-summer and *kharif* season of 2023, respectively. The complete details related to the experiment number 1 and 2 for the year 2023 are presented in Table 3.6 and Table 3.7. These total of 18 treatments (5-lines, 2-testers, 10-crosses and 1-standard check) were arranged in a RBD in three replications.

Table 3.6 Experimental details for the experiment number 1 and 2 of year 2023

1.	Crop name	Brinjal (*Solanum melongena* L.)
2.	Experiment year	2023
3.	Sowing of seeds	9th February, 2023 (for spring-summer season) and 20th June, 2023 (for *kharif* season)
4.	Transplanting	10th March, 2023 and 18th July, 2023 for spring-summer and *kharif* season, respectively
5.	Design of experiment	Randomized block design
6.	Total treatments	18
7.	Total lines	5 (IC090146, IC090781, IC090810, IC090828, IC090887)
7.	Number of testers (resistant checks)	2 (Pusa Bhairav and Pant Samrat)
8.	Number of obtained crosses	10
9.	Susceptible check	1 (Pant Rituraj)
10.	Replications	3
11.	Total number of plots	54

12.	Spacing	60 × 45 cm
13.	Number of plants per treatment per replication (plot)	12
14.	One plot size	3.24 m^2

Table 3.7 Treatment details for the experiment number 1 and 2 of year 2023

Treatment No.	**Genotype**	**Code**	**Specification**
	Parents		
T_1	IC090146	L1	**Lines**
T_2	IC090781	L2	
T_3	IC090810	L3	
T_4	IC090828	L4	
T_5	IC090887	L5	
T_6	Pusa Bhairav	T1	**Testers (Resistant Checks)**
T_7	Pant Samrat	T2	
	Crosses		
T_8	IC090146 × Pusa Bhairav	L1 × T1	**Crosses**
T_9	IC090146 × Pant Samrat	L1 × T2	
T_{10}	IC090781 × Pusa Bhairav	L2 × T1	
T_{11}	IC090781 × Pant Samrat	L2 × T2	
T_{12}	IC090810 × Pusa Bhairav	L3 × T1	
T_{13}	IC090810 × Pant Samrat	L3 × T2	
T_{14}	IC090828 × Pusa Bhairav	L4 × T1	
T_{15}	IC090828 × Pant Samrat	L4 × T2	
T_{16}	IC090887 × Pusa Bhairav	L5 × T1	
T_{17}	IC090887 × Pant Samrat	L5 × T2	
T_{18}	Pant Rituraj	-	**Susceptible check**

3.4.3 Salient features of standard check varieties

On the basis of their proven disease reaction against phomopsis blight of brinjal in the previously conducted research studies done by the different researchers world-wide, a total of three standard check varieties namely Pusa Bhairav, Pant Samrat (used as resistant checks) and Pant Rituraj (as susceptible check) were considered in the present investigation. The salient features of these selected check varieties are described hereby in the following sub-headings;

3.4.3.1 Pusa Bhairav

This variety was developed at IARI, New Delhi. It is an early, vigorous, profusely branched and high yielding cultivar. This variety exhibits resistance against phomopsis blight of egg-plant. Fruits are ellipsoidal in shape with dark purple peel in colour, smooth and have a glossy appearance. Fruit bearing occurs in cluster, typically 2-3 fruits cluster^{-1}. It is a cross of PPL × 11a-12-2-1. It has average fruit weight of 115-130 g with average yield of 30-50 tons ha^{-1}.

3.4.3.2 Pant Samrat

This variety was developed at GBPUAT, Uttarakhand. It was developed through pure line selection from a local collection *i.e.,* PB129. It is resistant to phomopsis blight and bacterial wilt diseases and less prone to jassids and shoot and fruit borer attack. It has dark purple colour and medium long fruits in clusters. It gives first picking in 70 DAT and its average yield is approximately 40 tons ha^{-1}. It has average fruit weight of 100-110 g. This is popular for cultivation in Himachal Pradesh, Uttarakhand, Punjab, Jammu & Kashmir, etc. (Singh *et al.,* 2007).

3.4.3.3 Pant Rituraj

This variety was also released from GBPUAT, Uttarakhand. It is the resultant of a pedigree selection and hybrid derivative of the cross between Type 3 × Pusa Purple Cluster (pedigree selection). It has globular to round shaped fruits with slight tapering towards the bottom and have a deep purple peel colour. The first picking starts at 60 DAT with an average yield of 30-40 tons/ha. The fruits have an average weight of 85-100 g. It is suitable for planting in summer as well as winter season. It is reported as susceptible against phomopsis blight infection (Karmakar and Singh, 2017). This variety is famous among farmers of Uttar Pradesh, Punjab, Bihar, Jharkhand, Uttarakhand, Himachal Pradesh and Jammu & Kashmir (Singh *et al.,* 2007).

3.5 Nursery raising of brinjal seedings

3.5.1 Preparation of media and fillings of pro-trays

For successful raising of the brinjal seedlings, an artificial rooting medium was prepared by taking the ingredients like cocopeat, perlite and vermiculite and these were mixed in a ratio of 3:1:1 and after that this prepared media was filled into uniformly spaced plastic portrays (9 rows × 11 column grid) of 46 cm length and 38 cm width, having a depth of 5 cm, and 3.5 cm diameter of of each hole.

3.5.2 Seed sowing and aftercare

The seeds of brinjal genotypes were sown in the appropriate timings in the plastic portrays filled with artificial sowing medium kept under hi-tech polyhouse. One seed per hole of the plastic portrays was sown and after sowing a light irrigation was given to enhance proper seed germination. All the necessary practices and precautions were followed for raising healthy seedlings till it attain the age of transplanting.

3.5.3 Field preparation

The field was prepared by cultivating and harrowing three crisscross tractor lines, then planking and levelling 15 days prior to date of transplanting of seedlings. Later, a ridge maker was used to prepare furrows and ridges.

3.5.4 Manure and fertilizer application

During field preparation, well-decomposed farm yard manures (FYM) were incorporated uniformly @ 25 t ha^{-1}. The recommended N: P: K dosages of 124, 62, and 30 kg per ha was fulfilled in the form of urea, phosphatic (SSP) and potassic (MOP) fertilizers considering the analyzed soil sample's report (Thind *et al.*, 2021).

3.5.5 Transplanting

Transplanting of about one month old healthy seedlings was performed carefully in the evening hours over the ridges maintaining a spacing of 60 × 45 cm. A light irrigation was provided after the transplanting for quick establishment of eggplant seedlings.

3.5.5 Gap filling and after care

When the seedlings were dead at initial period after transplanting gap filling was performed for maintaining the minimum plant each plot's population. Every crucial intercultural procedure and plant safety measure suggested by PAU, Ludhiana, Punjab, India for the successful crop growth were adopted for better growth and development of plants (Thind *et al.*, 2021).

3.6 Observations recorded

Various disease, growth, yield, morphological, and biochemical traits as presented in Table 3.8 were recorded throughout the research work.

Table 3.8 Observations recorded throughout the research work

(A) Disease parameters	
I	Percent leaf incidence (PLI) (%)
II	Percent fruit incidence (PFI) (%)
III	Percent leaf area diseased (PLAD)-eye estimation (%)
IV	Percent fruit area diseased (PFAD)-eye estimation (%)
V	Percent disease index (PDI)-for leaf at 7^{th}, 14^{th}, and 21^{st} DAI (%)
VI	Percent disease index (PDI)-for fruit at 7^{th}, 14^{th}, and 21^{st} DAI (%)
VII	Lesion size on fruits (cm^2)
(B) Growth parameters	
I	Days to first seed emergence (DAS)
II	Days taken to 50% seed emergence (DAS)
III	Plant height at 30, 60, 90 DAT and at final harvest (cm)
IV	Number of primary branches $plant^{-1}$ at final harvest
V	Total number of nodes at final harvest
VI	Internodal length of plant at final harvest (cm)
VII	Stem diameter (cm)
VIII	Peduncle length (cm)
IX	Petiole length (cm)
X	Leaf area (cm^2)
(C) Yield parameters	
I	Days to first flowering (DAT)
II	Days to 50% flowering (DAT)

III	Total number of long styled flower
IV	Total number of medium styled flower
V	Number of node to first fruiting
VI	Days to first fruit set (DAT)
VII	Days to first picking of fruits (DAT)
VIII	Total number of fruits plant^{-1}
IX	Average fruit weight (g)
X	Fruit length (cm)
XI	Fruit diameter (cm)
XII	Fruit yield plant^{-1} (kg)
XIII	Fruit yield plot^{-1} (kg)
XIV	Fruit yield hectare^{-1} (q)
(D) Morphological parameters	
I	Fruit shape
II	Fruit colour
III	Calyx spininess
IV	Leaf spininess
(E) Biochemical parameters	
I	Total chlorophyll content (mg g^{-1})
II	Total soluble solids (°Brix)
III	Ascorbic acid (mg 100 g^{-1})
IV	Vitamin A (IU g^{-1})
V	Total anthocyanin (mg 100 g^{-1})
VI	Total protein (%)
VII	Total phenol content (mg GAE g^{-1} DW)
VIII	Proline content (mg g^{-1} DW)
IX	Ash content (%)

3.8.1 Disease parameters

The disease parameters were recorded during 7 to 21 days since the inoculation of pathogen on randomly selected plants.

3.8.1.1 Percentage leaf incidence (PLI) (%)

PLI was determined by counting the number of diseased leaves exhibiting symptoms out of the total number of leaves on each tagged plant per treatment. Its percentage was then calculated using the following formula:

$$\textbf{Percentage leaf incidence}\ (\%) = \frac{\text{Total no. of diseased leaves in a plant}}{\text{Total no. of leaves in a plant}} \times 100$$

3.8.1.2 Percentage fruit incidence (PFI) (%)

PFI was derived by tallying the number of diseased fruits, showcasing symptoms, against the total fruit count per treatment in each tagged plant. Subsequently, its percentage was computed using the following formula:

$$\textbf{Percentage fruit incidence}\ (\%) = \frac{\text{Total no. of diseased fruits in a plant}}{\text{Total no. fruits in a plant}} \times 100$$

The disease incidence outcome for PLI and PFI was further categorised as high (>30%), medium (10-30%) and low (0-10%) based on with minor adjustments, the methods used by Tipu *et al.* (2021).

3.8.1.3 Percent leaf area diseased (PLAD)-eye estimation (%)

PLAD is typically determined by visually inspecting the diseased leaves and estimating the proportion of diseased leaf area to its healthy area. Five representative leaf samples (varying in size) were collected from different heights of each tagged plant. These samples were visually inspected for typical symptoms of *Phomopsis* infection. Thus, PLAD for each leaf was estimated and after the estimation of PLAD in each leaf, average percentage of diseased area for all sampled leaves of each plant per treatment in every replication was calculated using the following formula:

$$\textbf{Percent leaf area diseased}\ (\%) = \frac{\sum(\text{Percentage of diseased area of each leaf})}{\text{Total no. of sampled leaves}}$$

Thus, these obtained PLAD values were compared to the visual disease rating scale (from 0 to 5) suggested by Karmakar and Singh (2017) (as shown in Table 3.9) and accordingly rating was given.

3.8.1.4 Percent fruit area diseased (PFAD)-eye estimation (%)

Similarly, PFAD was analyzed by randomly selecting five fruits having disease symptoms from each selected plant per replication. Firstly, individual infected fruit area of a fruit was visually compared to the total fruit area (assuming it as 100%) and later on average percentage of fruit area diseased for all the selected fruits per plant in every treatment was calculated using the following formula:

$$\textbf{Percent fruit area diseased}\ (\%) = \frac{\sum(\text{Percentage of diseased area of each fruit})}{\text{Total no. of sampled fruits}}$$

Further, these obtained results of PFAD were compared according to Karmakar and Singh (2017) by a visual disease rating scale (starting from zero to five) (Table 3.9) and suitable rating index was given to them.

3.8.1.5 Percent disease index (PDI)-for leaf at 7th, 14th and 21st DAI (%)

For the calculation of PDI for leaf, 5-random diseased leaf samples were taken from the randomly tagged plant in each treatment at 7th, 14th, and 21st days after inoculation (DAI) and computed using the formula that McKinney (1923) and Singh (2002) proposed.

$$\textbf{PDI}\ (\%) = \frac{\text{Sum of total ratings}}{\text{Total no. of observations assessed} \times \text{highest grade in scale}} \times 100$$

The calculated PDI values for leaf were then compared with the visual disease rating scale suggested by Karmakar and Singh (2017) (Table 3.9) and appropriate rating index was assigned to each observation.

3.8.1.6 Percent disease index (PDI)-for fruit at 7th, 14th and 21st DAI (%)

5-Random samples of infected fruit were extracted from each treatment's randomly chosen plant and PDI for fruit at certain times was calculated using the formulas from McKinney (1923) and Singh (2002).

$$\textbf{PDI}\ (\%) = \frac{\text{Sum of total ratings}}{\text{Total no.of observations assessed} \times \text{highest disease grade in scale}} \times 100$$

Thus, obtained PDI values for fruit were compared by the visual disease rating scale as shown in Table 3.9 (Karmakar and Singh, 2017).

3.8.1.7 Lesion size on fruits (cm^2)

5-randomly selected diseased fruits in each tagged plant were examined for the observation and measurement was done with help of a measuring scale and categorization of disease reaction was done on the basis of size as mentioned in Table 3.10 (adopted from Islam *et al.* (2020) after some modifications).

Table 3.9 Assessment of *Phomopsis* infection in brinjal leaves and fruits with visual disease rating scale

Percent infection	Rating scale	Rating index
0	0	HR
1-20	1	R
21-40	2	MR/T
41-60	3	MS
61-80	4	S
81-100	5	HS

Table 3.10 Categorization of disease reaction on the basis of lesion size (cm^2) on infected brinjal fruits

Lesion size (cm^2)	Disease reaction
0	HR
0.01 – 0.50	R
0.51 – 1.0	MR/T
1.01 – 1.5	MT
1.51 – 2.0	MS
2.01 – 2.5	S
>2.5	HS

HR – highly resistant; R – resistant; MR/T – moderately resistant/tolerant; MT – moderately tolerant; MS – moderately susceptible; S – susceptible; HS – highly susceptible

3.8.2 Growth parameters

3.8.2.1 Days to first seed emergence (DAS)

The first green shoot to emerge from each treatment's rooting medium is usually a sign of the initial emergence. Therefore, it was determined how many days passed between the date of sowing (DAS) and the first seedling's emergence.

3.8.2.2 Days to 50% seed emergence (DAS)

This observation was noted by calculating the number of days counting from DAS to the date when the cumulative percentage of seed emergence reaches 50% or above in each treatment.

3.8.2.3 Plant height at 30, 60, 90 DAT and at final harvest (cm)

At 30, 60, 90 DAT and the time of the final harvest of the randomly chosen plants. A measuring scale was used to measure the plant's length from base to tip, and average was analyzed.

3.8.2.4 Number of primary branches plant^{-1} at final harvest

At the time of the most recent harvest, the main branches of 10 randomly selected plants in every treatment were counted for each replication, and the mean was determined.

3.8.2.5 Total number of nodes at final harvest

During the last harvest, the number of nodes was counted in randomly marked plants from cotyledonary node to last node and mean was determined.

3.8.2.6 Internodal length of plant at final harvest (cm)

During the last harvest of the randomly chosen plants, the plant's internodal length was measured using a measuring scale from the lower, middle, and top portion of the main branch, and the average was calculated.

3.8.2.7 Stem diameter (cm)

To provide a consistent measurement across all randomly marked plants in each treatment of each replication, the stem diameter was taken at a height of 5 cm above the soil surface. The diameter was measured using a computerized Vernier calliper. Additionally, the average stem diameter was determined.

3.8.2.8 Peduncle length (cm)

Harvesting the 5-mature brinjal fruits from the randomly chosen plants in each treatment per replication while making sure the peduncle stayed intact was how the peduncle length was determined. Using a digital vernier calliper, the peduncle was straightened and measured from the fruit's base to the calyx, where it was attached. The average was then calculated.

3.8.2.9 Petiole length (cm)

Five representative leaves were used as a sample from the middle section of each randomly tagged plant canopy per replication. Using a digital vernier calliper, the petiole length measured from base of leaf blade to the point of attachment to the main stem. The mean was then computed.

3.8.2.10 Leaf area (cm^2)

For each replication, a sample of five representative leaves was taken from the centre of each randomly tagged plant canopy and leaf area observed with the help of a 'leaf area meter' and mean was calculated.

3.8.3 Yield parameters

3.8.3.1 Days to first flowering (DAT)

The no. of days until the first flowering occurred for each treatment per replication in randomly tagged plants from the date of transplanting were counted and average was analysed.

3.8.3.2 Days to 50% flowering (DAT)

More than half of the plant population in each treatment had their days to 50% blooming measured from the transplanting date and mean was sum up.

3.8.3.3 Total number of long styled flower

Each randomly marked plant in each treatment per replication had its total no. of long-styled blooms tallied, and an average was calculated.

3.8.3.4 Total number of medium styled flower

The counting of total no. of medium styled flowers was done in each randomly tagged plant of each treatment per replication and average was sum up.

3.8.3.5 Number of node to first fruiting

The no. of node bearing the first fruit set was counted from base of the plant in each randomly selected plant of each treatment and mean was calculated.

3.8.3.6 Days to first fruit set (DAT)

The no. of days till the first fruit set was recorded from the date of transplanting in randomly marked plants in each treatment, and average was calculated.

3.8.3.7 Days to first picking of fruits (DAT)

The counting of days until 50% plant population per treatment in each replication reached to its edible maturity and mean was sum up.

3.8.3.8 Total number of fruits plant^{-1}

The no. of fruits counted in each picking of the randomly tagged plants in each replication and average was determined.

3.8.3.9 Average fruit weight (g)

The average weight of randomly chosen five brinjal fruits from each randomly marked plant per treatment was observed using an automated weighing machine.

3.8.3.10 Fruit length (cm)

Using a measuring scale, five randomly chosen fruits were measured for length. The measurement was taken from the fruit's shoulder to its base, and the mean was determined.

3.8.3.11 Fruit diameter (cm)

The selected fruits used for average fruit weight, were measured by Vernier caliper from three different portion (upper, middle and lower) and average was sum up.

3.8.3.12 Fruit yield plant^{-1} (kg)

The fruit yield of 10-randomly marked plants from each treatment in per replication was measured in each picking and mean was determined.

3.8.3.13 Fruit yield plot^{-1} (kg)

The fruits harvested from each plot were weighed at each picking.

3.8.3.14 Fruit yield hectare^{-1} (q)

Based on the production of per plot, fruit yield per hectare was calculated. Each plot yield was multiplied by the 1 ha area, which was divided by the overall plot area.

3.8.4 Morphological traits

3.8.4.1 Fruit shape

Observation of fruit-shape was taken by ‘visual group assessment’ (VG) at the harvest maturity stage (DUS stage code 40) and in contrast to the DUS standards established for the overall form of brinjal fruits in every treatment.

3.8.4.2 Fruit colour

The observation for fruit-colour was justified using visual group assessment (VG) at commercial harvest maturity stage (DUS stage code 40) and compared to DUS guidelines set for colour of skin of brinjal fruits in each treatment.

3.8.4.3 Calyx spininess

Calyx spininess was evaluated visually by ‘measurement/visual assessment’ (MS/VS) at the harvest maturity stage (DUS Stage Code 40) and categorize based on the presence and intensity of spines in each treatment.

3.8.4.4 Leaf spininess

Leaf spininess noted by ‘visual group observation’ (VG) on fully developed leaves (DUS Stage Code 20) in each treatment per replication.

3.8.5 Biochemical parameters

3.8.5.1 Total chlorophyll content (mg g^{-1})

The amount of ‘chlorophyll a, b and total chlorophyll’ was measured spectrophotometrically at 663 nm, 645 nm and 652 nm wavelengths respectively (Vernon and Seely, 2014). Five random fresh leaves from each randomly tagged plant per treatment were taken to the laboratory and cleaned with distilled water. After shade drying of these leaves, a composite sample of 0.5 g was weighed, grinded in a mortar pestle with 80% acetone (10 ml) at room temperature until a homogenous mixture is obtained. To separate the supernatant, this mixture is now moved to a centrifuge tube and centrifugated for 5 minutes at 5000 rpm. This supernatant was filtered through Whatman filter paper into a clean tube to remove leaf debris if present any. Now, the clarified acetone extract transferred to a cuvette and absorbance was measured at respective wavelengths using a spectrophotometer. These wavelengths correspond to the absorbance peaks of chlorophyll a and b. Further by following the derived equations from the work done by Arnon (1949) and Lichtenthaler and Wellburn (1983) 'chlorophyll a, b, and total chlorophyll' were computed:

$$\textbf{Chlorophyll a (mg / g FW)} = \frac{[12.7\ (A663) - 2.69\ (A645)]}{1000 \times W} \times V$$

$$\textbf{Chlorophyll b (mg / g FW)} = \frac{[22.9\ (A645) - 4.68\ (A663)]}{1000 \times W} \times V$$

$$\textbf{Total chlorophyll content (mg / g FW)} = \frac{[20.2\ (A645) + 8.02\ (A663)]}{1000 \times W} \times V$$

A − optical density; V − final vol. of chlorophyll extracted in 80% acetone; W − fresh wt. of tissue

3.8.5.2 Total soluble solids (°Brix)

Using a hand refractometer (0-32 °Brix), the total soluble solids, or TSS, of brinjal fruits were measured. Five chosen fruits from each treatment were combined to create a composite sample (10 ml). The sample was crushed at room temperature using a mortar pestle to extract the fruit juice. After placing a few extract droplets on the refractometer's prism and covering it with a plate, the reading was noted and the mean was computed.

3.8.5.3 Ascorbic acid (mg 100 g^{-1})

Using '2,6-Dichlorophenol indophenol' as a standard dye solution, the visual titration method was used to assess the ascorbic acid level (Ranganna, 2014). Using this procedure, 2,6-Dichlorophenol indophenol that was deep blue in alkaline solution is reduced to a pink end point that only lasts 2-4 seconds when ascorbic acid is present. The following formula was used to determine ascorbic acid:

$$\textbf{Ascorbic acid (mg / 100 g)} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{volume made up}}{\text{Volume of the aliquot taken} \times \text{volume of the sample}} \times 100$$

3.8.5.4 Vitamin A (IU g^{-1})

Vitamin A is quantified by measuring the absorbance of carotenoids extracted from the fruit sample, which are converted into retinol equivalents (IU g^{-1}). The reagents used are Acetone, anhydrous sodium sulphate, and petroleum ether. Using a mortar and pestle, 10–15 ml of acetone was mixed with 5 grams of fresh fruit and then anhydrous sodium sulphate crystals were introduced in small amounts. A beaker was used to decant the supernatant. After two iterations of the procedure, the combined supernatant was moved to a separatory funnel, and 10–15 millilitres of petroleum ether were added. The mixture was then well blended. On standing, two layers separated. Following the collection of the upper layer and disposal of lower layer and measurement at 452 nm with petroleum ether as blank (Ranganna, 2014).

$$\boldsymbol{\beta} - \textbf{carotene} \ (\mu\textbf{g/100 g}) = \frac{\text{O.D.} \times 13.9 \times 10^4 \times 100}{\text{wt. of sample taken} \times 560 \times 100}$$

$$\textbf{Vitamin A (IU/g)} = \frac{\beta - \text{carotene}}{0.6}$$

3.8.5.5 Total anthocyanin (mg 100 g^{-1})

To measure total anthocyanin in brinjal genotypes, the pH differential method was used. Brinjal samples were extracted with acidified methanol (0.1% HCl in methanol) under cold, dark conditions. Potassium chloride and sodium acetate buffers were used to dilute the extract, absorbance was recorded with a spectrophotometer at 520 and 700 nm. As recommended by Giusti and Wrolstad (2001), the anthocyanin content was determined as ‘cyanidin-3-glucoside’ equivalents using the formula as mentioned below;

$$\textbf{Total anthocyanin (mg/100}\boldsymbol{g}\textbf{)} = \frac{(\text{A} \times \text{mwt.} \times \text{DF} \times 1000)}{\varepsilon \times \text{l}}$$

$$\text{A} = (\text{A520} - \text{A700})\text{pH at 1.0} - (\text{A520} - \text{A700})\text{pH at 4.5}$$

mwt. −molecular wt. of 'cyanidin − 3 − glucoside' (449.2 g/mol); DF − dilution factor; ε − molar extinction coefficient (26,900 l /mol)/cm) and l − path length (1 cm)

3.8.5.6 Total protein (%)

Total protein in brinjal fruits were analyzed by Kjeldahl method. Approximately 2 g of dried and powdered brinjal fruit sample is weighed and digested with concentrated sulfuric acid (H_2SO_4) in the presence of a catalyst mixture on the digestion of Kel plus-kes-12. The Kel-plus automatic nitrogen analyzer was used to distill the digested material. The sample was then distilled by adding concentrated NaOH and steam for three minutes. Drops of methyl red indicator were then used to absorb the ammonia gas in 0.5 N standard H_2SO_4. Following distillation, titration was performed to the same end point as the sample using sulfuric acid solutions titrated against 0.5 N NaOH and a blank. Thus, the sample's nitrogen content (%) was determined. In order to determine the protein content of the brinjal fruits, the Micro-Kjeldahl method was used to estimate the fruit's nitrogen content, and the formulae proposed by Sadasivam and Manickam (1992) were used to compute the protein content (%).

$$\textbf{Nitrogen}\ (\%) = \frac{(\text{Titre value of sample} - \text{Titre value of blank}) \times \text{normality of HCl} \times 14 \times \text{vol.} \times 100}{\text{aliquot of digest} \times \text{wt.of sample} \times 1000}$$

$$\textbf{Protein}\ (\%) = \text{Nitrogen}\ (\%) \times 6.25$$

3.8.5.7 Total phenol content (mg GAE g^{-1} DW)

To measure the phenols in brinjal genotypes, the method outlined by Stratil *et al.* (2006) was followed with few modifications. 80% methanol was used to extract one gram of dry powdered material, which was then sonicated for half an hour at room temperature. The extract was filtered through Whatman No. 1 paper. For estimate, 400 µl Na_2CO_3 (7.5%) and 500 µl, 10-fold diluted Folin-Ciocalteu Reagent (FCR) were combined with 100 µl of extract. A spectrophotometer was used to detect absorbance at 765 nm after the incubation for 30 minutes at 37°C in dark. To adjust for background absorbance, a blank solution comprising 400 µl sodium carbonate, 500 µl diluted FCR, and 100 µl methanol was utilized. To verify the process, a gallic acid standard (100 µg ml^{-1}) was used as a control.

3.8.5.8 Proline content (mg g^{-1} DW)

The amount of proline in the leaf was analyzed by the methodology suggested by Bates *et al.* (1973). The leaf samples grown on full sunlight were taken after the 3rd week since inoculation for the analysis. Firstly, homogenization of 0.5 gm of leaf tissue was carried out with 10 ml of 3 percent aqueous 5-Sulfosalicylic acid. After filtration through Whatman Filter Paper No. 2, for one hour at 100°C, 2-millilitres of filtrate combined with 2-millilitres 'acid-ninhydrin' and 2-millilitres of 'glacial acetic acid'. The reaction further terminated by using ice cold water bath. The chromophore containing toluene was aspirated from the aqueous phase following extraction with 4 ml of toluene, and proline measurement was carried out at 520 nm. In this L-proline was used as the standard and a standard curve was prepared. The test sample's proline analyzed using 'standard curve' using the following formula:

$$\textbf{Proline content}\ (\textbf{mg per g DW}) = \frac{(\text{mg proline per ml} \times \text{ml toluene}) \times 5}{115.5 \times \text{g sample}}$$

3.8.5.9 Ash content (%)

The ash content of whole plant analyzed adhering to AOAC standards (1977) which involves careful sample preparation, starting with the washing and oven-drying of the plant material to achieve consistent moisture content. The dried samples are finely ground, sieved through a 40-mesh sieve, and a 1 g test portion is weighed with precision. The test portion is placed in a pre-weighed porcelain crucible and ashed in a muffle furnace preheated to 600°C, with gradual heating to prevent splattering. After 4–5 hours of ashing, the crucible is cooled in a desiccator to avoid moisture absorption and weighed immediately.

The ash content was calculated by the formula:

$$\textbf{Ash content}\ (\%) = \frac{\text{Wt. of ash (g)}}{\text{Initial wt of test portion (g)}} \times 100$$

$$\textbf{Wt. of ash}\ (\textbf{g}) = \text{Final wt. of crucible} - \text{Initial wt. of crucible}$$

3.9 Statistical analysis

The mean of each entry per replication for various characters under the investigation employed to statistical analysis. All of the characters' statistical analyses were conducted using the RBD approach suggested by Panse and Sukhatme (1984). ANOVA and CD tests were used to examined the significance of genotype variation at the 5% and 1% probability levels. "F" test was employed to see significance differences.

3.9.1 Analysis of variance (ANOVA)

Source of variation	$d.f.$	$S.S.$	$M.S.S.$	$F\ cal.value$	$F\ cal.value$ at	
					5%	**1%**
$Replications$	$(r-1)$	(SSR)	(MSR)			
$Genotypes$	$(g-1)$	(SSG)	(MSG)			
$Error$	$(r-1)\times(g-1)$	(SSE)	(MSE)			
$Total$	$(rg-1)$					

$$\text{Here } r = \text{no. of replications; } g = \text{no. of genotypes}$$

At the significance level of 5%, the obtained and tabulated "F" values were compared. When the computed "F" value exceeds the table value, it is deemed significant, meaning that one of the pairs differed significantly and a CD was calculated.

3.9.2 Standard error of mean (SEm)

It is the measure of controlled variation in a sample and is represented by SEm (±). It is the mean difference between the population parameter (μ) and the sample estimate of mean (x).

$$\textbf{SEm}\ (\pm) = \frac{\sqrt{2MSE}}{r}$$

3.9.3 Critical difference (CD)

It is employed to contrast the noted variations between treatments. A difference is deemed substantial if it exceeds the crucial difference, and vice versa. When the "F" test was significant, the crucial difference between treatment means was calculated at the 5% and 1% levels of probability. This formula was used to calculate it:

$$\textbf{CD} = \frac{\sqrt{2MSE}}{r} \times' \text{t value at 5 percent and 1 percent of error d.f.}'$$

3.9.4 Estimates of parameters of variability

According to Burton and DeVane's (1953) following formulas were used to calculate various coefficient of variation:

$$\text{PCV (\%)} = \frac{\sigma p}{\bar{X}} \times 100$$

$$\text{GCV (\%)} = \frac{\sigma g}{\bar{X}} \times 100$$

$$\text{ECV (\%)} = \frac{\sigma e}{\bar{X}} \times 100$$

σp = 'Phenotypic standard deviation'; σg = 'Genotypic standard deviation' σe = 'Environmental standard deviation'; $\bar{X} =' \mathit{Grand\ mean}$

3.9.5 Heritability (h^2)

The formula provided by Burton and DeVane (1953) and Johnson *et al*. (1955) was used to compute heritability in the broad sense (h^2bs):

$$\text{Heritability (\%)} = \frac{\sigma^2 v}{\sigma^2 v + \sigma^2 e} x100$$

$\sigma^2 v$ = 'Genotypic variance'; $\sigma^2 e$ = 'Environmental variance'

3.9.6 Genetic advance (GA)

According to Burton and DeVane (1953) and Johnson *et al.* (1955), the following analysis was done on the estimated genetic advance (GA) that would result from choosing 5% better individuals:

$$\text{Genetic advance (GA)} = K.\sigma\text{p}.\text{h}^2$$

$K = 2.06$ ("Selection differential at 5%"); σp = "Phenotypic standard deviation"; h^2 = "Heritability in broad sense"

$$\text{Genetic advance as percentage of mean (\%)} = \frac{\text{Expected GA}}{\bar{\text{X}}} x100$$

The following limits were applied in order to classify the magnitude of certain parameters:

$$\boldsymbol{PCV\ and\ GCV} = (High > 20\%;\ Moderate = 10 - 20\%;\ Low < 10\%)$$

$$\boldsymbol{Heritability}\ (\mathbf{h^2bs}) = (\text{H}igh > 60\%;\ Moderate = 30 - 60\%;\ Low < 30\%)$$

$$\boldsymbol{Genetic\ advance\ (GA)} = (\text{H}igh > 30\%;\ Moderate = 10 - 30\%;\ Low < 10\%)$$

3.9.7 Estimation of correlation at phenotypic, genotypic and environmental levels

Covariance analysis was performed on each character to calculate 'phenotypic' (PCV), 'genotypic' (GCV), and 'environment coefficients of correlation' (ECV).

Analysis of covariance

Source of variation	***d.f.***	***Mean sum of product***	***Expected Mean Sum of Product***
Replications	$(r-1)$	Mr_{xy}	$\sigma e_{xy} + \text{g}.\sigma r_{xy}$
Genotypes	$(g-1)$	Mg_{xy}	$\sigma e_{xy} + \text{r}.\sigma g_{xy}$
Error	$(r-1) \times (g-1)$	Me_{xy}	σe_{xy}

$$\text{Error covariance } (\sigma e_{xy}) = Me_{xy}$$

$$\text{Genotypic covariance } (\sigma g_{xy}) = Mg_{xy} - Me_{xy}/r$$

$$\text{Phenotypic covariance } (\sigma p_{xy}) = \sigma g_{xy} + \sigma e_{xy}$$

‘Phenotypic’ (rp_{xy}), ‘genotypic’ (rg_{xy}) and ‘environment coefficients of correlation’ (re_{xy}) were calculated by following method given by Al-Jibouri *et al.* (1958):

$$\text{Phenotypic coefficient of correlation } (rp_{xy}) = \frac{\sigma p_{xy}}{(\sigma^2 px.\sigma^2 py)^{1/2}}$$

$$\text{Genotypic coefficient of correlation } (rg_{xy}) = \frac{\sigma g_{xy}}{(\sigma^2 gx.\sigma^2 gy)^{1/2}}$$

$$\text{Environmental coefficient of correlation } (re_{xy}) = \frac{\sigma e_{xy}}{(\sigma^2 ex.\sigma^2 ey)^{1/2}}$$

σp_{xy} = ‘Phenotypic covariance’ between two traits, x and y

σg_{xy} = ‘Genotypic covariance’ between two traits, x and y

σe_{xy} = ‘Environmental covariance’ between two traits, x and y

$\sigma^2 p_x$ and $\sigma^2 p_y$ = ‘Phenotypic variance’ of traits, x and y, respectively

$\sigma^2 g_x$ and $\sigma^2 g_y$ = ‘Genotypic variance’ of traits, x and y, respectively

$\sigma^2 e_x$ and $\sigma^2 e_y$ = ‘Environmental variance’ of traits, x and y, respectively

The phenotypic coefficient of correlation's significance was evaluated using Fisher and Yates' (1963) "r" values at n-2 degrees of freedom, where "n" stands for the no. of genotypes.

3.9.8 Estimates of direct and indirect effects

The ‘path-coefficient’ is a standardized partial ‘regression coefficient’. It makes it possible to separate correlation coefficients into effects that are direct and indirect. The route coefficient analysis of 37 component qualities with marketable fruit yield plot-1 was finished as follows, in compliance with Dewey and Lu (1959):

$$Py_1 + Py_2.r_{12} + Py_3.r_{13} + \ldots\ldots + Py_n.r_{1n} = ry_1$$

$$Py_1.r_{12} + Py_2 + Py_3.r_{23} + \ldots\ldots + Py_n.r_{2n} = ry_2$$

$$\vdots$$

$$Py_1.r_{n1} + Py_2.r_{n2} + Py_3.r_{n3} + \ldots\ldots + Py_n = ry_n$$

Where,

P_{y1}, P_{y2}, P_{yn} *are the direct path effects of* $1, 2, 3, \ldots . n$ *variables on the dependent variable 'y'*

$r_{12}, r_{13,} \ldots . r_{(n-1)n}$ *are the possible coefficients of correlation between various independent variables*

$r_{y1}, r_{y2,} r_{y3,} \ldots . r_{yn}$ *are correlation coeffcients of independent variables with dependent variable 'y'*

It was considered that the variable or factors not included in the current analysis were responsible for variation in dependent variable which was not determined by including the 37 variables. The following formula was used to determine how much of an impact the variable or variables had on the dependent variable:

$$\text{Residual effect } (P \times R) = (1 - R^2)^{1/2}$$

$$R^2 = P_{y1ry1} + P_{y2ry2} + \ldots\ldots\ldots . . + P_{ynryn}$$

Total of yield variance that could be explained by the yield component features is known as R^2, or the square multiple correlation coefficient. Windostat version 9.3 from IndoStat services, Hyderabad, was used to do the statistical analysis for each observed character under investigation.

3.9.9 Line × tester analysis

The modified line × tester analysis performed using the techniques provided by Arunachalam (1974) and Kempthorne (1957). Following the mating pattern, five selected lines (4-moderately resistant on the basis of disease and biochemical parameters and 1-susceptible line which was found good in horticultural traits) were crossed with two testers (Pusa Bhairav and Pant Samrat), yielding ten F_1 crosses in total (Table 3.5).

3.9.9.1 Analysis of variance

The analysis of variance was employed following 'Panse and Sukhatme (1984) model':

$$Yij = gi + rj + eij$$

Where,

$(i = 1 \dots \dots, g); (j = 1 \dots \dots, r)$

$Yij =$ ' Phenotypic observation of i^{th} genotype in j^{th} replication';

$\mu =$ ' General mean'; $gi =$ ' Effect of i^{th} genotype'; $rj =$ ' Effect of j^{th} replication';

$eij =$ 'Error component'

ANOVA

Source of variation	**d.f.**	**S.S.**	**Expected mean square (EMS)**
Replication	(r-1)	$1/g \sum_{j=1}^{r} y_1^2 - (\sum_{j=1}^{r} y_1)^2 / gr$	-
Genotype (excluding check)	(g-1)	$1/r \sum_{j=1}^{g} y_1^2 - (\sum_{j=1}^{g} y_1)^2 / gr$	$M_g=\sigma_e^2+rr_g^2$
Parent	(p-1)	$1/r \sum_{j=1}^{p} y_1^2 - (\sum_{j=1}^{p} y_1)^2 / pr$	$M_p=\sigma_e^2+rr_p^2$
Line/Female	(f-1)	$1/r \sum_{j=1}^{t} y_1^2 - (\sum_{j=1}^{t} y_1)^2 / mr$	$M_f=\sigma_e^2+rr_f^2$
Tester/Male	(m-1)	$1/r \sum_{j=1}^{m} y_1^2 - (\sum_{j=1}^{m} y_1)^2 / \mathrm{fr}$	$M_m=\sigma_e^2+rr_m^2$
Line vs Testers	1	Parents SS-Lines SS-Testers SS	
Crosses	(h-1)	$1/g \sum_{j=1}^{h} y_1^2 - (\sum_{j=1}^{h} y_1)^2 / hr$	$M_h=\sigma_e^2+rr_h^2$
Parent vs Crosses	1	Progenies SS-Parents SS-Cross SS	

Error	(g-1) (r-1)	Total SS-Progenies SS-Replication SS	$Me=\sigma_e^2$

where,

g = fm + f + m; p = f + m; h = fm

m = no. of testers; f = no. of lines; p = no. of parents; h = no. of crosses; r = no. of replications; g = no. of genotypes

The mean squares, which were calculated by dividing the various sums of squares by their corresponding degrees of freedom, were compared to the error mean squares using the F-test at the 5% level of significance.

3.9.9.2 Combining ability analysis

3.9.9.2.1 Analysis of variance

The combining ability analysis was conducted using Arunachalam (1974) methodology.

ANOVA for combining ability

Source of variation	d. f.	SS	MS	EMS
Replication	r–1	SS_R	-	-
Cross	h–1	SS_H	-	-
Tester/Male	m–1	SS_M	M_1	$\sigma_e^2 + \frac{fr}{m-1}\sum_i^f g_i^2$
Line/Female	f–1	SS_F	M_2	$\sigma_e^2 + \frac{mr}{f-1}\sum_i^m g_i^2$
Female × Male	(f-1) (m-1)	SS_{MP}	M_3	$\sigma_e^2 + \frac{fr}{m-1}\sum_i^f\sum_i^m s_{ij}^2$
Error	(mf-1) (r-1)		M_5	σ_e^2

where,

r, m and f are no. of replications, testers (males) and lines (females), respectively.

$$SS_R = \sum_{k=1}^{r} Y..k/fm - (Y...)2/mfr$$

$$SS_H = \sum_{k=1}^{m} \sum_{j=1}^{f} Yij./r - ((Y...)2/mfr$$

$$SS_M = \sum_{i=1}^{m} Yi../fr - (...)2/mfr$$

$$SS_F = \sum_{j=1}^{f} Y.j./mr - (Y...)2/mfr$$

$$SS_{MF} = \sum_{i}^{m} \sum_{j}^{f} (Yij.)2/r - \sum_{1}^{m} Yi../fr - \sum_{j}^{f} Y.j./mr + (Y...)2/mfr$$

Various 'sums of squares' divided with its corresponding d.f. to determine the final 'mean squares'. The mean squares were then compared to the associated error mean squares at the '5% level of significance' using the 'F-test'.

3.9.9.2.2 Estimation of general and specific combining ability effects

The GCA and SCA effects were estimated by following the Arunachalam (1976) model:

$$Y_{ijk} = \mu + gi + gj + Sij + eijk$$

where,

μ = general mean

Y_{ijk} = mean value of a character measured on i^{th} line × j^{th} tester in k^{th} replication/value of the ijk^{th} observation of the cross involving i^{th} line and j^{th} tester in k^{th} replication

g_i = 'GCA effect of i^{th} line (female)'

g_j = 'GCA effect of j^{th} tester (male)'

S_{ij} = 'SCA of the cross involving ith line and jth tester'

e_{ijk} = 'Error associated with ijkth observation'

i = 'ith line (1 to 8)'

j = 'jth tester (1 and 2)'

k = 'kth replication (1, 2 and 3)'

3.9.9.2.2.1 Individual effects were estimated as follows

(i) "Estimation of general mean" (μ) $= \frac{Y...}{mfr}$

where,

Y... = 'Total of all the cross-combinations'

m = 'No. of testers (male)'

f = 'No. of lines (female)'

r = 'No. of replications'

(ii) "GCA effect of ith line (female)"

$$g_i = \frac{Yi..}{mr} - \frac{Y...}{mfr}$$

where,

Y_i = 'Total of ith female (line) parent over all males and replications'

(iii) "GCA effect of jth tester (male)"

$$g_j = \frac{Y.j.}{fr} - \frac{Y...}{mfr}$$

where,

Y_j = total of jth male (tester) parent over all females and replications

(iv) "SCA effect of ijth cross"

$$S_{ij} = \frac{Yij.}{r} - \frac{Yi..}{mr} - \frac{Y.j.}{fr} + \frac{Y...}{mfr}$$

where,

$Y_{ij..}$ = 'ijth combination total over all replications'

(v) "Standard error for combining ability effects"

(a) SE ± (g_i) lines = $\pm\sqrt{Me/mr}$

(b) SE ± (g_j) testers = $\pm\sqrt{Me/fr}$

(c) SE ± (S_{ij}) crosses = $\pm\sqrt{Me/r}$

(d) SE ± (g_i-g_j) lines = $\pm\sqrt{2Me/mr}$

(e) SE ± (g_i-g_j) testers = $\pm\sqrt{2Me/fr}$

(f) SE ± (S_{ij}-S_{kj}) crosses = $\pm\sqrt{2Me/r}$

where,

Me = 'Mean squares due to error'

r = 'No. of replications'

(vi) "Test of significance for GCA and SCA":

There are two methods;

Method 1:

GCA and SCA effects ≥ ($SE_{gi}/SE_{gj}/SE_{sij}$) × 't' tabulated at error degree of freedom and P=0.05 were marked significant (*).

Method II:

(a) t_i (cal) for GCA of lines (females) = (g_i-0)/SE(g_i)

(b) t_j (cal) for GCA of testers (males) = $(g_j-0)/SE(g_j)$

(c) t_{ij} (cal) for SCA of crosses = $(s_{ij}-0)/SE(s_{ij})$

where,

t_i (cal), t_j (cal) and t_{ij} (cal) are the calculated 't' values,

g_i = GCA effect of i^{th} line

g_j = GCA effect of j^{th} tester and

s_{ij} = SCA effect of ij^{th} cross

The 'GCA effects' of 'line and testers' and 'SCA effects' of 'crosses' were identified significant when the values 't_i (cal)', 't_j (cal)' and 't_{ij} (cal)' ≥'t' tabulated value at 'error d.f.' and 'P=0.05' (*) and 'P=0.01' (**).

3.9.9.3 Estimation of heterosis

Data on a number of quantitative characteristics were used to examine the extent of heterosis. The method proposed by Turner (1953) and Hayes *et al.* (1955) was used to compute the percentage enhancement or decrement in the mean values of F_1 over 'mid parent (relative heterosis)', 'better-parent (heterobeltiosis)', and 'heterosis over susceptible check'.

The following formulas are used to estimate heterosis:

1. Heterosis over mid parent (MPH) % (Relative heterosis) = $\frac{\overline{F_1} - \overline{MP}}{\overline{MP}} \times 100$

2. Heterosis over better parent (BPH) % (Heterobeltiosis) = $\frac{\overline{F_1} - \overline{BP}}{\overline{BP}} \times 100$

3. Heterosis over susceptible check (HSC) % (Pant Rituraj) = $\frac{\overline{F_1} - \overline{HSC}}{\overline{HSC}} \times 100$

3.9.9.3.1 Calculation of standard error

SE for testing heterosis over MP *i.e.*, SE (H_1) = $\pm\sqrt{2Me/r}$

SE for testing heterosis over BP *i.e.*, SE (H_2) = $\pm\sqrt{2Me/r}$

SE for testing heterosis over SC *i.e.*, SE (H_3) = $\pm\sqrt{2Me/r}$

3.9.9.3.2 Test of significance for heterosis

1. Heterosis over MP = $\overline{F_1} - \overline{MP}$/SE ($H_1$) = '$t_1$' calculated
2. Heterosis over BP = $\overline{F_1} - \overline{BP}$/SE ($H_2$) = '$t_2$' calculated
3. Heterosis over SC = $\overline{F_1} - \overline{SC}$/SE ($H_3$) = '$t_3$' calculated

The "t" tab. values at 'error d.f.' and 'P=0.05' were compared with "t-cal. values (t_1, t_2, and t_3)" for heterosis over 'mid parent (MPH)', 'better parent (BPH)' and 'susceptible check (HSC)'. An asterisk (*) was placed on "t" computed values compared to "t" tab. values and designated as significant/non-significant (Dabholkar, 1992).

Study-1: Screening of brinjal genotypes against phomopsis blight and validation of resistant genotypes (Year 2022)

Plate 1: A view of seed sowing of brinjal genotypes

Plate 2: A view of ready to transplant seedlings of brinjal genotypes

Plate 3: A view of well-established brinjal crop in the experimental field

Plate 4: A view of tagging in brinjal plant

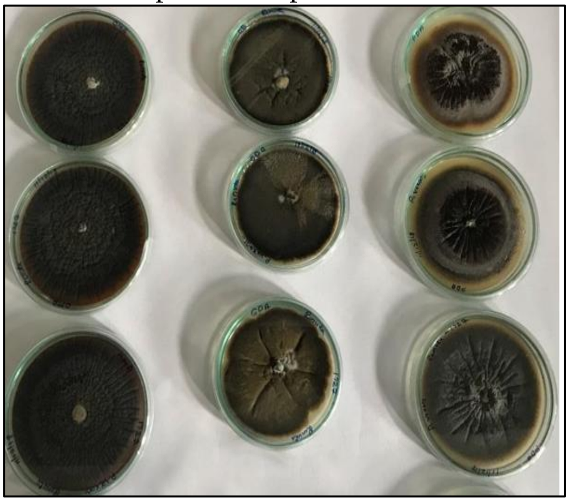

Plate 5: A view of prepared subcultures of *Phomopsis vexans*

Plate 6: A view of artificial inoculation of fungal spore suspension in brinjal plant

Plate 7: A view of medium and long styled flowers of brinjal

Plate 8: A view of brinjal genotypes at the fruiting stage

Plate 9: A view of *Phomopsis* infected brinjal fruits and leaf in brinjal genotypes

Plate 10: A view of estimation of ascorbic acid through titration method

Plate 11: A view during TSS measurement

Plate 12: A view of unopened brinjal flower bud

Plate 13: A view of emasculation in the brinjal plant

Plate 14: A view of emasculated flower bud and bagging in the brinjal genotypes

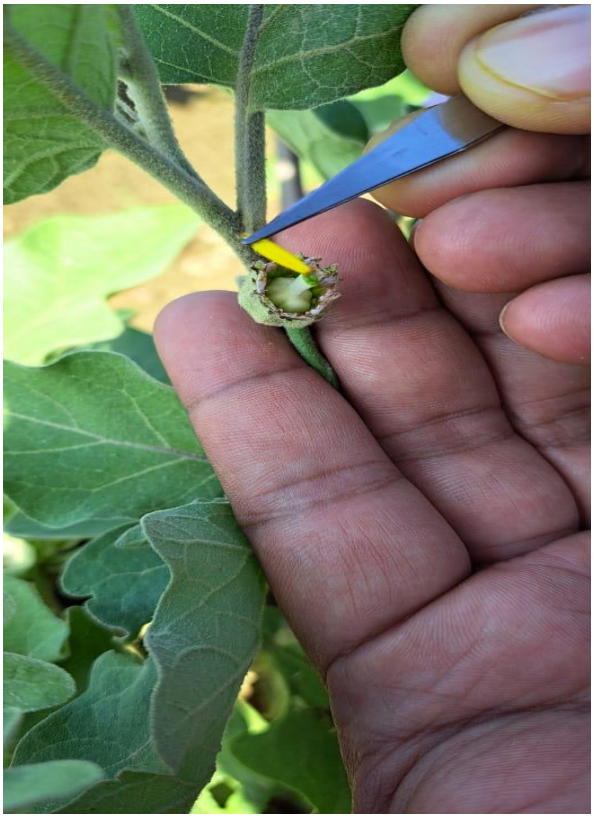

Plate 15: A view of pollination in brinjal genotypes

Plate 16: A view of mentioning details of crosses and date on the tags

Plate 17: A view of tagged brinjal plant after bagging

Plate 18: A view of brinjal fruit set after pollination

Study-2: Estimation of heterosis, combining ability for yield and yield attributes in parents, their crosses and comparison with a susceptible check (Year 2023)

Plate 19: A view of germinated seedlings of brinjal genotypes

Plate 20: A view during the transplanting of brinjal genotypes

Plate 21: A view of irrigation in the established brinjal crop

Plate 22: A view of brinjal plant at fruiting stage

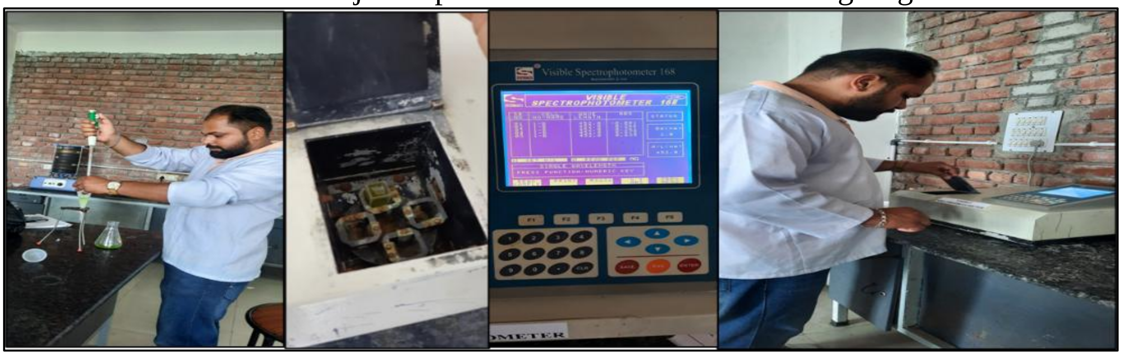

Plate 23: A view during the estimation of various biochemical parameters (vitamin A, total phenol, proline, etc.) with spectrophotometer

This chapter represents findings of current work **"Heterosis and Combining Ability Studies in Phomopsis Blight-Resistant Genotypes of Brinjal (*Solanum melongena* L.)"**, conducted at the Vegetable Research Farm of Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India. In this chapter importance of each observation, along with detailed responses across different genotypes, is discussed. Relevant references are cited to support the findings, ensuring a robust connection between the results obtained and the existing literature. The results and discussion under following subheadings ensure a systematic presentation of results, facilitating a clear understanding of the study's findings and their implications.

Study-1: Screening of brinjal genotypes against phomopsis blight and validation of resistant genotypes (Year 2022)

The screening of thirty three brinjal genotypes against phomopsis blight was carried out for two consecutive seasons, spring-summer and *kharif* in the year 2022. The Bartlett's Chi-square test for testing of homogeniety of variances was applied. This test revealed that the error variances were homogeneous for all traits except percent disease index (PDI)-for leaf at 7th days after inoculation (DAI) (%) and ash content (%), therefore pooled analysis over both seasons was carried out. The results, pooled over seasons, are systematically presented in the following sections:

4.1 Analysis of variance of brinjal genotypes in the year 2022

The results of 'analysis of variance' (ANOVA) for various studied parameters in the presented investigation are summarized and presented in Appendices I. The mean sum of square of genotypes revealed that there was a significant difference at 1 percent level for all the studied parameters.

4.2 Mean performance studies of brinjal genotypes in the year 2022

The data for 47 parameters were analyzed statistically and the results thus obtained has been shown in Tables 4.2.1 to 4.2.16. The pooled results regarding mean performance of 'brinjal genotypes' for the year 2022 are summarized below in the following headings:

4.2.1 Disease parameters

4.2.1.1 Percentage leaf incidence (PLI) (%)

Different genotypes denoted significant difference in respect of PLI and as presented in Table 4.2.1. The minimum (8.85%) PLI was observed in G_{32}, whereas, the maximum (37.50%) in G_{33}. The obtained findings revealed significant differences among genotypes, emphasizing the existing genetic variability. This variation is critical for identifying genotypes with enhanced resistance to leaf-related diseases, which is a key factor in sustainable brinjal production. These findings suggest that G_{32} could be prioritized in breeding programs to develop resistant cultivars, while G_{33} might require improvement through hybridization or other genetic interventions. Moreover, the resistance observed in G_{32} could have practical implications for reducing dependency on chemical pesticides, thereby contributing to eco-friendly farming practices and cost efficiency. The notable differences in PLI among genotypes correspond to existing studies of Mahadevakumar *et al.* (2017); Kumar *et al.* (2020) and Bhanushree *et al.* (2022) emphasizing the importance of choosing disease-resistant varieties to minimize yield losses.

4.2.1.2 Percentage fruit incidence (PFI) (%)

As shown in Table 4.2.1 a substantial variability was noticed for PFI. The minimum (5.80%) PFI was recorded in G_{32}, while the maximum (32.93%) in G_{33}. This trait is crucial for ensuring fruit quality and minimizing post-harvest losses. The lowest PFI was observed in G_{32}, indicating strong resistance to fruit diseases. This genotype (G_{32}) demonstrates promising potential meant for breeding experiments to enhance yield stability & fruit quality. On other hand, G_{33} exhibited the highest PFI suggesting susceptibility to fruit infections. Similar results were presented by Pande and Singh (2015); Jakatimath *et al.* (2017); Karmakar and Singh (2017); Mahadevakumar *et al.* (2017) and Kumar *et al.* (2020) in brinjal genotypes.

Table 4.2.1 Mean performance of brinjal genotypes for percent leaf incidence (%) and percent fruit incidence (%) in the year 2022

Genotypes	Percent leaf incidence (%)			Percent fruit incidence (%)		
	Spring-Summer season	***Kharif* season**	**Pooled**	**Spring-Summer season**	***Kharif* season**	**Pooled**
G_1	23.15	26.58	24.87	20.54	23.48	22.01
G_2	26.89	29.15	28.02	23.12	25.28	24.20
G_3	23.47	25.17	24.32	24.36	26.89	25.63
G_4	12.57	14.85	13.71	12.45	15.78	14.12
G_5	17.38	20.58	18.98	16.45	19.75	18.10
G_6	22.58	25.68	24.13	24.36	27.18	25.77
G_7	25.38	28.47	26.93	19.56	22.78	21.17
G_8	26.87	27.14	27.01	25.45	28.78	27.12
G_9	15.17	18.58	16.88	12.45	16.78	14.62
G_{10}	18.15	22.87	20.51	14.8	16.85	15.83
G_{11}	26.32	29.63	27.98	21.85	24.1	22.98
G_{12}	23.58	28.85	26.22	27.48	29.58	28.53
G_{13}	35.78	38.48	37.13	30.18	32.45	31.32
G_{14}	26.47	29.15	27.81	21.14	23.78	22.46
G_{15}	30.15	33.78	31.97	22.47	24.58	23.53
G_{16}	26.32	29.15	27.74	25.68	27.36	26.52
G_{17}	27.44	29.15	28.30	26.54	28.45	27.50
G_{18}	21.85	23.76	22.81	17.85	19.88	18.87
G_{19}	23.77	28.78	26.28	21.56	23.78	22.67
G_{20}	22.74	21.68	22.21	19.54	21.79	20.67
G_{21}	20.47	23.87	22.17	19.41	22.11	20.76
G_{22}	23.78	23.96	23.87	20.45	22.05	21.25
G_{23}	26.37	28.52	27.45	25.87	27.14	26.51
G_{24}	26.78	28.34	27.56	24.18	26.78	25.48
G_{25}	25.78	27.59	26.69	23.48	25.69	24.59
G_{26}	30.69	33.18	31.94	27.74	29.45	28.60
G_{27}	31.89	35.29	33.59	25.32	28.15	26.74
G_{28}	20.78	21.69	21.24	26.32	27.14	26.73
G_{29}	30.41	33.45	31.93	20.78	22.58	21.68
G_{30}	21.78	24.56	23.17	21.28	23.85	22.57
G_{31}	10.56	11.12	10.84	8.51	8.69	8.60
G_{32}	8.58	9.12	8.85	5.42	6.17	5.80
G_{33}	36.48	38.52	37.50	31.28	34.58	32.93
SEm (±)	0.39	0.44	0.42	0.35	0.37	0.36
CD (P=0.05)	1.12	1.23	0.89	0.98	1.04	0.68
CV (%)	2.82	2.88	2.85	2.83	2.72	2.76

4.2.1.3 Percent leaf area diseased (PLAD)-eye estimation (%)

Results presented in Table 4.2.2 exhibited substantial variation in PLAD. The minimum (13.52%) PLAD was observed in G_{32}, whereas, the maximum (65.30%) in G_{33}. The obtained results revealed significant genotypic variation, emphasizing the importance of genetic diversity in determining resistance to foliar diseases. PLAD is a critical trait that directly affects photosynthetic efficiency, plant vigor, and overall yield. The minimum PLAD recorded in G_{32} highlights its strong resistance to foliar diseases, likely due to inherent genetic factors or robust plant defense mechanisms (Karmakar and Singh, 2017). In contrast, G_{33} exhibited the maximum PLAD, indicating significant susceptibility to foliar diseases. The high PLAD in G_{33} could be due to weak cuticular defenses, poor structural integrity of leaf tissues, or greater susceptibility to pathogen colonization. Identifying genotypes like G_{32} with low PLAD is instrumental in breeding programs aimed at enhancing resistance to foliar diseases. The wide range of PLAD observed among the genotypes corroborates findings from earlier studies such as Kumar *et al.* (2020) and Bhanushree *et al.* (2022) that underscore the critical role of genotype in determining disease susceptibility.

4.2.1.4 Percent fruit area diseased (PFAD)-eye estimation (%)

As per the results stated in Table 4.2.2 exhibited a substantial variation for PFAD among brinjal genotypes. The minimum (12.62%) PFAD was observed in G_{32}, while the maximum (62.84%) in G_{33}. The results obtained hereby indicating significant differences, highlighting the genotypic variability in resistance to fruit diseases. PFAD is a critical parameter influencing fruit quality, marketability, and overall economic returns for growers. The minimum PFAD recorded in G_{32} demonstrates its potential as a resistant genotype. Low PFAD in G_{32} could be attributed to strong genetic defenses, such as the production of biochemical compounds or structural barriers that inhibit pathogen establishment and spread (Karmakar and Singh, 2017). In contrast, G_{33} exhibited the highest PFAD, indicating considerable susceptibility to fruit diseases. The identification of resistant genotypes such as G_{32} provides a foundation for breeding programs aimed at improving fruit quality and reducing disease-induced yield losses.

Such wide variation in PFAD aligns with of Kumar *et al.* (2020) and Bhanushree *et al.* (2022).

4.2.1.5 Percent disease index (PDI)-for leaf at 7th, 14th, and 21st DAI (%)

As shown in Table 4.2.2 and 4.2.3, there was a significant difference noticed for the character PDI-for leaf at 7th, 14th, and 21st DAI. The minimum (3.14%, 7.18% and 13.05%) PDI-for leaf was recorded in G_{32}, whereas the maximum (14.37%, 36.09%, and 65.61%) in G_{33} at 7th, 14th, and 21st DAI, respectively. Substantial variation was observed among the genotypes considered in the present study. These further highlights existing variations in genotypes at their genetic level in responses to foliar disease progression. Temporal analysis regarding PDI underscores the importance of monitoring disease dynamics for informed genotype selection and disease management practices, contributing to sustainable and profitable brinjal production. The lowest PDI values were consistently recorded in G_{32} indicating robust resistance to foliar diseases at all stages of disease progression. This finding underscores G_{32}'s capability to suppress pathogen establishment and proliferation, potentially due to a combination of physical barriers, biochemical defenses, or slower disease progression rates. Conversely, G_{33} exhibited the highest PDI values, signifying high susceptibility to foliar diseases. The rapid escalation of PDI in G_{33} indicates a lack of effective disease management mechanisms, making it unsuitable for disease-prone environments without intensive chemical interventions. These results emphasizing the importance of genotypic differences in determining the resistance dynamics of brinjal genotypes. Similar findings observed by Karmakar and Singh (2017); Mahadevakumar *et al.* (2017) and Bhanushree *et al.* (2022b) in brinjal.

4.2.1.6 Percent disease index (PDI)-for fruit at 7th, 14th, and 21st DAI (%)

The results presented in Table 4.2.3 and 4.2.4 revealed a significant difference for this trait. The minimum (1.97%, 4.23% and 11.27%) PDI-for fruit was recorded in G_{32}, while the maximum (10.95%, 23.45%, and 62.52%) in G_{33} at 7th, 14th, and 21st DAI, respectively. The results related to PDI-for fruits at different days interval after inoculation showed significant genotypic differences, emphasizing the critical role of genetic factors in fruit disease resistance. Such analysis of PDI is instrumental in understanding disease progression and its impact on fruit quality and yield. The minimum PDI values at 7^{th}, 14^{th}, and 21^{st} DAI were consistently recorded in G_{32}, highlighting its strong resistance to fruit diseases. It highlights its vulnerability and the need for targeted genetic improvement or intensive management. Similar findings observed by Pande and Singh (2015); Jakatimath *et al.* (2017); Karmakar and Singh (2017); Kumar *et al.* (2020) and Bhanushree *et al.* (2022) highlighting the significance of genetic variability in determining fruit disease resistance.

Table 4.2.2 Mean performance of brinjal genotypes for percent leaf area diseased-eye estimation (%), percent fruit area diseased-eye estimation (%) and percent disease index-for leaf at 7th DAI (%) in the year 2022

Genotypes	Percent leaf area diseased-eye estimation (%)			Percent fruit area diseased-eye estimation (%)			Percent disease index-for leaf at 7th DAI (%)		
	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled
G_1	52.21	54.86	53.54	31.15	33.15	32.15	8.12	10.45	9.29
G_2	51.35	53.11	52.23	32.85	35.48	34.17	8.23	11.12	9.68
G_3	40.25	42.85	41.55	41.85	44.25	43.05	10.25	12.48	11.37
G_4	21.35	23.74	22.55	22.15	22.78	22.47	4.85	7.15	6.00
G_5	26.35	28.85	27.60	25.69	27.12	26.41	6.25	7.48	6.87
G_6	34.25	36.37	35.31	41.96	42.48	42.22	9.15	11.25	10.20
G_7	36.12	38.58	37.35	33.78	34.48	34.13	8.47	10.48	9.48
G_8	35.47	37.86	36.67	38.52	39.48	39.00	10.18	13.18	11.68
G_9	25.85	26.15	26.00	24.52	25.44	24.98	5.12	7.25	6.19
G_{10}	28.52	29.45	28.99	26.86	28.35	27.61	6.00	8.15	7.08
G_{11}	50.25	53.47	51.86	48.15	49.45	48.80	11.12	13.45	12.29
G_{12}	35.40	37.45	36.43	40.12	42.87	41.50	10.05	12.18	11.12
G_{13}	60.47	64.25	62.36	58.39	61.45	59.92	12.44	15.56	14.00
G_{14}	40.58	41.25	40.92	42.85	44.58	43.72	9.74	12.45	11.10
G_{15}	50.17	53.45	51.81	35.58	36.12	35.85	10.00	13.02	11.51
G_{16}	37.85	39.75	38.80	44.85	46.35	45.60	9.10	11.48	10.29
G_{17}	41.25	41.78	41.52	41.15	43.78	42.47	10.14	13.48	11.81
G_{18}	50.21	53.65	51.93	44.38	47.58	45.98	9.12	11.38	10.25
G_{19}	41.78	43.58	42.68	41.78	44.78	43.28	9.05	11.48	10.27
G_{20}	40.28	42.78	41.53	39.78	41.45	40.62	8.18	10.43	9.31
G_{21}	36.18	38.15	37.17	36.48	39.12	37.80	9.35	12.18	10.77
G_{22}	44.17	45.12	44.65	37.45	39.42	38.44	8.05	10.25	9.15
G_{23}	44.10	46.25	45.18	37.12	37.89	37.51	8.26	11.00	9.63
G_{24}	49.78	51.48	50.63	39.17	39.88	39.53	8.00	10.00	9.00
G_{25}	51.28	54.22	52.75	40.12	44.89	42.51	7.00	11.00	9.00
G_{26}	37.15	39.48	38.32	36.18	39.45	37.82	8.12	11.45	9.79
G_{27}	45.78	48.25	47.02	30.48	34.89	32.69	8.00	10.00	9.00
G_{28}	34.78	36.41	35.60	32.45	35.48	33.97	8.10	10.45	9.28
G_{29}	33.14	36.15	34.65	38.78	42.45	40.62	11.25	14.45	12.85
G_{30}	44.74	47.89	46.32	34.36	38.78	36.57	10.00	12.45	11.23
G_{31}	16.85	19.12	17.99	11.28	14.78	13.03	4.02	5.38	4.70
G_{32}	12.47	14.57	13.52	11.78	13.45	12.62	3.02	3.25	3.14
G_{33}	64.25	66.35	65.30	60.78	64.89	62.84	12.85	15.89	14.37
SEm (±)	0.69	0.72	0.71	0.68	0.56	0.62	0.14	0.16	0.15
CD (P=0.05)	1.96	2.08	1.50	1.90	1.57	1.23	0.40	0.46	0.30
CV (%)	2.99	2.98	3.02	3.24	2.52	2.86	2.82	2.57	2.70

Table 4.2.3 Mean performance of brinjal genotypes for percent disease index-for leaf at 14th, 21st DAI (%) and percent disease index-for fruit at 7th DAI (%) in the year 2022

Genotypes	Percent disease index-for leaf at 14th DAI (%)			Percent disease index-for leaf at 21st DAI (%)			Percent disease index-for fruit at 7th DAI (%)		
	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled
G_1	18.26	26.41	22.34	40.58	40.63	40.61	5.86	7.83	6.85
G_2	19.24	27.83	23.54	42.76	42.82	42.79	6.04	8.07	7.06
G_3	21.68	31.36	26.52	48.17	48.24	48.21	6.97	9.3	8.14
G_4	11.91	17.24	14.58	26.47	26.53	26.50	3.51	4.69	4.10
G_5	13.36	19.33	16.35	29.68	29.74	29.71	3.97	5.31	4.64
G_6	19.46	28.16	23.81	43.24	43.32	43.28	6.24	8.33	7.29
G_7	17.72	25.64	21.68	39.37	39.45	39.41	5.79	7.73	6.76
G_8	23.49	33.98	28.74	52.21	52.28	52.25	7.05	9.42	8.24
G_9	12.21	17.69	14.95	27.14	27.22	27.18	3.72	4.98	4.35
G_{10}	13.74	19.88	16.81	30.53	30.59	30.56	4.44	5.94	5.19
G_{11}	24	34.7	29.35	53.33	53.38	53.36	6.49	8.66	7.58
G_{12}	21.53	31.14	26.34	47.84	47.91	47.88	6.86	9.17	8.02
G_{13}	27.99	40.45	34.22	62.19	62.23	62.21	9.21	12.29	10.75
G_{14}	21.9	31.68	26.79	48.66	48.74	48.70	6.33	8.45	7.39
G_{15}	22.67	32.77	27.72	50.37	50.42	50.40	7.39	9.86	8.63
G_{16}	20.16	29.15	24.66	44.81	44.85	44.83	6.91	9.23	8.07
G_{17}	22.19	32.09	27.14	49.30	49.38	49.34	7.08	9.46	8.27
G_{18}	19.67	28.47	24.07	43.72	43.80	43.76	6.43	8.59	7.51
G_{19}	20.35	29.43	24.89	45.22	45.27	45.25	5.67	7.56	6.62
G_{20}	18.46	26.7	22.58	41.02	41.08	41.05	6.11	8.16	7.14
G_{21}	20.74	30	25.37	46.09	46.16	46.13	6.59	8.8	7.70
G_{22}	18.12	26.2	22.16	40.26	40.31	40.29	5.88	7.85	6.87
G_{23}	18.96	27.42	23.19	42.14	42.18	42.16	6.26	8.36	7.31
G_{24}	17.93	25.92	21.93	39.84	39.88	39.86	5.42	7.24	6.33
G_{25}	19.53	28.26	23.90	43.40	43.48	43.44	5.76	7.69	6.73
G_{26}	18.54	26.82	22.68	41.20	41.26	41.23	5.58	7.45	6.52
G_{27}	18.22	26.38	22.30	40.49	40.58	40.54	5.74	7.66	6.70
G_{28}	17.12	24.75	20.94	38.04	38.07	38.06	5.18	6.92	6.05
G_{29}	25.28	36.54	30.91	56.18	56.23	56.21	7.28	9.72	8.50
G_{30}	21.29	30.78	26.04	47.32	47.36	47.34	7.03	9.39	8.21
G_{31}	8.21	11.83	10.02	18.24	18.20	18.22	2.52	3.35	2.94
G_{32}	5.89	8.46	7.18	13.08	13.02	13.05	1.69	2.25	1.97
G_{33}	29.51	42.67	36.09	65.57	65.64	65.61	9.38	12.51	10.95
SEm (±)	0.32	0.41	0.37	0.57	0.67	0.62	0.10	0.13	0.11
CD (P=0.05)	0.90	1.18	0.72	1.60	1.89	1.32	0.27	0.36	0.22
CV (%)	2.93	2.57	2.73	2.31	2.73	2.54	2.79	2.83	2.83

Table 4.2.4 Mean performance of brinjal genotypes for percent disease index-for fruit at 14th DAI, 21st DAI (%) and lesion size on fruits (cm^2) in the year 2022

Genotypes	Percent disease index-for fruit at 14th DAI (%)			Percent disease index-for fruit at 21st DAI (%)			Lesion size on fruits (cm^2)		
	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled
G_1	11.72	17.61	14.67	39.05	39.14	39.10	1.018	1.024	1.021
G_2	12.08	18.17	15.13	40.28	40.37	40.33	0.740	0.744	0.742
G_3	13.93	20.93	17.43	46.44	46.51	46.48	1.429	1.434	1.432
G_4	7.01	10.55	8.78	23.37	23.44	23.41	0.543	0.548	0.546
G_5	7.95	11.94	9.95	26.49	26.53	26.51	0.636	0.643	0.640
G_6	12.48	18.74	15.61	41.61	41.64	41.63	1.422	1.426	1.424
G_7	11.59	17.40	14.50	38.63	38.66	38.65	0.768	0.772	0.770
G_8	14.11	21.19	17.65	47.03	47.09	47.06	0.839	0.842	0.841
G_9	7.45	11.21	9.33	24.82	24.90	24.86	0.581	0.577	0.579
G_{10}	8.88	13.36	11.12	29.61	29.68	29.65	0.679	0.674	0.677
G_{11}	12.97	19.49	16.23	43.24	43.30	43.27	0.736	0.742	0.739
G_{12}	13.73	20.62	17.18	45.75	45.83	45.79	1.547	1.550	1.549
G_{13}	18.43	27.66	23.05	61.42	61.47	61.45	2.021	2.024	2.023
G_{14}	12.65	19.00	15.83	42.17	42.24	42.21	0.914	0.910	0.912
G_{15}	14.77	22.19	18.48	49.24	49.30	49.27	0.812	0.817	0.815
G_{16}	13.82	20.76	17.29	46.08	46.14	46.11	1.451	1.446	1.449
G_{17}	14.17	21.28	17.73	47.22	47.28	47.25	0.826	0.820	0.823
G_{18}	12.86	19.32	16.09	42.88	42.93	42.91	1.401	1.406	1.404
G_{19}	11.34	17.02	14.18	37.80	37.82	37.81	1.312	1.319	1.316
G_{20}	12.21	18.35	15.28	40.71	40.78	40.75	1.306	1.310	1.308
G_{21}	13.19	19.81	16.50	43.96	44.02	43.99	0.887	0.891	0.889
G_{22}	11.75	17.66	14.71	39.18	39.24	39.21	0.732	0.738	0.735
G_{23}	12.53	18.81	15.67	41.76	41.79	41.78	1.218	1.225	1.222
G_{24}	10.84	16.29	13.57	36.14	36.20	36.17	0.943	0.950	0.947
G_{25}	11.51	17.30	14.41	38.37	38.45	38.41	0.891	0.898	0.895
G_{26}	11.16	16.76	13.96	37.19	37.24	37.22	0.850	0.852	0.851
G_{27}	11.47	17.24	14.36	38.24	38.31	38.28	0.753	0.757	0.755
G_{28}	10.36	15.57	12.97	34.52	34.59	34.56	0.782	0.784	0.783
G_{29}	14.57	21.87	18.22	48.56	48.60	48.58	0.979	0.984	0.982
G_{30}	14.07	21.12	17.60	46.89	46.94	46.92	0.874	0.878	0.876
G_{31}	5.03	7.53	6.28	16.77	16.73	16.75	0.290	0.284	0.287
G_{32}	3.39	5.06	4.23	11.29	11.25	11.27	0.236	0.231	0.234
G_{33}	18.75	28.14	23.45	62.50	62.54	62.52	2.080	2.087	2.084
SEm (±)	0.19	0.25	0.23	0.64	0.61	0.63	0.01	0.01	0.01
CD (P=0.05)	0.54	0.74	0.46	1.85	1.72	0.99	0.04	0.04	0.03
CV (%)	2.76	2.43	2.61	2.78	2.67	2.76	2.60	2.54	2.56

4.2.1.7 Lesion size on fruits (cm^2)

Results presented in Table 4.2.4 revealed substantial differences for lesion size on fruits among the 33 genotypes evaluated. The minimum lesion size (0.234 cm^2) was recorded in G_{32}, establishing it as the most resistant genotype. Several genotypes exhibited lesion sizes in proximity to G_{32}, including G_{31} (0.287 cm^2), G_2 (0.742 cm^2), G_{22} (0.735 cm^2), G_{10} (0.579 cm^2), G_5 (0.640 cm^2), G_9 (0.677 cm^2) and G_{27} (0.755 cm^2), indicating a group of genotypes with relatively superior resistance to fruit lesion development. In contrast, G_{33} recorded the maximum lesion size (2.084 cm^2), followed by G_{13} (2.023 cm^2) and G_{12} (1.549 cm^2), representing highly susceptible genotypes. Lesion size serves as a critical indicator of a genotype's ability to resist pathogen spread and disease severity on fruit tissues (Karmakar and Singh, 2017). The minimal lesion expansion in G_{32} and related resistant genotypes suggests effective genetic and physiological mechanisms, including strong cell wall integrity, production of antifungal compounds, and reduced pathogen colonization rates. Conversely, genotypes with large lesions (G_{33}, G_{13}, G_{12}) exhibit weak resistance mechanisms, permitting rapid pathogen colonization and extensive fruit tissue damage. The considerable variation in lesion sizes across genotypes aligns with documented findings by Karmakar and Singh, 2017; Kumar *et al.* (2020) and Bhanushree *et al.* (2022b) regarding differential disease resistance among brinjal germplasm.

4.2.2 Growth parameters

4.2.2.1 Days to first seed emergence (DAS)

The results shown in Table 4.2.5 for this characteristic denoted substantial variability among genotypes. The minimum (6.14) days count to first seed emergence since the days after sowing was observed in G_{13}, while the maximum (9.26) was in G_{27}. From a breeding perspective, days to first seed emergence is a critical trait that can be targeted for the development of early-maturing genotypes, particularly for regions with shorter growing seasons or where early market availability is desired. This variation is indicative of genetic diversity within the genotype itself concerning seed germination behavior under the same environmental and cultural conditions or may be due to environmental factors (soil moisture, temperature) and quality of seed. The genotype G_{13} exhibited the earliest emergence, demonstrating its potential for rapid establishment in the field. In contrast, genotype G_{27} showed the longest duration to emergence.

4.2.2.2 Days to 50% seed emergence (DAS)

Results depicted in Table 4.2.5 stated sufficient variations across the genotypes for the character. The minimum (7.53) days to 50% seed emergence since the days after sowing was observed in G_{13}, whereas the maximum (11.23) was in G_{17}. These existing variability for the character highlighting the existing genetic variation among genotypes. Early emergence, as seen in G_{13}, is crucial for synchronized growth, efficient resource use, and adaptation to short growing seasons, making it advantageous for growers seeking uniform and timely crop establishment. Conversely, delayed emergence in G_{17} may reflect slower metabolic activity, reduced enzyme activity during seed imbibition, or inherent physiological constraints in radicle elongation and emergence processes, collectively resulting in prolonged time to achieve 50% seedling emergence.

4.2.2.3 Plant height at 30 DAT, 60 DAT, 90 DAT and final harvest (cm)

Different genotypes exhibited significant variation in respect of plant height measured since the days after transplanting (DAT) and has shown in Table 4.2.5 and 4.2.6. The highest (43.57 cm, 65.72 cm, 72.45 cm, and 81.63 cm) plant height was notices in G_{32}, while the lowest (30.37 cm, 35.80 cm, 43.22 cm, and 52.69 cm) in G_7 at 30 DAT, 60 DAT, 90 DAT and final harvest, respectively. Plant height is a critical indicator of vegetative vigor and overall growth dynamics. Such, significant variations probably due to inherent genotypic differences between the genotypes. Genotypes with greater plant height, like G_{32}, are likely to have better resource acquisition efficiency, including light interception, which can contribute positively to biomass accumulation and yield potential. The results of present findings were in agreement with Kumar and Arumugam (2013) and Das *et al.* (2017) in brinjal genotypes.

4.2.2.4 Number of primary branches plant^{-1} at final harvest

The data shown in Table 4.2.7 regarding this character revealed significant difference among brinjal genotypes. The maximum (8.11) count of primary branches per plant was in G_{32}, whereas minimum observed (3.33) in G_7. The variations in the no. of primary branches per plant among the genotypes reflect an interplay of genetic makeup, hormonal regulation, resource availability, and environmental conditions. The genotype G_{32}, with the highest no. of branches, likely possesses superior genetic potential for lateral growth and optimal hormonal balance, particularly auxin-to-cytokinin ratios, which play a crucial role in shoot branching. These results were in close conformity with Kumar and Arumugam (2013) and Saikia *et al.* (2021) in brinjal genotypes.

Table 4.2.5 Mean performance of brinjal genotypes for days to first seed emergence (DAS), days to 50% seed emergence (DAS) and plant height at 30 DAT (cm) in the year 2022

Genotypes	Days to first seed emergence (DAS)			Days to 50% seed emergence (DAS)			Plant height at 30 DAT (cm)		
	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled
G_1	8.50	8.15	8.33	9.48	9.39	9.44	30.15	33.56	31.86
G_2	8.36	8.04	8.20	10.05	9.78	9.92	29.44	34.13	31.79
G_3	8.81	8.25	8.53	10.69	9.66	10.18	30.60	32.85	31.73
G_4	6.00	7.23	6.62	7.41	9.08	8.25	37.19	40.32	38.76
G_5	6.58	7.46	7.02	7.86	9.18	8.52	36.39	39.48	37.94
G_6	8.44	8.11	8.28	10.28	10.28	10.28	29.67	35.16	32.42
G_7	9.05	8.86	8.96	10.74	10.56	10.65	28.78	31.96	30.37
G_8	8.28	7.86	8.07	9.65	9.69	9.67	35.40	38.20	36.80
G_9	6.89	7.48	7.19	8.89	9.48	9.19	36.23	39.12	37.68
G_{10}	6.43	6.38	6.40	7.55	7.89	7.72	36.05	38.92	37.49
G_{11}	9.12	9.00	9.06	11.00	10.89	10.95	32.10	34.58	33.34
G_{12}	8.61	8.84	8.73	10.09	10.99	10.54	33.27	36.14	34.71
G_{13}	5.89	6.38	6.14	7.18	7.88	7.53	35.42	38.10	36.76
G_{14}	8.04	7.63	7.84	9.55	9.28	9.42	30.50	32.89	31.70
G_{15}	8.69	9.05	8.87	10.28	10.63	10.46	32.55	34.96	33.76
G_{16}	8.47	8.13	8.30	9.64	9.75	9.70	29.14	33.21	31.18
G_{17}	9.08	9.36	9.22	11.21	11.25	11.23	33.21	36.25	34.73
G_{18}	8.95	8.66	8.81	11.09	10.78	10.94	32.77	36.12	34.45
G_{19}	8.33	8.15	8.24	9.93	9.85	9.89	29.87	34.05	31.96
G_{20}	8.76	8.53	8.65	10.85	10.28	10.57	31.10	33.89	32.50
G_{21}	8.18	8.01	8.10	9.63	9.33	9.48	32.59	36.18	34.39
G_{22}	8.88	8.59	8.74	11.47	10.25	10.86	31.30	34.85	33.08
G_{23}	8.72	8.96	8.84	11.36	10.78	11.07	35.30	39.08	37.19
G_{24}	8.42	8.24	8.33	10.87	10.15	10.51	30.45	33.69	32.07
G_{25}	9.21	9.10	9.16	11.39	10.69	11.04	33.26	35.88	34.57
G_{26}	8.22	8.09	8.16	10.44	10.18	10.31	32.88	36.17	34.53
G_{27}	9.40	9.11	9.26	10.98	10.88	10.93	33.18	35.87	34.53
G_{28}	8.26	8.19	8.23	9.69	9.88	9.79	30.00	32.74	31.37
G_{29}	8.54	8.25	8.40	10.58	10.45	10.52	34.47	36.89	35.68
G_{30}	8.74	8.96	8.85	11.88	9.89	10.89	33.03	35.48	34.26
G_{31}	6.59	7.39	6.99	7.88	9.14	8.51	40.33	44.25	42.29
G_{32}	6.88	7.32	7.10	8.39	8.58	8.49	42.25	44.89	43.57
G_{33}	7.66	7.88	7.77	9.08	10.25	9.67	37.75	39.85	38.80
SEm (±)	0.14	0.11	0.13	0.14	0.15	0.14	0.50	0.52	0.51
CD (P=0.05)	0.40	0.31	0.26	0.40	0.41	0.31	1.40	1.45	1.10
CV (%)	2.96	2.31	2.68	2.49	2.58	2.53	2.60	2.47	2.52

Table 4.2.6 Mean performance of brinjal genotypes for plant height at 60 (DAT), 90 (DAT) and final harvest (cm) in the year 2022

Genotypes	Plant height at 60 DAT (cm)			Plant height at 90 DAT (cm)			Plant height at final harvest (cm)		
	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled
G_1	42.05	47.32	44.69	52.19	60.12	56.16	61.23	72.45	66.84
G_2	38.23	44.15	41.19	50.00	56.25	53.13	60.02	65.25	62.64
G_3	40.17	46.25	43.21	48.05	54.85	51.45	57.22	63.14	60.18
G_4	49.30	58.21	53.76	60.01	69.14	64.58	70.03	77.89	73.96
G_5	49.05	56.1	52.58	59.26	66.00	62.63	69.28	76.25	72.77
G_6	39.30	45.39	42.35	51.15	56.28	53.72	62.24	68.36	65.30
G_7	32.18	39.42	35.80	38.07	48.36	43.22	45.23	60.14	52.69
G_8	44.77	50.12	47.45	55.14	62.48	58.81	63.66	73.18	68.42
G_9	48.47	53.78	51.13	59.00	64.25	61.63	69.12	75.89	72.51
G_{10}	48.00	54.12	51.06	58.34	62.87	60.61	68.20	74.52	71.36
G_{11}	42.66	48.35	45.51	52.00	58.96	55.48	62.15	70.12	66.14
G_{12}	41.82	47.10	44.46	53.18	59.12	56.15	66.00	74.36	70.18
G_{13}	47.90	54.25	51.08	57.20	63.28	60.24	68.10	71.96	70.03
G_{14}	42.89	48.18	45.54	54.77	59.41	57.09	65.82	69.96	67.89
G_{15}	44.07	49.36	46.72	50.32	57.86	54.09	61.00	68.12	64.56
G_{16}	39.60	46.78	43.19	49.20	57.96	53.58	62.34	69.25	65.80
G_{17}	43.54	48.12	45.83	54.03	61.15	57.59	64.50	72.18	68.34
G_{18}	38.90	44.32	41.61	48.22	56.89	52.56	68.09	68.36	68.23
G_{19}	37.03	43.05	40.04	47.43	52.39	49.91	57.40	65.89	61.65
G_{20}	45.10	51.78	48.44	55.00	60.14	57.57	64.36	72.58	68.47
G_{21}	46.01	53.1	49.56	47.15	61.78	54.47	58.35	74.29	66.32
G_{22}	41.00	48.32	44.66	52.42	57.89	55.16	62.58	68.36	65.47
G_{23}	43.18	49.47	46.33	53.26	58.14	55.70	68.08	67.96	68.02
G_{24}	38.05	45.78	41.92	47.14	55.96	51.55	67.00	66.11	66.56
G_{25}	44.75	50.07	47.41	53.50	59.63	56.57	65.39	70.12	67.76
G_{26}	39.01	44.96	41.99	50.00	54.12	52.06	62.40	67.36	64.88
G_{27}	43.20	48.58	45.89	46.87	58.36	52.62	58.25	69.88	64.07
G_{28}	37.00	43.19	40.10	48.35	53.78	51.07	64.22	66.21	65.22
G_{29}	40.65	46.32	43.49	51.69	57.17	54.43	63.28	68.17	65.73
G_{30}	42.38	47.85	45.12	53.00	55.89	54.45	65.15	67.14	66.15
G_{31}	60.05	67.78	63.92	65.40	74.10	69.75	75.00	82.89	78.95
G_{32}	62.30	69.14	65.72	68.54	76.36	72.45	77.14	86.12	81.63
G_{33}	58.24	63.44	60.84	64.00	70.12	67.06	72.25	81.45	76.85
SEm (±)	0.61	0.83	0.73	0.77	0.84	0.80	0.94	1.07	1.05
CD (P=0.05)	1.78	2.33	1.41	2.16	2.37	1.53	2.62	3.26	2.05
CV (%)	2.40	2.88	2.69	2.50	2.43	2.46	2.53	2.62	2.61

Table 4.2.7 Mean performance of brinjal genotypes for number of primary branches plant^{-1}, total number of nodes plant^{-1} and internodal length of plant (cm) at final harvest in the year 2022

Genotypes	No. of primary branches plant^{-1} at final harvest			Total no. of nodes plant^{-1} at final harvest			Internodal length of plant at final harvest (cm)		
	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled
G_1	4.61	5.36	4.99	12.05	15.23	13.64	6.20	6.48	6.34
G_2	4.78	5.12	4.95	12.00	14.70	13.35	6.13	6.38	6.26
G_3	5.15	5.49	5.32	11.20	13.58	12.39	5.61	6.25	5.93
G_4	5.49	5.96	5.73	14.03	17.25	15.64	6.89	7.35	7.12
G_5	5.40	5.88	5.64	13.55	18.12	15.84	7.20	7.48	7.34
G_6	4.50	5.36	4.93	12.10	15.63	13.87	6.32	6.45	6.39
G_7	3.17	3.48	3.33	8.68	13.47	11.08	5.45	5.14	5.30
G_8	5.00	4.96	4.98	13.52	16.32	14.92	7.77	8.28	8.03
G_9	5.36	5.05	5.21	13.64	17.25	15.45	7.72	8.17	7.95
G_{10}	5.27	5.48	5.38	13.55	18.20	15.88	6.87	7.39	7.13
G_{11}	5.12	5.00	5.06	12.18	15.59	13.89	6.29	6.49	6.39
G_{12}	3.98	4.45	4.22	13.68	17.32	15.50	7.93	8.28	8.11
G_{13}	5.22	5.88	5.55	13.50	16.89	15.20	6.74	7.19	6.97
G_{14}	4.83	5.41	5.12	12.70	18.20	15.45	7.17	7.45	7.31
G_{15}	4.14	4.58	4.36	11.96	16.32	14.14	6.18	6.10	6.14
G_{16}	4.87	5.46	5.17	12.18	16.12	14.15	6.36	6.42	6.39
G_{17}	5.10	5.44	5.27	12.75	15.96	14.36	6.93	7.39	7.16
G_{18}	4.76	5.36	5.06	13.51	16.88	15.20	7.89	8.25	8.07
G_{19}	4.39	4.78	4.59	11.20	15.10	13.15	5.64	6.38	6.01
G_{20}	4.56	5.28	4.92	12.56	17.28	14.92	8.11	8.45	8.28
G_{21}	3.97	4.28	4.13	11.55	16.98	14.27	5.69	5.98	5.84
G_{22}	4.10	4.48	4.29	12.52	18.15	15.34	6.42	6.12	6.27
G_{23}	4.37	5.44	4.91	12.65	17.29	14.97	7.68	8.36	8.02
G_{24}	5.18	5.50	5.34	13.10	18.59	15.85	7.32	7.15	7.24
G_{25}	4.42	4.90	4.66	12.70	16.87	14.79	7.08	6.85	6.97
G_{26}	4.30	4.48	4.39	12.20	17.85	15.03	6.38	6.20	6.29
G_{27}	4.87	5.28	5.08	11.60	16.22	13.91	5.67	6.45	6.06
G_{28}	5.00	5.49	5.25	12.64	17.74	15.19	7.70	8.32	8.01
G_{29}	5.06	5.38	5.22	12.53	14.87	13.70	6.65	7.11	6.88
G_{30}	4.98	5.45	5.22	12.58	16.52	14.55	7.02	6.82	6.92
G_{31}	7.47	7.88	7.68	14.65	19.30	16.98	8.60	9.05	8.83
G_{32}	8.21	8.01	8.11	15.10	19.89	17.50	8.72	9.36	9.04
G_{33}	7.04	7.43	7.24	14.20	18.65	16.43	8.31	8.48	8.40
SEm (±)	0.07	0.08	0.08	0.19	0.27	0.24	0.11	0.10	0.10
CD (P=0.05)	0.21	0.23	0.15	0.55	0.77	0.47	0.30	0.29	0.06
CV (%)	2.58	2.67	2.61	2.63	2.83	2.79	2.63	2.45	2.54

4.2.2.5 Total number of nodes plant^{-1} at final harvest

As per the data obtained from Table 4.2.7, a significant variation was noticed for the trait. The highest (17.50) no. of nodes plant^{-1} observed in G_{32}, whereas minimum (11.08) in G_7. The total no. of nodes is an important trait influencing canopy architecture, photosynthetic surface area, and potential yield. The highest no. of nodes plant^{-1} in G_{32} could be due to genetic traits resulting, advancements in node count during the vegetative growth phase.

4.2.2.6 Internodal length of plant at final harvest (cm)

The data concerning to internodal length of plant shown in Table 4.2.7, revealed considerable difference among genotypes. The minimum (5.30 cm) internodal length was measured in G_7, while the maximum (9.04) in G_{32}. Smaller internodal length facilitates increased number of node formation along the main stem, thereby promoting greater branching opportunities and enhancing the flower count plant^{-1}. This architectural advantage can potentially increase flower and fruit production, contributing to improved yield potential in brinjal genotypes. Consequently, G_7, with the minimum internodal length, possesses a more favorable plant architecture for reproductive development compared to G_{32}, which exhibits extended internodes and consequently fewer nodes per unit stem length. Similar results were also confirmed by Kumar and Arumugam (2013) in brinjal genotypes.

4.2.2.7 Stem diameter (cm)

Results stated in Table 4.2.8 exhibited sufficient variation among genotypes for stem diameter. The maximum (2.96 cm) stem diameter was recorded in G_{31}, whereas the minimum (1.25 cm) in G_7. Stem diameter is a critical trait affecting the plant's ability to support its canopy and resist lodging. The observed variation in stem diameter among the genotypes underscores the role of both genetic potential and physiological processes in determining plant robustness. The thickest stem observed in G_{31}, suggests enhanced cambial activity leading to greater accumulation of vascular tissues, including xylem and phloem. The other reasons might be genetic diversity and abiotic factors such as soil fertility, water availability, and planting density interact with genetic traits to influence stem thickness.

4.2.2.8 Peduncle length (cm)

As per the data obtained from Table 4.2.8, a significant variation was noticed for the trait. The longest (7.27 cm) peduncle was recorded in G_{32}, whereas the shortest (3.57 cm) in G_7. The observed variation in peduncle length among genotypes highlights the interplay of genetic, hormonal, and resource factors in determining this trait. Peduncle length is a critical trait for both fruit positioning and harvesting efficiency. The variation in peduncle length reflects underlying genetic diversity or might be due to the higher gibberellin activity or greater tissue sensitivity to these hormones, leading to enhanced elongation. Genotypes like G_{32}, with longer peduncles, are advantageous for ensuring better fruit exposure and reducing susceptibility to fungal infections due to improved airflow. These findings are matched with the work done by Kumar *et al.* (2013); Vandana *et al.* (2014) and Das *et al.* (2017) in brinjal genotypes.

4.2.2.9 Petiole length (cm)

Results shown in Table 4.2.8 indicated substantial difference among genotypes for this character. The maximum (4.71 cm) petiole length was recorded in G_{24}, whereas the minimum (1.47 cm) in G_{32}. Petiole length significantly influences plant canopy architecture, light capture, and airflow within the crop. The observed differences in petiole length among genotypes highlight the balance between genetic potential and environmental adaptation. The longer petiole length as noticed in G_{24} may indicate allocation of resources toward vegetative growth, enhancing leaf positioning. Similar observations in brinjal genotypes noticed by Kumar *et al.* (2013); Vandana *et al.* (2014) and Das *et al.* (2017).

4.2.2.10 Leaf area (cm^2)

The data related to leaf area as shown in Table 4.2.9, indicated significant variation among genotypes. The maximum (295.77 cm^2) leaf area was found in G_{31}, whereas, minimum (122.74 cm^2) in G_4. Leaf area is a critical trait influencing a plant’s ability to photosynthesize effectively and sustain growth. The significant variation in leaf area among genotypes highlights the genetic and physiological diversity influencing plant productivity and adaptability. Leaf area is directly correlated with a plant's photosynthetic surface, influencing its ability to capture sunlight and produce carbohydrates. G_{31}'s larger leaf area suggests a greater potential for photosynthetic activity and energy production, supporting vigorous growth and higher biomass accumulation. These findings are corroborated by Naqvi *et al.* (2008) and Das *et al.* (2017) in diverse genotypes of brinjal.

4.2.3 Yield parameters

4.2.3.1 Days to first flowering (DAT)

The results related to the parameter showed substantial variability across brinjal genotypes (Table 4.2.9). The minimum (47.17) days to first flowering (DAT) was observed in G_{33}, while maximum (56.29) in G_1. It is a critical parameter in crop phenology, influencing the reproductive development and yield potential of brinjal genotypes. Sufficient variability for this trait in the evaluated brinjal genotypes, indicating genetic diversity and differential adaptability to flowering induction factors such as photoperiod, temperature, and genotype-specific physiological traits. It signifies the presence of inherent variation within the genotypes, which can be exploited in breeding programs for tailoring flowering time to specific agro-climatic conditions. These findings align with the observations reported by Kumar and Arumugam (2013) and Saikia *et al.* (2021) in studies on brinjal genotypes.

4.2.3.2 Days to 50% flowering (DAT)

The results revealed (Table 4.2.9) significant variability of the analyzed trait. The minimum (54.48) days to 50% flowering (DAT) was noticed in in G_{33}, while maximum (61.91) in G_2. It is an essential phenological indicator that serves as a benchmark for assessing genetic variability, adaptability, and synchronization of flowering within and among brinjal genotypes. The observed difference underscores the genetic diversity present in the evaluated genotypes, making it possible to select for desired flowering times depending on cultivation needs. These findings are consistent with those of Parida *et al.* (2020) and Saikia *et al.* (2021) in brinjal genotypes.

4.2.3.3 Total number of long styled flower

The data pertaining to total no. of long styled flower presented in Table 4.2.10, exhibited significant difference. The highest (48.95) count of total no. of long styled flower plant^{-1} recorded in G_{13}, whereas lowest (22.01) in G_2. Long-styled flowers are typically associated with normal fruit development, while their count reflects the plant's reproductive efficiency. The existing considerable variation suggests a strong influence of genetic factors controlling floral traits, which could be pivotal for selection in breeding programs. Genotypes like G_{13} with a higher no. of long-styled flowers have a better potential for higher fruit yield, assuming favorable environmental conditions and effective pollination.

4.2.3.4 Total number of medium styled flower

A close review of data flaunted in Table 4.2.10, clearly shows a significant variation among genotypes. The maximum (26.31) no. of medium styled flower plant^{-1} found in G_4, whereas lowest (10.34) in G_7. Medium-styled flowers, while often associated with partial fertility or reduced fruiting success compared to long-styled flowers, play a substantial role in assessing the reproductive profile of genotypes. The observed variation underscores the genetic diversity among genotypes, reflecting differences in floral morphology and resource allocation.

4.2.3.5 Number of node to first fruiting

From the obtained results a substantial difference was observed for the character (Table 4.2.10). The minimum (4.50) no. of node to first fruiting was observed in G_7, whereas maximum (7.54) in G_{32}. This parameter reflects the plant’s ability to transition from vegetative growth to reproductive development efficiently. The variation suggests genetic diversity in the developmental patterns of the genotypes, making this trait valuable for selection in breeding programs.

4.2.3.6 Days to first fruit set (DAT)

The results stated in Table 4.2.11 showed that this attribute has considerable variability. The minimum (54.58) days to first fruit set (DAT) was recorded in G_{31}, whereas maximum (64.28) in G_{19}. This parameter directly influences the crop's earliness and productivity potential, which are critical for both growers and breeders. The variation underscores the genetic diversity present in the genotypes, providing opportunities for selecting traits suitable for varying agro-climatic conditions and cultivation systems. Genotypes like G_{31}, with earlier fruit set, are advantageous for markets demanding early harvests and for cultivation in short growing seasons. This report has also been concluded by Das *et al.* (2017) in brinjal genotypes.

4.2.3.7 Days to first picking of fruits (DAT)

The results of this trait revealed substantial difference (Table 4.2.11). The minimum (60.98) days to first fruit set (DAT) was observed in G_{31}, whereas maximum (73.61) in G_{19}. It is an important agronomic trait in brinjal cultivation. It determines the earliness of the crop and reflects the efficiency of the genotype in transitioning from vegetative to reproductive stages. This trait significantly influences the marketability and economic returns of the crop, as early pickings often fetch higher market prices. Genotypes like G_{31}, which mature earlier, are ideal for markets prioritizing early-season harvests, allowing farmers to capitalize on higher prices during early availability. This variation underscores the genetic diversity, offering opportunities for targeted selection in breeding programs. The results that were subsequently obtained are consistent with the findings of Das *et al.* (2017), Parida *et al.* (2020), and Kumari *et al.* (2023) in brinjal genotypes.

Table 4.2.8 Mean performance of brinjal genotypes for stem diameter (cm), peduncle length (cm) and petiole length (cm) in the year 2022

Genotypes	Stem diameter (cm)			Peduncle length (cm)			Petiole length (cm)		
	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled
G_1	2.00	2.45	2.23	4.60	4.84	4.72	3.06	3.20	3.13
G_2	2.10	2.30	2.20	4.19	4.41	4.30	3.98	4.04	4.01
G_3	1.25	1.48	1.37	5.78	5.95	5.87	3.37	3.49	3.43
G_4	1.43	2.08	1.76	5.85	6.09	5.97	2.95	3.01	2.98
G_5	1.88	2.36	2.12	4.04	4.28	4.16	2.82	2.89	2.86
G_6	2.30	2.48	2.39	4.57	4.82	4.70	3.85	3.92	3.89
G_7	1.02	1.47	1.25	3.45	3.69	3.57	4.01	4.13	4.07
G_8	2.40	2.86	2.63	5.95	6.18	6.07	3.13	3.26	3.20
G_9	1.16	1.45	1.31	6.20	6.44	6.32	2.68	2.80	2.74
G_{10}	1.33	1.44	1.39	4.85	5.08	4.97	2.44	2.56	2.50
G_{11}	1.47	1.88	1.68	5.12	5.28	5.20	3.44	3.59	3.52
G_{12}	2.08	2.46	2.27	5.29	5.52	5.41	3.32	3.38	3.35
G_{13}	2.55	2.96	2.76	5.43	5.67	5.55	2.18	2.25	2.22
G_{14}	2.26	2.45	2.36	3.90	4.13	4.02	2.34	2.41	2.38
G_{15}	1.30	1.46	1.38	6.00	6.24	6.12	4.09	4.22	4.16
G_{16}	1.87	2.36	2.12	3.97	4.19	4.08	3.00	3.08	3.04
G_{17}	1.50	2.12	1.81	4.15	4.38	4.27	3.50	3.64	3.57
G_{18}	2.43	2.85	2.64	4.24	4.47	4.36	3.68	3.81	3.75
G_{19}	2.19	2.48	2.34	4.53	4.75	4.64	3.60	3.74	3.67
G_{20}	2.04	2.39	2.22	5.38	5.6	5.49	3.78	3.90	3.84
G_{21}	2.30	2.44	2.37	5.69	5.91	5.80	4.04	4.10	4.07
G_{22}	2.50	2.78	2.64	4.72	4.95	4.84	3.40	3.45	3.43
G_{23}	2.60	2.88	2.74	6.12	6.36	6.24	3.73	3.87	3.80
G_{24}	1.40	1.68	1.54	5.90	6.13	6.02	4.65	4.77	4.71
G_{25}	1.79	2.08	1.94	4.24	4.46	4.35	3.81	3.93	3.87
G_{26}	2.43	2.85	2.64	4.34	4.57	4.46	3.88	4.02	3.95
G_{27}	1.97	2.25	2.11	5.08	5.31	5.20	3.93	4.00	3.97
G_{28}	2.15	2.48	2.32	5.19	5.41	5.30	4.49	4.55	4.52
G_{29}	2.02	2.43	2.23	5.50	5.73	5.62	3.56	3.62	3.59
G_{30}	1.22	1.48	1.35	6.06	6.28	6.17	4.41	4.48	4.45
G_{31}	2.87	3.05	2.96	7.11	7.36	7.24	3.29	3.41	3.35
G_{32}	2.90	3.00	2.95	7.15	7.39	7.27	1.43	1.50	1.47
G_{33}	2.80	3.05	2.93	6.72	6.96	6.84	2.16	2.24	2.20
SEm (±)	0.03	0.04	0.03	0.08	0.08	0.08	0.05	0.05	0.05
CD (P=0.05)	0.08	0.10	0.06	0.23	0.22	0.16	0.13	0.15	0.09
CV (%)	2.53	2.65	2.61	2.70	2.47	2.58	2.38	2.65	2.53

Table 4.2.9 Mean performance of brinjal genotypes for leaf area (cm^2), days to first flowering (DAT) and days to 50% flowering (DAT) in the year 2022

Genotypes	Leaf area (cm^2)			Days to first flowering (DAT)			Days to 50% flowering (DAT)		
	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled
G_1	157.80	164.6	161.20	54.21	58.36	56.29	60.34	62.78	61.56
G_2	167.23	175.1	171.17	55.62	54.36	54.99	61.97	61.85	61.91
G_3	154.22	161.8	158.01	55.32	51.48	53.40	62.05	57.94	60.00
G_4	119.38	126.1	122.74	50.45	50.36	50.41	54.18	57.65	55.92
G_5	131.15	138.32	134.74	50.89	51.47	51.18	55.25	58.17	56.71
G_6	163.77	169.88	166.83	52.96	52.35	52.66	58.69	56.10	57.40
G_7	173.12	180.22	176.67	51.28	52.78	52.03	59.38	57.12	58.25
G_8	188.10	200.15	194.13	53.58	53.78	53.68	59.15	58.47	58.81
G_9	142.24	150.36	146.30	51.18	52.12	51.65	56.35	58.63	57.49
G_{10}	126.09	138.11	132.10	51.21	53.14	52.18	57.35	60.14	58.75
G_{11}	182.20	189.32	185.76	53.25	52.47	52.86	58.96	54.32	56.64
G_{12}	171.34	178.38	174.86	54.45	47.18	50.82	63.17	52.10	57.64
G_{13}	139.12	145.3	142.21	50.25	50.54	50.40	55.14	58.86	57.00
G_{14}	170.21	177.35	173.78	52.17	50.54	51.36	59.78	57.43	58.61
G_{15}	166.23	173.43	169.83	52.78	54.32	53.55	60.78	61.20	60.99
G_{16}	193.54	197.77	195.66	54.14	53.41	53.78	63.74	56.91	60.33
G_{17}	183.29	196.25	189.77	52.65	48.63	50.64	60.78	53.25	57.02
G_{18}	175.11	183.12	179.12	53.15	54.36	53.76	59.47	59.63	59.55
G_{19}	169.32	176.3	172.81	54.1	54.32	54.21	60.47	59.48	59.98
G_{20}	153.28	166.22	159.75	56.47	54.18	55.33	62.47	60.28	61.38
G_{21}	183.45	189.52	186.49	55.63	55.14	55.39	59.78	62.74	61.26
G_{22}	180.20	192.23	186.22	53.69	52.48	53.09	60.32	58.47	59.40
G_{23}	195.44	203.5	199.47	52.17	54.36	53.27	59.47	57.18	58.33
G_{24}	198.10	204.6	201.35	54.18	53.98	54.08	62.78	60.36	61.57
G_{25}	160.44	167.32	163.88	52.78	52.17	52.48	60.78	56.42	58.60
G_{26}	156.48	159.25	157.87	53.58	52.47	53.03	62.38	59.74	61.06
G_{27}	177.38	183.55	180.47	53.47	51.36	52.42	62.78	59.24	61.01
G_{28}	184.90	192.36	188.63	52.34	53.14	52.74	60.78	55.21	58.00
G_{29}	190.15	197.58	193.87	51.78	53.48	52.63	58.45	59.65	59.05
G_{30}	192.70	200.02	196.36	54.21	53.48	53.85	64.18	58.28	61.23
G_{31}	292.17	299.36	295.77	49.32	47.15	48.24	55.28	54.21	54.75
G_{32}	254.63	263.15	258.89	47.96	48.78	48.37	54.89	55.32	55.11
G_{33}	208.10	215.47	211.79	47.24	47.10	47.17	54.20	54.75	54.48
SEm (±)	2.66	2.68	2.64	0.87	0.66	0.77	0.93	0.90	0.92
CD (P=0.05)	7.46	7.46	4.85	2.43	1.85	1.54	2.60	2.61	1.86
CV (%)	2.62	2.53	2.56	2.86	2.19	2.53	2.70	2.69	2.70

Table 4.2.10 Mean performance of brinjal genotypes for total number of long styled flower, total number of medium styled flower and number of node to first fruiting in the year 2022

Genotypes	Total no. of long styled flower			Total no. of medium styled flower			No. of node to first fruiting		
	Spring-summer season	***Kharif* season**	**Pooled**	**Spring-summer season**	***Kharif* season**	**Pooled**	**Spring-summer season**	***Kharif* season**	**Pooled**
G_1	23.12	25.85	24.49	21.12	24.58	22.85	4.85	5.69	5.27
G_2	20.55	23.47	22.01	19.85	22.39	21.12	5.36	4.52	4.94
G_3	22.12	27.68	24.90	22.71	24.35	23.53	5.62	6.48	6.05
G_4	49.15	45.32	47.24	25.48	27.14	26.31	4.53	5.48	5.01
G_5	43.89	39.25	41.57	25.47	23.85	24.66	4.55	5.21	4.88
G_6	24.18	27.69	25.94	16.47	19.25	17.86	5.56	6.38	5.97
G_7	25.36	21.58	23.47	10.25	10.43	10.34	4.75	4.25	4.50
G_8	20.35	28.65	24.50	21.96	23.47	22.72	5.45	4.85	5.15
G_9	39.58	36.15	37.87	24.85	23.69	24.27	6.21	5.62	5.92
G_{10}	36.47	32.12	34.30	23.48	22.64	23.06	5.74	6.42	6.08
G_{11}	32.85	33.18	33.02	14.85	15.23	15.04	6.47	5.55	6.01
G_{12}	25.18	28.32	26.75	17.25	15.36	16.31	5.23	4.69	4.96
G_{13}	49.25	48.65	48.95	24.36	27.31	25.84	5.75	6.18	5.97
G_{14}	32.17	31.85	32.01	14.58	16.87	15.73	4.57	5.25	4.91
G_{15}	32.85	36.48	34.67	13.25	13.48	13.37	5.14	4.56	4.85
G_{16}	28.18	31.78	29.98	18.69	15.74	17.22	5.52	6.45	5.99
G_{17}	30.18	31.58	30.88	21.87	24.63	23.25	5.32	5.45	5.39
G_{18}	27.89	29.65	28.77	19.47	18.63	19.05	4.85	5.31	5.08
G_{19}	37.48	39.15	38.32	23.18	21.74	22.46	5.12	4.85	4.99
G_{20}	29.15	30.57	29.86	22.48	25.67	24.08	5.12	5.89	5.51
G_{21}	28.59	29.58	29.09	22.78	24.85	23.82	5.35	5.48	5.42
G_{22}	38.59	39.47	39.03	23.78	22.71	23.25	5.14	5.38	5.26
G_{23}	35.78	38.45	37.12	22.75	24.89	23.82	5.84	6.28	6.06
G_{24}	36.85	41.58	39.22	21.45	22.96	22.21	6.14	6.39	6.27
G_{25}	32.85	34.85	33.85	19.32	20.78	20.05	5.48	6.18	5.83
G_{26}	30.25	36.78	33.52	17.25	19.65	18.45	4.85	5.22	5.04
G_{27}	32.18	39.15	35.67	18.32	16.75	17.54	5.11	5.48	5.30
G_{28}	35.48	35.85	35.67	21.36	24.85	23.11	5.25	5.11	5.18
G_{29}	32.48	28.58	30.53	22.18	24.87	23.53	6.45	5.89	6.17
G_{30}	23.58	21.96	22.77	13.24	13.25	13.25	5.78	6.22	6.00
G_{31}	46.89	49.58	48.24	18.35	21.78	20.07	6.29	7.22	6.76
G_{32}	45.96	48.96	47.46	22.14	22.48	22.31	7.22	7.85	7.54
G_{33}	41.58	44.89	43.24	23.74	23.48	23.61	6.44	7.12	6.78
SEm (±)	0.42	0.58	0.51	0.31	0.33	0.32	0.09	0.08	0.09
CD (P=0.05)	1.23	1.63	1.02	0.88	0.93	0.63	0.26	0.23	0.17
CV (%)	2.18	2.92	2.61	2.67	2.70	2.69	2.89	2.44	2.65

4.2.3.8 Total number of fruits plant^{-1}

The associated results for the character exhibited sufficient variability in brinjal genotypes (Table 4.2.11). The maximum (43.40) count of fruits per plant observed in G_{32}, while minimum (15.16) in G_8. The total no. of fruits plant^{-1} is a crucial agronomic trait directly influencing the yield and economic profitability of brinjal cultivation. This trait reflects the reproductive success of the genotype and its efficiency in resource allocation from vegetative growth to fruit production. The considerable variation underscores the genetic diversity of the genotypes, offering opportunities for targeted breeding and selection. Higher fruiting genotypes often ensure better productivity even under suboptimal conditions, assuming effective resource management and pollination. Genotype G_{32}, with the highest fruit count, demonstrates superior reproductive efficiency and yield potential, making it an excellent candidate for high-yield breeding programs. This result is also consistent with the results of Kumar and Arumugam (2013), Das *et al.* (2017), Saikia *et al.* (2021), and Kumari *et al.* (2023) in brinjal genotypes.

4.2.3.9 Average fruit weight (g)

Significant differences among genotypes are observed for average fruit weight (Table 4.2.12). The maximum (129.87 g) average fruit weight was noticed in G_{31}, whereas, minimum (51.86 g) in G_{29}. The average fruit weight is a vital trait in brinjal cultivation, as it directly impacts the market value and overall yield of the crop. This parameter reflects the balance between fruit size and the no. of fruits plant^{-1}, which are important considerations for both consumers and growers. The wide variation emphasizes the genetic diversity in fruit size traits among the genotypes and adaptability of the crop, offering flexibility for targeted breeding and market segmentation. Das *et al.* (2017); Parida *et al.* (2020) and Kumari *et al.* (2023) also reported comparable findings in brinjal genotypes.

4.2.3.10 Fruit length (cm)

The data reported in Table 4.2.12 showed that the character varied significantly across genotypes. The longest (15.15 cm) fruit length was recorded in G_{31}, while shortest (6.85 cm) in G_3. The fruit length is a key morphological trait in brinjal that significantly influences consumer preference, marketability, and utility. Variations in fruit length reflect genetic diversity and can guide breeding programs to tailor varieties for specific culinary or market needs. The significant variation in fruit length among brinjal genotypes reflects the genetic diversity and adaptability of the crop. This diversity provides a foundation for breeding programs to develop varieties tailored to diverse consumer demands and growing conditions. The results shown above are consistent with the findings of Kumar and Arumugam (2013), Das *et al.* (2017), Parida *et al.* (2020) and Kumari *et al.* (2023) in brinjal genotypes.

4.2.3.11 Fruit diameter (cm)

As indicated in Table 4.2.12, a substantial variability was seen for fruit diameter across the genotypes. The maximum (7.56 cm) fruit diameter was observed in G_{21}, whereas minimum (3.20 cm) in G_3. The fruit diameter is a key morphological trait in brinjal, significantly influencing consumer preference, marketability, and utility. The wide variation underscores adaptability and the genetic diversity among genotypes and the potential for selection based on market and consumer preferences. These findings align with studies done by Kumar and Arumugam (2013); Parida *et al.* (2020) and Kumari *et al.* (2023) on brinjal genotypes.

4.2.3.12 Fruit yield plant^{-1} (kg)

The data provided in Table 4.2.13, denoted significant variation for the character. The maximum (3.78 kg) fruit yield plant^{-1} was observed in G_{32}, whereas minimum (1.09 kg) in G_7. The fruit yield plant^{-1} represents the most significant agronomic trait in brinjal cultivation, as it directly determines the crop's economic value and productivity. Yield is a composite trait influenced by multiple factors (polygenic character), including fruit count, size, and quality. The superior yield of G_{32} (3.78 kg/plant) emerges from the synergistic interaction of multiple traits: (1) enhanced plant height and architecture providing greater resource capture capacity; (2) increased branching and node numbers creating more reproductive sites; (3) superior fruit production efficiency (43.40 fruits/plant); and (4) robust disease resistance mechanisms that preserved both vegetative and reproductive tissues from pathogenic damage. In contrast, G_7's minimal yield (1.09 kg/plant) reflects not only the lowest plant height (52.69 cm at final harvest) and fewest primary branches (3.33) and nodes (11.08), but also lower fruit set (15.16 fruits/plant), resulting in reduced biomass and reproductive output. The genotype G_{32}'s comprehensive superiority across morphological, reproductive, and disease resistance parameters demonstrates that yield is indeed a polygenic, composite trait influenced by multiple interdependent factors. These findings underscore the importance of integrated genotype selection in breeding programs, where disease resistance must be coupled with superior morpho-agronomic traits to achieve substantial yield improvements in brinjal cultivation under disease-prone conditions. These findings corroborated those of Kumar and Arumugam (2013); Das *et al.* (2017); Saikia *et al.* (2021); Kumari *et al.* (2023); Rajan *et al.* (2023) and Rajashree *et al.* (2023) in brinjal genotypes.

4.2.3.13 Fruit yield plot^{-1} (kg)

As per the data shown in Table 4.2.13, a significant difference was noticed for this trait. The highest (26.51 kg) yield per plant basis was observed in G_{32}, whereas minimum (7.01 kg) in G_7. This multiplicative effect demonstrates that genotypes with superior individual plant productivity contribute proportionally greater cumulative yield at the plot level. This is a critical trait, reflecting the cumulative productivity of brinjal genotypes under a defined growing space. It is a practical measure of yield potential and suitability for commercial cultivation. Fruit yield plot^{-1} represents the cumulative productive output of all plants within a defined growing space and serves as the most practical measure of genotypic yield potential under field conditions. Plot-level yield integrates both the genetic capacity of the genotype for individual plant productivity and the preservation of that productivity against yield-reducing disease pressure. The results are consistent with the findings of Das *et al.* (2017) and Kumari *et al.* (2023) in brinjal genotypes.

Table 4.2.11 Mean performance of brinjal genotypes for days to first fruit set (DAT), days to first picking of fruits (DAT) and total number of fruits plant^{-1} in the year 2022

Genotypes	Days to first fruit set (DAT)			Days to first picking of fruits (DAT)			Total no. of fruits plant^{-1}		
	Spring-summer season	***Kharif* season**	**Pooled**	**Spring-summer season**	***Kharif* season**	**Pooled**	**Spring-summer season**	***Kharif* season**	**Pooled**
G_1	60.24	65.47	62.86	69.25	74.96	72.11	16.78	22.58	19.68
G_2	61.32	60.17	60.75	70.22	67.25	68.74	20.85	24.89	22.87
G_3	58.85	58.65	58.75	68.49	66.49	67.49	24.35	26.87	25.61
G_4	56.10	57.13	56.62	61.48	61.69	61.59	38.25	40.78	39.52
G_5	57.34	57.66	57.50	62.32	62.21	62.27	29.80	32.47	31.14
G_6	60.12	56.75	58.44	68.95	65.85	67.40	20.23	26.78	23.51
G_7	57.85	57.82	57.84	65.24	64.19	64.72	18.96	18.45	18.71
G_8	59.38	52.33	55.86	68.25	66.28	67.27	14.62	15.69	15.16
G_9	57.32	58.32	57.82	63.41	62.98	63.20	28.04	30.78	29.41
G_{10}	58.12	59.18	58.65	64.15	63.24	63.70	26.21	25.85	26.03
G_{11}	64.85	59.88	62.37	73.52	68.95	71.24	21.78	28.18	24.98
G_{12}	58.45	56.34	57.40	67.12	66.17	66.65	14.28	22.48	18.38
G_{13}	55.25	56.32	55.79	60.28	61.74	61.01	30.46	33.49	31.98
G_{14}	62.38	59.67	61.03	74.38	66	70.19	24.39	16.78	20.59
G_{15}	58.27	64.28	61.28	69.22	70.89	70.06	19.22	25.48	22.35
G_{16}	56.48	58.29	57.39	64.17	66.42	65.30	24.69	22.36	23.53
G_{17}	62.05	55.47	58.76	70.41	62.78	66.60	20.28	28.78	24.53
G_{18}	63.78	61.28	62.53	70.85	70.18	70.52	20.19	26.71	23.45
G_{19}	64.82	63.74	64.28	72.36	74.86	73.61	21.85	18.78	20.32
G_{20}	63.41	60.29	61.85	71.22	68.74	69.98	21.08	29.36	25.22
G_{21}	63.24	63.75	63.50	73.89	69.66	71.78	19.47	22.48	20.98
G_{22}	60.17	60.74	60.46	71.48	66.84	69.16	22.29	28.96	25.63
G_{23}	59.47	58.22	58.85	69.49	66.26	67.88	28.69	21.47	25.08
G_{24}	60.28	64.12	62.20	68.28	71.41	69.85	20.78	19.63	20.21
G_{25}	59.84	56.38	58.11	66.36	63.85	65.11	18.31	26.78	22.55
G_{26}	58.25	60.74	59.50	66.72	67.12	66.92	24.74	20.78	22.76
G_{27}	62.74	59.65	61.20	70.14	68.45	69.30	19.87	28.78	24.33
G_{28}	60.36	56.24	58.30	67.58	68.41	68.00	17.07	26.31	21.69
G_{29}	62.38	60.85	61.62	71.29	69.28	70.29	21.65	27.48	24.57
G_{30}	64.17	58.39	61.28	71.96	68.47	70.22	15.69	21.78	18.74
G_{31}	54.87	54.28	54.58	61.78	60.17	60.98	32.21	36.18	34.20
G_{32}	56.17	54.22	55.20	63.87	62.34	63.11	44.02	42.78	43.40
G_{33}	55.36	54.78	55.07	63.28	62.88	63.08	32.54	38.36	35.45
SEm (±)	0.87	0.84	0.85	1.02	1.00	1.00	0.35	0.40	0.38
CD (P=0.05)	2.45	2.37	1.67	2.86	2.77	2.05	1.00	1.12	0.75
CV (%)	2.52	2.47	2.51	2.60	2.59	2.59	2.62	2.61	2.62

Table 4.2.12 Mean performance of brinjal genotypes for average fruit weight (g), fruit length (cm) and fruit diameter (cm) in the year 2022

Genotypes	Average fruit weight (g)			Fruit length (cm)			Fruit diameter (cm)		
	Spring-summer season	*Kharif* season	Pooled	Spring-summer season	*Kharif* season	Pooled	Spring-summer season	*Kharif* season	Pooled
G_1	59.63	61.24	60.44	7.25	7.36	7.31	4.55	4.85	4.70
G_2	64.85	63.24	64.05	7.25	7.44	7.35	3.28	3.44	3.36
G_3	60.38	59.41	59.90	6.58	7.12	6.85	3.25	3.15	3.20
G_4	82.69	83.74	83.22	9.12	8.89	9.01	4.02	3.88	3.95
G_5	72.31	70.58	71.45	9.12	9.51	9.32	3.95	3.78	3.86
G_6	57.39	59.34	58.37	7.85	8.18	8.02	3.45	3.44	3.45
G_7	58.74	56.98	57.86	8.28	8.23	8.26	3.39	4.07	3.73
G_8	82.34	81.82	82.08	8.48	8.39	8.44	3.46	4.07	3.77
G_9	66.51	69.21	67.86	8.89	9.08	8.99	3.65	3.77	3.71
G_{10}	59.36	60.78	60.07	8.45	9.04	8.75	4.12	4.23	4.18
G_{11}	60.88	60.91	60.90	7.36	7.48	7.42	3.18	3.25	3.22
G_{12}	61.48	62.47	61.98	7.15	7.23	7.19	3.25	3.35	3.30
G_{13}	65.74	68.67	67.21	9.35	9.41	9.38	3.96	4.01	3.99
G_{14}	65.55	64.78	65.17	8.25	8.22	8.24	3.48	3.45	3.47
G_{15}	58.17	58.96	58.57	7.47	7.48	7.48	3.35	3.48	3.42
G_{16}	66.74	63.46	65.10	7.36	7.52	7.44	5.12	5.14	5.13
G_{17}	69.72	70.89	70.31	8.15	8.48	8.32	4.25	4.35	4.30
G_{18}	68.6	70.15	69.38	7.85	7.55	7.70	5.15	5.12	5.14
G_{19}	63.48	65.63	64.56	7.48	7.25	7.37	4.45	4.4	4.43
G_{20}	78.22	78.27	78.25	8.42	8.33	8.38	3.55	3.56	3.56
G_{21}	67.52	66.32	66.92	7.96	8.11	8.04	7.55	7.56	7.56
G_{22}	59.87	58.25	59.06	8.36	8.48	8.42	4.45	4.45	4.45
G_{23}	63.05	63.93	63.49	8.45	8.32	8.39	4.54	4.58	4.56
G_{24}	61.78	60.57	61.18	8.21	7.89	8.05	4.38	4.45	4.42
G_{25}	61.52	59.66	60.59	7.22	7.48	7.35	3.88	3.89	3.89
G_{26}	73.53	73.22	73.38	7.11	7.78	7.45	5.08	5.12	5.10
G_{27}	59.34	60.12	59.73	8.08	8.12	8.10	3.68	3.58	3.63
G_{28}	74.22	74.18	74.20	8.12	8.45	8.29	4.36	4.41	4.39
G_{29}	52.83	50.88	51.86	8.55	8.61	8.58	4.88	4.92	4.90
G_{30}	54.28	55.36	54.82	7.45	7.52	7.49	5.28	5.28	5.28
G_{31}	130.78	128.96	129.87	15.08	15.22	15.15	6.15	6.18	6.17
G_{32}	105.88	106.45	106.17	14.28	14.18	14.23	3.88	3.97	3.93
G_{33}	99.12	98.55	98.84	10.48	10.44	10.46	4.25	4.22	4.24
SEm (±)	1.00	1.03	1.02	0.13	0.13	0.13	0.05	0.06	0.06
CD (P=0.05)	2.81	2.95	2.10	0.35	0.38	0.23	0.15	0.18	0.13
CV (%)	2.51	2.57	2.53	2.60	2.72	2.65	2.12	2.51	2.35

4.2.3.14 Fruit yield hectare^{-1} (q)

The data relevant to fruit yield hectare^{-1} is shown in Table 4.2.13, that exhibited significant variation among brinjal genotypes. The maximum (654.53 q) fruit yield plant^{-1} was observed in G_{32}, whereas minimum (172.95 q) in G_7. The fruit yield hectare^{-1} is the most comprehensive measure of productivity in brinjal cultivation, reflecting the total yield obtained over a standardized area. This parameter directly impacts the economic viability of the crop for commercial production and is affected by an interplay of genetic, agronomic and abiotic factors. Such extensive variation demonstrates the existing diversity at the genetic level among genotypes that highlights opportunities for targeted assortment to meet specific cultivation goals. These findings corroborated those of Kumar and Arumugam (2013); Das *et al.* (2017); Saikia *et al.* (2021); Kumari *et al.* (2023); Rajan *et al.* (2023); Rajashree *et al.* (2023) in brinjal genotypes.

4.2.4 Biochemical parameters

4.2.4.1 Total chlorophyll content (mg g^{-1})

The results of total chlorophyll showed the significant different among genotypes (Table 4.2.14). The maximum (1.19 mg g^{-1}) total chlorophyll content was found in G_{31} and minimum (0.67 mg g^{-1}) was recorded in G_{10}. Chlorophyll content is a crucial indicator of a plant's ability to capture light energy, which directly impacts growth, yield, and stress resilience, including tolerance to phomopsis blight**.** This significant variability among brinjal genotypes reflects the genetic diversity affecting photosynthetic efficiency and overall plant vigor. Genotypes with higher chlorophyll content, such as G_{31}, are likely to exhibit better photosynthetic activity, contributing to enhanced energy availability for defense mechanisms against biotic stresses. These findings align with studies done by Kumari *et al.* (2023); Lyngdoh *et al*. (2025); Lyu *et al*. (2025) in brinjal genotypes.

4.2.4.2 Total soluble solids (°Brix)

The results regarding the total soluble solids among the brinjal genotypes were found to be significant (as indicated in Table 4.2.14). The highest (5.43 °Brix) TSS was noted in G_{32}, while minimum (4.28 °Brix) in G_5. The significant variation in TSS observed among the brinjal genotypes, highlights the genetic diversity influencing fruit quality and stress adaptability. Genotypes with higher TSS are indicative of better sugar accumulation and metabolic efficiency, which not only enhances fruit flavor but may also contribute to increased resilience against stresses like phomopsis blight. These findings corroborated those of Saurabh and Sarvanan (2020) and Kumar *et al.* (2024b) in eggplant.

Table 4.2.13 Mean performance of brinjal genotypes for fruit yield plant^{-1} (kg), fruit yield plot^{-1} (kg) and fruit yield hectare^{-1} (q) in the year 2022

Genotypes	Fruit yield plant^{-1} (kg)			Fruit yield plot^{-1} (kg)			Fruit yield hectare^{-1} (q)		
	Spring-summer season	*Kharif* season	Pooled	Spring-summer season	*Kharif* season	Pooled	Spring-summer season	*Kharif* season	Pooled
G_1	1.59	1.29	1.44	8.22	8.00	8.11	202.95	197.52	200.24
G_2	1.35	1.57	1.46	7.88	8.22	8.05	194.56	202.95	198.75
G_3	1.39	1.6	1.50	8.28	8.30	8.29	204.43	204.93	204.68
G_4	1.98	2.25	2.12	18.36	13.18	15.77	453.31	325.41	389.36
G_5	1.89	2.16	2.03	14.89	12.96	13.93	367.63	319.98	343.81
G_6	1.16	1.45	1.31	8.55	7.88	8.22	211.10	194.56	202.83
G_7	1.12	1.05	1.09	6.89	7.12	7.01	170.11	175.79	172.95
G_8	1.21	1.28	1.25	8.12	7.65	7.89	200.48	188.88	194.68
G_9	1.86	2.1	1.98	14.25	12.90	13.58	351.83	318.50	335.17
G_{10}	1.82	2.04	1.93	12.54	12.85	12.70	309.61	317.27	313.44
G_{11}	1.33	1.7	1.52	9.25	9.10	9.18	228.38	224.68	226.53
G_{12}	1.67	1.12	1.40	8.00	7.22	7.61	197.52	178.26	187.89
G_{13}	1.7	1.84	1.77	12.28	9.80	11.04	303.19	241.96	272.58
G_{14}	1.6	1.08	1.34	9.18	8.56	8.87	226.65	211.35	219.00
G_{15}	1.12	1.5	1.31	8.96	9.00	8.98	221.22	222.21	221.72
G_{16}	1.48	1.41	1.45	10.27	9.56	9.92	253.57	236.04	244.80
G_{17}	1.44	1.85	1.65	12.47	12.69	12.58	307.88	313.32	310.60
G_{18}	1.39	1.8	1.60	9.87	10.11	9.99	243.69	249.62	246.65
G_{19}	1.41	1.23	1.32	10.22	10.42	10.32	252.33	257.27	254.80
G_{20}	1.65	1.83	1.74	12.10	11.36	11.73	298.75	280.48	289.61
G_{21}	1.32	1.49	1.41	8.57	8.88	8.73	211.59	219.25	215.42
G_{22}	1.34	1.62	1.48	9.14	10.12	9.63	225.67	249.86	237.76
G_{23}	1.21	1.37	1.29	11.65	10.40	11.03	287.64	256.78	272.21
G_{24}	1.31	1.18	1.25	8.74	7.92	8.33	215.79	195.54	205.67
G_{25}	1.13	1.48	1.31	8.12	8.90	8.51	200.48	219.74	210.11
G_{26}	1.69	1.52	1.61	10.87	10.12	10.50	268.38	249.86	259.12
G_{27}	1.18	1.55	1.37	8.45	8.65	8.55	208.63	213.57	211.10
G_{28}	1.27	1.53	1.40	9.23	8.55	8.89	227.89	211.10	219.49
G_{29}	1.15	1.41	1.28	8.54	8.21	8.38	210.85	202.70	206.78
G_{30}	1.61	1.1	1.36	7.48	7.12	7.30	184.68	175.79	180.24
G_{31}	3.45	3.79	3.62	25.47	23.25	24.36	628.85	574.04	601.45
G_{32}	3.68	3.88	3.78	27.15	25.87	26.51	670.33	638.73	654.53
G_{33}	3.15	3.48	3.32	23.57	18.34	20.96	581.94	452.81	517.38
SEm (±)	0.03	0.03	0.03	0.15	0.13	0.14	3.92	3.41	3.67
CD (P=0.05)	0.08	0.07	0.05	0.42	0.38	0.27	11.07	9.63	7.91
CV (%)	2.90	2.55	2.72	2.29	2.29	2.28	2.73	2.40	2.59

Table 4.2.14 Mean performance of brinjal genotypes for total chlorophyll content (mg g^{-1}), total soluble solids (°Brix) and ascorbic acid (mg 100 g^{-1}) in the year 2022

Genotypes	Total chlorophyll content (mg g^{-1})			Total soluble solids (°Brix)			Ascorbic acid (mg 100 g^{-1})		
	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled	Spring-Summer season	*Kharif* season	Pooled
G_1	0.811	0.842	0.827	4.21	4.69	4.45	1.10	1.45	1.28
G_2	0.835	0.872	0.854	4.55	4.85	4.70	1.91	1.65	1.78
G_3	0.901	0.879	0.890	4.72	5.21	4.97	1.98	1.68	1.83
G_4	0.799	0.771	0.785	4.52	4.89	4.71	1.96	1.77	1.87
G_5	0.785	0.698	0.742	4.11	4.45	4.28	1.88	1.68	1.78
G_6	0.851	0.828	0.840	4.58	4.89	4.74	2.01	2.18	2.10
G_7	0.938	0.929	0.934	5.15	5.48	5.32	1.24	1.86	1.55
G_8	0.805	0.875	0.840	4.45	4.25	4.35	1.42	1.48	1.45
G_9	0.685	0.695	0.690	4.23	4.48	4.36	1.78	1.55	1.67
G_{10}	0.679	0.652	0.666	5.12	5.48	5.30	1.70	1.49	1.60
G_{11}	0.933	0.968	0.951	5.30	5.33	5.32	1.78	1.42	1.60
G_{12}	0.921	0.938	0.930	5.11	5.45	5.28	1.75	1.52	1.64
G_{13}	0.721	0.695	0.708	4.85	4.60	4.73	1.14	1.01	1.08
G_{14}	0.878	0.865	0.872	4.74	4.96	4.85	1.69	1.48	1.59
G_{15}	0.911	0.888	0.900	5.10	5.05	5.08	1.78	1.52	1.65
G_{16}	0.851	0.905	0.878	4.28	4.78	4.53	1.88	1.55	1.72
G_{17}	0.952	0.969	0.961	4.55	4.88	4.72	1.79	1.36	1.58
G_{18}	0.869	0.871	0.870	5.17	5.36	5.27	1.55	1.78	1.67
G_{19}	0.89	0.901	0.896	5.45	5.15	5.30	1.63	1.53	1.58
G_{20}	0.938	0.912	0.925	5.12	5.34	5.23	1.97	1.56	1.77
G_{21}	0.938	0.92	0.929	4.58	4.36	4.47	1.89	1.71	1.80
G_{22}	0.835	0.859	0.847	4.56	4.88	4.72	1.88	1.68	1.78
G_{23}	0.862	0.881	0.872	5.12	4.62	4.87	1.56	1.64	1.60
G_{24}	0.901	0.936	0.919	4.78	5.25	5.02	1.14	1.43	1.29
G_{25}	0.924	0.965	0.945	5.32	5.12	5.22	2.15	1.92	2.04
G_{26}	0.857	0.884	0.871	5.48	5.12	5.30	1.48	1.57	1.53
G_{27}	0.897	0.923	0.910	4.85	5.35	5.10	1.98	1.87	1.93
G_{28}	0.912	0.925	0.919	4.52	4.88	4.70	1.25	1.31	1.28
G_{29}	0.881	0.894	0.888	4.58	4.78	4.68	1.72	1.85	1.79
G_{30}	0.941	0.915	0.928	5.18	5.20	5.19	1.92	1.92	1.92
G_{31}	1.253	1.128	1.191	5.36	5.48	5.42	2.25	2.05	2.15
G_{32}	1.175	1.196	1.186	5.47	5.38	5.43	2.45	2.35	2.40
G_{33}	0.689	0.708	0.699	4.85	4.78	4.82	1.41	1.28	1.35
SEm (±)	0.02	0.01	0.01	0.07	0.08	0.08	0.03	0.03	0.03
CD (P=0.05)	0.04	0.04	0.03	0.20	0.23	0.15	0.08	0.07	0.05
CV (%)	2.96	2.94	2.93	2.53	2.86	2.69	2.89	2.82	2.85

4.2.4.3 Ascorbic acid (mg 100 g^{-1})

Substantial variations were noticed in the studied genotypes for the trait ascorbic acid (as shown in Table 4.2.14). The maximum (2.40 mg 100 g^{-1}) content of ascorbic acid was found in G_{32}, whereas minimum (1.08 mg 100 g^{-1}) in G_{13}. As a potent antioxidant, ascorbic acid helps mitigate oxidative damage caused by pathogen-induced stress, supporting plant health and resistance. Genotypes like G_{32}, with higher ascorbic acid levels, offer better disease tolerance and align with consumer demand for nutrient-rich produce, benefiting both farmers and markets. This variation underscores the value of ascorbic acid as a key trait for breeding phomopsis blight-resistant brinjal varieties. These outcomes align with the studies of Kumar *et al.* (2012); Mohamed *et al.* (2019); Kumar and Arumugam (2013); Nandi *et al.* (2021); Kumari *et al.* (2023) in brinjal genotypes.

4.2.4.4 Vitamin A (IU g^{-1})

The study showed significant variation in vitamin A content presented in Table 4.2.15. The maximum (0.285 IU g^{-1}) vitamin A was observed in G_{32}, while the minimum (0.137 IU g^{-1}) was in G_{13}. Vitamin A functions as a precursor to antioxidant compounds, including β-carotene, which contribute to reducing oxidative stress during pathogen attacks and help maintain cellular integrity against fungal colonization. As a lipophilic antioxidant, vitamin A operates synergistically with other non-enzymatic antioxidants to neutralize reactive oxygen species (ROS) generated during pathogenic stress responses. The significant variation in vitamin A content among brinjal genotypes highlights its importance as a breeding target for developing phomopsis blight-resistant and nutritionally enriched varieties. Early studies by Bajaj *et al.* (1979) demonstrated that brinjal cultivars exhibit considerable nutritional heterogeneity, with variation in carotenoid and antioxidant content contributing to differential stress tolerance. Genotypes like G_{32}, with elevated vitamin A content, potentially support enhanced resilience against phomopsis blight by strengthening cellular antioxidant defenses and reducing oxidative damage during fungal infection.

4.2.4.5 Total anthocyanin (mg 100 g^{-1})

Results regarding total anthocyanin revealed significant difference among genotypes (Table 4.2.15). The maximum (690.37 mg per 100 g) total anthocyanin was found in G_{32}, whereas minimum (18.30 mg per 100 g) was noted in G_{13}. Total anthocyanin content plays a critical role in phomopsis blight resistance due to its antioxidant properties, which mitigate oxidative stress during infection. High-anthocyanin genotypes, like G_{32}, enhance disease tolerance and nutritional value, making them ideal for breeding resilient brinjal varieties. These outcomes align with the studies of Koley *et al.* (2019); Harisha *et al.* (2023) and Kumari *et al.* (2023) in brinjal genotypes.

4.2.4.6 Total protein (%)

The data regarding total protein has shown in Table 4.2.15 which states a sufficient differences among genotypes. The highest (1.75%) total protein was noticed in G_{32} and minimum (0.53%) was recorded in G_{33}. This trait contributes to both nutrition and defense against phomopsis blight. High-protein genotypes, like G_{32}, support stronger defense mechanisms by producing resistance-related proteins, reducing disease impact. This dual benefit of disease resilience and nutritional value makes protein content a key trait for breeding blight-resistant brinjal varieties. The significant variation in protein content underscores its importance as a trait for breeding brinjal varieties with enhanced resistance to phomopsis blight, ensuring better yields and sustainable production.

4.2.4.7 Total phenol content (mg GAE g^{-1} DW)

The relevant data to total phenol indicated in Table 4.2.16 demonstrated substantial variation in across various genotypes. The maximum (0.718 mg GAE g^{-1} DW) total phenol was recorded for G_{32} and minimum (0.189 mg GAE g^{-1} DW) for in G_{33}. Total phenol content is key to brinjal's defense against phomopsis blight, with higher levels enhancing resistance through antioxidant activity and pathogen inhibition. Genotypes like G_{32}, with higher phenol content, offer greater resilience and reduced fungicide reliance, supporting sustainable farming. This variation highlights phenol content as a vital trait for breeding blight-resistant varieties. These outcomes align with the studies of Patel *et al.* (2013); Kaur *et al.* (2014); Koley *et al.* (2019); Nandi *et al.* (2021) and Kumari *et al.* (2023) in brinjal genotypes.

4.2.4.8 Proline content (mg g^{-1} DW)

Significant variation was observed in proline content among the evaluated genotypes and is presented in Table 4.2.16. The maximum proline content (8.69 mg g^{-1} DW) was recorded in G_{32}, followed closely by G_{31} (8.36 mg g^{-1} DW), while the minimum (5.23 mg g^{-1} DW) was observed in G_{18}. The proximity of proline values in G_{32} and G_{31} suggests these genotypes possess similar biochemical mechanisms for stress tolerance and physiological resilience under adverse conditions. Proline content serves as a critical biochemical parameter and stress biomarker that accumulates in plant tissues during biotic and abiotic stress exposure (Singh *et al.*, 2017; El Moukhtari *et al.,* 2020; Hai *et al.,* 2024 and Cebeci *et al.,* 2025). The elevated proline content in G_{32} and G_{31} indicates enhanced osmoprotective capacity, enabling these genotypes to stabilize proteins, scavenge reactive oxygen species (ROS), and maintain cellular homeostasis during pathogen infection. As an organic osmolyte, proline reduces cellular osmotic potential, thereby enhancing water retention and turgor pressure maintenance, physiological adaptations essential for resistance to phomopsis blight. The substantial variation in proline content across genotypes (5.23–8.69 mg g^{-1} DW) underscores its potential utility as a biochemical marker for selecting stress-tolerant genotypes in breeding programs. Genotypes G_{32} and G_{31}, with superior proline accumulation capacity, possess strengthened natural defense mechanisms, potentially reducing dependence on chemical fungicides and supporting environmentally sustainable cultivation practices. These findings align with those reported by Attia *et al.*, 2022 and Cebeci *et al.*, 2025 in eggplant, demonstrating proline's significance as a physiological indicator of disease resistance potential in *Solanum* species.

4.2.4.9 Ash content (%)

The data on ash content has depicted in Table 4.2.16. The analysis indicates significant difference in ash content among brinjal genotypes. The highest (8.29%) ash content was recorded in G_{31} and minimum (5.29%) was found in G_{33}. Ash content serves as an important biochemical parameter in evaluating the quality and nutritional composition of brinjal genotypes. The reason behind might be the genetic diversity & potential for targeted breeding programs. High ash content can also contribute to the plant's resilience, as minerals play a crucial role in physiological processes and stress responses. The findings can guide growers in adopting genotypes that align with consumer trends and enhance their competitive edge in the brinjal industry. These findings are in concordance with the observations of Dar *et al.* (2014) and Mohamed *et al.* (2019) in brinjal.

4.3 Morphological observation

The details related to the morphological observations of brinjal genotypes for various characteristics is presented in Table 4.3.

Table 4.2.15 Mean performance of brinjal genotypes for vitamin A (IU g^{-1}), total anthocyanin (mg 100 g^{-1}) and total protein (%) in the year 2022

Genotypes	Vitamin A (IU g^{-1})			Total anthocyanin (mg 100 g^{-1})			Total protein (%)		
	Spring-summer season	*Kharif* season	Pooled	Spring-summer season	*Kharif* season	Pooled	Spring-summer season	*Kharif* season	Pooled
G_1	0.178	0.188	0.183	23.79	23.84	23.82	0.98	0.89	0.94
G_2	0.158	0.139	0.149	24.18	24.69	24.44	0.61	0.68	0.65
G_3	0.198	0.179	0.189	24.55	24.12	24.34	0.64	0.63	0.64
G_4	0.225	0.201	0.213	25.32	25.55	25.44	0.78	0.84	0.81
G_5	0.215	0.193	0.204	25.27	25.50	25.39	0.69	0.83	0.76
G_6	0.197	0.187	0.192	25.48	24.96	25.22	0.81	0.85	0.83
G_7	0.192	0.174	0.183	23.96	24.44	24.20	0.62	0.6	0.61
G_8	0.168	0.138	0.153	24.37	24.29	24.33	0.65	0.58	0.62
G_9	0.214	0.181	0.198	25.12	25.45	25.29	0.78	0.75	0.77
G_{10}	0.199	0.178	0.189	25.11	25.40	25.26	0.71	0.65	0.68
G_{11}	0.176	0.169	0.173	24.5	24.92	24.71	0.65	0.63	0.64
G_{12}	0.211	0.201	0.206	24.52	25.48	25.00	0.81	0.78	0.80
G_{13}	0.138	0.135	0.137	18.47	18.12	18.30	0.56	0.54	0.55
G_{14}	0.225	0.212	0.219	25.14	25.48	25.31	0.72	0.76	0.74
G_{15}	0.235	0.216	0.226	24.66	24.96	24.81	0.83	0.83	0.83
G_{16}	0.245	0.218	0.232	25.06	25.40	25.23	0.92	0.96	0.94
G_{17}	0.221	0.209	0.215	21.11	21.87	21.49	0.64	0.69	0.67
G_{18}	0.148	0.151	0.150	25.45	25.03	25.24	0.71	0.78	0.75
G_{19}	0.195	0.185	0.190	25.12	24.00	24.56	0.94	0.95	0.95
G_{20}	0.183	0.189	0.186	24.29	24.52	24.41	0.94	0.92	0.93
G_{21}	0.235	0.221	0.228	21.01	20.55	20.78	0.71	0.75	0.73
G_{22}	0.239	0.226	0.233	24.56	24.88	24.72	0.97	0.93	0.95
G_{23}	0.158	0.142	0.150	24.12	24.45	24.29	0.88	0.87	0.88
G_{24}	0.212	0.204	0.208	21.14	21.58	21.36	0.87	0.9	0.89
G_{25}	0.216	0.210	0.213	22.08	22.48	22.28	0.92	0.91	0.92
G_{26}	0.255	0.232	0.244	25.12	24.78	24.95	0.65	0.61	0.63
G_{27}	0.250	0.229	0.240	25.10	25.62	25.36	0.75	0.76	0.76
G_{28}	0.214	0.206	0.210	24.58	25.06	24.82	0.85	0.84	0.85
G_{29}	0.179	0.178	0.179	23.82	24.25	24.04	0.94	0.93	0.94
G_{30}	0.245	0.244	0.245	22.95	22.72	22.84	0.85	0.88	0.87
G_{31}	0.248	0.252	0.250	320.80	320.89	320.85	1.6	1.85	1.73
G_{32}	0.285	0.284	0.285	690.33	690.40	690.37	1.62	1.88	1.75
G_{33}	0.169	0.168	0.169	477.31	477.23	477.27	0.58	0.48	0.53
SEm (±)	0.00	0.00	0.00	2.25	2.15	2.22	0.01	0.01	0.01
CD (P=0.05)	0.01	0.01	0.01	6.48	6.06	4.03	0.04	0.04	0.03
CV (%)	2.84	2.76	2.79	5.82	5.54	5.74	2.66	2.62	2.63

Table 4.2.16 Mean performance of brinjal genotypes for total phenol (mg GAE g^{-1} DW), proline (mg g^{-1} DW) and ash content (%) in the year 2022

Genotypes	Total phenol (mg GAE g^{-1} DW)			Proline content (mg g^{-1} DW)			Ash content (%)		
	Spring-summer season	*Kharif* season	Pooled	Spring-summer season	*Kharif* season	Pooled	Spring-summer season	*Kharif* season	Pooled
G_1	0.204	0.212	0.208	5.85	6.28	6.07	5.50	5.98	5.74
G_2	0.345	0.325	0.335	5.56	6.00	5.78	6.35	5.88	6.12
G_3	0.320	0.345	0.333	6.45	6.11	6.28	5.78	6.45	6.12
G_4	0.380	0.395	0.388	6.98	6.85	6.92	6.61	7.05	6.83
G_5	0.356	0.385	0.371	6.52	6.79	6.66	6.58	6.97	6.78
G_6	0.405	0.408	0.407	6.85	7.38	7.12	5.12	5.48	5.30
G_7	0.378	0.352	0.365	6.11	6.48	6.30	7.23	6.95	7.09
G_8	0.364	0.365	0.365	7.15	6.78	6.97	6.15	5.86	6.01
G_9	0.367	0.378	0.373	6.51	6.78	6.65	6.54	6.66	6.60
G_{10}	0.351	0.349	0.350	6.45	6.58	6.52	6.17	6.48	6.33
G_{11}	0.410	0.418	0.414	7.02	7.38	7.20	5.41	5.49	5.45
G_{12}	0.404	0.407	0.406	6.00	6.39	6.20	7.15	7.38	7.27
G_{13}	0.198	0.203	0.201	5.10	5.47	5.29	5.48	5.16	5.32
G_{14}	0.371	0.374	0.373	6.89	6.85	6.87	6.18	6.48	6.33
G_{15}	0.398	0.400	0.399	7.39	7.48	7.44	5.60	6.18	5.89
G_{16}	0.337	0.375	0.356	6.50	6.98	6.74	6.12	6.45	6.29
G_{17}	0.370	0.355	0.363	7.11	7.45	7.28	5.25	5.89	5.57
G_{18}	0.412	0.408	0.410	5.00	5.46	5.23	7.15	6.56	6.86
G_{19}	0.391	0.374	0.383	6.25	6.85	6.55	6.67	7.48	7.08
G_{20}	0.409	0.428	0.419	7.12	7.45	7.29	5.65	5.88	5.77
G_{21}	0.416	0.439	0.428	5.20	5.49	5.35	6.85	7.45	7.15
G_{22}	0.390	0.384	0.387	7.11	7.48	7.30	7.76	7.50	7.63
G_{23}	0.400	0.428	0.414	7.01	6.85	6.93	7.25	6.78	7.02
G_{24}	0.384	0.377	0.381	7.22	7.40	7.31	7.25	7.88	7.57
G_{25}	0.366	0.359	0.363	5.51	5.95	5.73	7.15	7.48	7.32
G_{26}	0.414	0.438	0.426	6.58	7.10	6.84	7.14	7.48	7.31
G_{27}	0.395	0.412	0.404	7.44	7.05	7.25	6.72	6.97	6.85
G_{28}	0.387	0.357	0.372	7.10	7.46	7.28	6.84	7.38	7.11
G_{29}	0.396	0.421	0.409	6.12	6.42	6.27	6.68	7.12	6.90
G_{30}	0.402	0.418	0.410	7.00	7.36	7.18	6.85	6.87	6.86
G_{31}	0.630	0.658	0.644	8.23	8.48	8.36	8.12	8.45	8.29
G_{32}	0.714	0.722	0.718	8.52	8.86	8.69	7.56	8.36	7.96
G_{33}	0.180	0.198	0.189	5.46	5.11	5.29	5.12	5.45	5.29
SEm (±)	0.01	0.01	0.01	0.10	0.10	0.10	0.10	0.10	0.10
CD (P=0.05)	0.02	0.02	0.01	0.28	0.27	0.19	0.28	0.28	0.18
CV (%)	2.82	2.93	2.85	2.53	2.43	2.49	2.62	2.58	2.60

Table 4.3 Morphological observations for fruit shape, fruit colour, calyx spininess and leaf spininess of brinjal genotypes in the year 2022

Genotypes	Fruit shape	Fruit colour	Calyx spininess	Leaf spininess
G_1	Ovoid	Purple	Weak	Present
G_2	Cylindrical	Purple	Absent	Absent
G_3	Globular	Purple	Absent	Absent
G_4	Cylindrical	Purple	Weak	Present
G_5	Cylindrical	Purple	Weak	Present
G_6	Ovoid	Purple	Absent	Absent
G_7	Ellipsoid	Purple	Weak	Present
G_8	Cylindrical	Purple	Absent	Absent
G_9	Cylindrical	Purple	Weak	Present
G_{10}	Cylindrical	Purple	Weak	Absent
G_{11}	Globular	Purple	Absent	Absent
G_{12}	Ovoid	Purple	Absent	Absent
G_{13}	Cylindrical	Purple	Absent	Absent
G_{14}	Globular	Purple	Weak	Present
G_{15}	Ovoid	Purple	Medium	Present
G_{16}	Cylindrical	Purple	Absent	Absent
G_{17}	Ovoid	Purple	Weak	Present
G_{18}	Cylindrical	Purple	Absent	Absent
G_{19}	Ellipsoid	Purple	Absent	Absent
G_{20}	Globular	Purple	Weak	Present
G_{21}	Cylindrical	Purple	Weak	Present
G_{22}	Ovoid	Purple	Weak	Present
G_{23}	Ovoid	Purple	Absent	Absent
G_{24}	Globular	Purple	Absent	Absent
G_{25}	Cylindrical	Purple	Absent	Absent
G_{26}	Ovoid	Purple	Weak	Present
G_{27}	Ellipsoid	Purple	Absent	Absent
G_{28}	Ovoid	Purple	Absent	Absent
G_{29}	Cylindrical	Purple	Absent	Absent
G_{30}	Globular	Purple	Absent	Absent
G_{31}	Ellipsoid	Purple	Absent	Absent
G_{32}	Cylindrical	Purple	Absent	Absent
G_{33}	Globular	Purple	Absent	Absent

4.4 Variability studies of brinjal genotypes in the year 2022

4.4.1 Phenotypic correlation coefficient analysis (pooled over seasons of the year 2022)

The results related to phenotypic correlation coefficient analysis, pooled over season of the year 2022 has been presented in the Table 4.4.1 and described for the following considered parameters;

4.4.1.1 Percent leaf incidence (PLI) (%)

PLI showed a highly significant positive correlation with percent disease index-for leaf at 21st DAI (0.873), PFI (0.871), PDI-for fruit 21st DAI (0.861), PFAD (0.809), PLAD (0.803), lesion size on fruits (0.623), days to 50% seed emergence (0.383) and days to 50% flowering (0.288). Conversely, highly significant negative correlation with fruit yield plot^{-1} (-0.479), plant height at final harvest (-0.458), internodal length of plant at final harvest (-0.402), total number of nodes at final harvest (-0.396), number of primary branches plant^{-1} at final harvest (-0.395) and peduncle length (-0.290). However, a significant negative correlation was observed with total number of long styled flower (-0.240), leaf area (-0.226) and total number of medium styled flower (-0.206).

4.4.1.2 Percent fruit incidence (PFI) (%)

It showed a highly significant positive correlation with PDI-for fruit 21st DAI (0.845), percent PDI-for leaf at 21st DAI (0.835), PFAD (0.819), PLAD (0.735), lesion size on fruits (0.701), days to 50% seed emergence (0.414), petiole length (0.302) and had significant positive correlation with days to 50% flowering (0.251). However, it showed highly significant negative correlation with fruit yield plot^{-1} (-0.544), plant height at final harvest (-0.452), number of primary branches plant^{-1} at final harvest (-0.425), total number of nodes at final harvest (-0.349), total number of long styled flower (-0.328), internodal length of plant at final harvest (-0.304), peduncle length (-0.286) and had a significant negative correlation with leaf area (-0.257).

4.4.1.3 Percent leaf area diseased (PLAD)-eye estimation (%)

This trait showed a highly significant and positive correlation with percent fruit area diseased PFAD (0.804), PDI-for fruit 21^{st} DAI (0.798), PDI-for leaf at 21^{st} DAI (0.786), lesion size on fruits (0.634), days to 50% seed emergence (0.405), days to 50% flowering (0.328) and also had significant positive correlation with and petiole length (0.246). Conversely, it had a highly significant negative correlation with fruit yield plot^{-1} (-0.432), plant height at final harvest (-0.363), total number of nodes at final harvest & internodal length of plant at final harvest (-0.304), number of primary branches plant-1 at final harvest (-0.302), and also showed a significant negative correlation with total number of long styled flower (-0.223) and peduncle length (-0.215).

4.4.1.4 Percent fruit area diseased (PFAD)-eye estimation (%)

It exhibited a highly significant positive correlation with PDI-for leaf at 21^{st} DAI (0.919), PDI-for fruit 21^{st} DAI (0.908), lesion size on fruits (0.846) and days to 50% seed emergence (0.332). Additionally, it showed a highly significant negative correlation with fruit yield plot^{-1} (-0.386), plant height at final harvest (-0.322), number of primary branches plant^{-1} at final harvest (-0.297), total number of nodes at final harvest (-0.276), peduncle length (-0.262), and also had a significant negative correlation with leaf area (-0.227), internodal length of plant at final harvest (-0.222) and total number of long styled flower (-0.214).

4.4.1.5 Percent disease index (PDI)-for leaf at 21^{st} DAI (%)

It had highly positive significant correlation with PDI-for fruit 21^{st} DAI (0.973), lesion size on fruits (0.727) and days to 50% seed emergence (0.371). However, it showed highly significant negative correlation with fruit yield plot^{-1} (-0.498), plant height at final harvest (-0.389), total number of nodes at final harvest (-0.382), number of primary branches per plant at final harvest (-0.359), total number of long styled flower (-0.345) and internodal length of plant at final harvest (-0.301).

4.4.1.6 Percent disease index (PDI)-for fruit 21st DAI (%)

It exhibited a highly significant positive correlation with lesion size on fruits (0.783), days to 50% seed emergence (0.356) and had positive significant correlation with days to 50 % flowering (0.235). Additionally, it showed highly significant negative correlation with fruit yield plot^{-1} (-0.483), plant height at final harvest (-0.388), total number of nodes at final harvest (-0.381), total number of long styled flower (-0.367), number of primary branches plant^{-1} at final harvest (-0.363) and demonstrated a significant negative correlation plant height at final harvest (-0.301) and internodal length of plant at final harvest (-0.294).

4.4.1.7 Lesion size on fruits (cm^2)

It exhibited a significant positive correlation with stem diameter (0.227) and negative significant correlation with fruit yield plot^{-1} (-0.204) and leaf area (-0.208).

4.4.1.8 Days to 50% seed emergence (DAS)

This character showed a highly significant positive correlation with petiole length (0.664) and days to 50% flowering (0.368). Also, it had highly significant negative correlation with fruit yield plot^{-1} (-0.559), plant height at final harvest (-0.533), total number of long styled flower (-0.525), number of primary branches plant^{-1} at final harvest (-0.490), total number of nodes at final harvest (-0.439), total number of medium styled flower (-0.434), and had a significant negative correlation with peduncle length (-0.250) and internodal length of plant at final harvest (-0.245).

4.4.1.9 Plant height at final harvest (cm)

This trait showed highly significant positive correlation with total number of nodes at final harvest (0.878), fruit yield plot^{-1} (0.809), number of primary branches per plant at final harvest (0.804), internodal length of plant at final harvest (0.780), total number of long styled flower (0.648), peduncle length (0.588), stem diameter (0.433), total number of medium styled flower (0.426) and leaf area (0.336). However, it had highly significant negative correlation with petiole length (-0.634) and days to 50% flowering (-0.578).

4.4.1.10 Number of primary branches plant^{-1} at final harvest

It had showed highly significant and positive correlation with fruit yield per plot (0.840), total number of nodes at final harvest (0.669), internodal length of plant at final harvest (0.662), peduncle length (0.620), total number of long styled flower (0.615), leaf area (0.552), stem diameter (0.400) and total number of medium styled flower (0.344). However, it showed a highly significant and negative correlation with petiole length (-0.581) and days to 50% flowering (-0.566).

4.4.1.11 Total number of nodes at final harvest

It exhibited a highly significant and positive correlation with internodal length of plant at final harvest (0.787), fruit yield plot^{-1} (0.674), total number of long styled flower (0.657), peduncle length (0.510), stem diameter (0.455), total number of medium styled flower (0.368) and leaf area (0.320). It showed a highly significant negative correlation with petiole length (-0.470) and days to 50% flowering (-0.444).

4.4.1.12 Internodal length of plant at final harvest (cm)

This character showed a highly significant and positive correlation with fruit yield plot^{-1} (0.607), peduncle length (0.545), stem diameter (0.449), leaf area (0.424), total number of long styled flower (0.419) and total number of medium styled flower (0.330). Conversely, it showed a highly significant and negative correlation with days to 50% flowering (-0.491) and petiole length (-0.323).

4.4.1.13 Stem diameter (cm)

It showed a highly significant and positive correlation with leaf area (0.451), fruit yield plot^{-1} (0.375), total number of long styled flower (0.350) and total number of medium styled flower (0.312). Additionally, it had a significant negative correlation with petiole length (-0.297) and days to 50% flowering (-0.269).

4.4.1.14 Peduncle length (cm)

It exhibited highly significant and positive correlation with fruit yield plot^{-1} (0.521), leaf area (0.494), total number of long styled flower (0.453), total number of medium styled flower (0.289) and also showed a significant positive correlation with. It had a highly significant and negative correlation with days to 50% flowering (-0.298) and also had significant negative correlation with petiole length (-0.212).

4.4.1.15 Petiole length (cm)

It showed a highly significant and positive correlation with days to 50% flowering (0.550) and also had a highly significant negative correlation with fruit yield plot^{-1} (-0.640), total number of long styled flower (-0.472) and total number of medium styled flower (-0.329).

4.4.1.16 Leaf area (cm^2)

This trait showed a highly significant and positive correlation with fruit yield plot^{-1} (0.384) and had positive significant correlation with total number of long style flower (0.200). It had a significant negative correlation with days to 50% flowering (-0.253).

4.4.1.17 Days to 50% flowering (DAT)

It exhibited showed a highly significant and negative correlation with fruit yield plot^{-1} (-0.650) and total number of long styled flower (-0.552).

4.4.1.18 Total number of long styled flower

It showed a highly significant and positive correlation with fruit yield plot^{-1} (0.768) and total number of medium styled flower (0.441).

4.4.1.19 Total number of medium styled flower

This trait showed a significant and positive correlation with fruit yield plot^{-1} (0.402).

4.4.1.20 Number of node to first fruiting

The number of node to first fruiting showed highly significant and positive correlation with total anthocyanin (0.682), fruit yield plant^{-1} (0.639), fruit length (0.608), fruit yield plot^{-1} (0.559), total number of fruits plant^{-1} (0.547), total protein (0.517), average fruit weight (0.445), fruit yield hectare^{-1} (0.421), total phenols (0.337), ascorbic acid (0.313), proline content (0.269), total chlorophyll content (0.267) and also had a significant positive correlation with vitamin A (0.198). However, it showed a highly significant negative correlation with days to first fruit set (-0.342) and days to first picking of fruits (-0.313).

4.4.1.21 Days to first fruit set (DAT)

It exhibited a highly significant positive correlation with days to first picking of fruits (0.829). While, this trait had highly significant negative correlation with average fruit weight (-0.567), fruit length (-0.565), fruit yield plant^{-1} (-0.558), fruit yield plot^{-1} (-0.557), total number of fruits plant^{-1} (-0.528), total anthocyanin (-0.474) and fruit yield hectare^{-1} (-0.452).

4.4.1.22 Days to first picking of fruits (DAT)

It showed a highly significant negative correlation with total number of fruits plant^{-1} (-0.640), fruit yield plot^{-1} (-0.637), fruit yield hectare^{-1} (-0.612), fruit yield plant^{-1} (-0.582), fruit length (-0.560), average fruit weight (-0.509) and total anthocyanin (-0.385).

4.4.1.23 Total number of fruits plant^{-1}

The total number of fruits plant^{-1} showed a highly significant positive correlation with fruit yield plot^{-1} (0.895), fruit yield hectare^{-1} (0.841), fruit yield plant^{-1} (0.836), fruit length (0.731), total anthocyanin (0.683), average fruit weight (0.637), total protein (0.430), ascorbic acid (0.357), total phenols (0.307) and also had a significant positive correlation with proline content (0.230) and vitamin A (0.221).

4.4.1.24 Average fruit weight (g)

It showed highly significant positive correlation with fruit yield plant^{-1} (0.879), fruit length (0.865), fruit yield plot^{-1} (0.839), total anthocyanin (0.754), fruit yield hectare^{-1} (0.668), total protein (0.590), total phenols (0.483), total chlorophyll content (0.401), proline content (0.364), vitamin A (0.275), ascorbic acid (0.268), ash content (0.263) and had a significant positive correlation with fruit diameter (0.236).

4.4.1.25 Fruit length (cm)

This trait showed a highly significant and positive correlation with fruit yield plant^{-1} (0.895), fruit yield plot^{-1} (0.860), total anthocyanin (0.807), total protein (0.732), fruit yield hectare^{-1} (0.698), total phenols (0.596), proline content (0.465), total chlorophyll content (0.424), ascorbic acid (0.394), ash content (0.368), vitamin A (0.354) and had a significant positive correlation with fruit diameter (0.219).

4.4.1.26 Fruit diameter (cm)

Fruit diameter had highly significant positive correlation with ash content (0.410), total protein (0.275), vitamin A (0.274) and also showed the significant correlation with total chlorophyll content (0.228) and total phenols (0.216).

4.4.1.27 Fruit yield plant^{-1} (kg)

It showed highly significant positive correlation with fruit yield plot^{-1} (0.944), total anthocyanin (0.888), fruit yield hectare^{-1} (0.791), total protein (0.589), total phenols (0.433), ascorbic acid (0.353), vitamin A (0.322), proline content (0.304), total chlorophyll content (0.266) and had a significant positive correlation with ash content (0.200).

4.4.1.28 Fruit yield hectare^{-1} (q)

This trait showed a highly significant and positive correlation with fruit yield plot^{-1} (0.922), total anthocyanin (0.548), total protein (0.365) and also showed the significant positive correlation with total phenols (0.257) and proline content (0.222).

4.4.1.29 Total chlorophyll content (mg g^{-1})

It showed a highly significant positive correlation with total phenols (0.774), total protein (0.721), proline content (0.574), vitamin A (0.539), ascorbic acid (0.529), ash content (0.518), total soluble solids (0.502) and total anthocyanin (0.403).

4.4.1.30 Total soluble solids (°Brix)

This trait showed a highly significant positive correlation with total phenols (0.452), ash content (0.329), total protein (0.315), ascorbic acid (0.275), total anthocyanin (0.266), proline content (0.260) and also had a significant positive correlation with vitamin A (0.247).

4.4.1.31 Ascorbic acid (mg 100 g^{-1})

It showed a highly significant and positive correlation with total phenols (0.733), total protein (0.611), vitamin A (0.533), proline content (0.427), ash content (0.391), total anthocyanin (0.365) and fruit yield $plot^{-1}$ (0.292).

4.4.1.32 Vitamin A (IU g^{-1})

This trait showed a highly significant correlation with total phenols (0.619), proline content (0.618), total protein (0.585), ash content (0.553), total anthocyanin (0.351) and fruit yield $plot^{-1}$ (0.272).

4.4.1.33 Total anthocyanin (mg 100 g^{-1})

It exhibited a highly significant and positive correlation with fruit yield $plot^{-1}$ (0.782), total protein (0.602), total phenols (0.461), proline content (0.312) and also had a significant positive correlation with and ash content (0.217).

4.4.1.34 Total protein (%)

Total protein content showed a highly significant and positive correlation with total phenols (0.789), proline content (0.640), ash content (0.597) and fruit yield $plot^{-1}$ (0.528).

4.4.1.35 Total phenols (mg GAE g^{-1} DW)

This trait showed a highly significant positive correlation with proline content (0.703), ash content (0.646) and fruit yield $plot^{-1}$ (0.393).

4.4.1.36 Proline content (mg g^{-1} DW)

It showed a highly significant positive correlation with ash content (0.331) and fruit yield $plot^{-1}$ (0.320).

4.4.1.37 Ash content (%)

It showed a significant positive correlation with fruit yield $plot^{-1}$ (0.173).

Fruit yield in brinjal represents a complex quantitative trait shaped by numerous genetic and environmental interactions across different developmental stages, with phenotypic correlations revealing distinct association patterns among morphological, phenological, agronomic, and biochemical traits. Pooled phenotypic correlation analysis demonstrated that the dependent variable, fruit yield $plot^{-1}$ (kg), exhibited highly significant negative associations with disease parameters (PLI, PFI, PDI for leaf and fruit, and PLAD), indicating that reduced disease burden directly protected yield-determining organs and preserved photosynthetic and reproductive tissues, thereby enhancing plot-level productivity. These findings are consistent with Sujin et al. (2017), who reported that pest incidence significantly compromises fruit yield $plant^{-1}$. Earliness traits (days to 50% seed emergence, days to 50% flowering, and days to first fruit picking) showed highly significant negative correlations with fruit yield $plot^{-1}$, reflecting earlier maturity (reduction in time, attaining of fruiting period) within defined growing seasons; conversely, earlier-flowering genotypes possessed extended reproductive periods enabling greater fruit set and accumulation, aligning with Mangi *et al.* (2017), who reported significant negative phenotypic correlations between yield per plant and days to first flowering (-0.302) and days to 50% flowering (-0.272). Most morphological growth traits exhibited highly significant positive phenotypic correlations with fruit yield per plot, particularly plant height, number of primary branches per plant, and total nodes per plant, reflecting enhanced vegetative vigour and biomass accumulation supporting greater reproductive output, corroborated by Mangi *et al.* (2017) reporting positive phenotypic correlations of total yield per plant with plant height (0.385), plant spread (0.660), and primary branches (0.545); notably, petiole length exhibited a highly significant negative correlation, suggesting unfavourable resource allocation patterns toward vegetative growth at the expense of reproduction. Yield component traits (average fruit weight, fruit length, fruit yield per plant, fruit yield per hectare) demonstrated highly significant positive phenotypic correlations with fruit yield per plot, reflecting direct multiplicative effects wherein G_{32}'s superior per-plant yield (3.78 kg/plant) contributed to plot-level productivity (26.51 kg/plot) compared to G_7 (1.09 kg/plant and 7.01 kg/plot, respectively). Biochemical quality traits (ascorbic acid, vitamin A, total anthocyanin, total proteins, total phenolic compounds, and free proline) exhibited highly significant positive phenotypic correlations with fruit yield per plot, indicating that genotypes accumulating higher concentrations of these antioxidants and osmoprotectants simultaneously achieved superior fruit yield through enhanced physiological resilience under disease stress, exemplified by G_{32} recording maximum fruit yield per plot (26.51 kg) while simultaneously exhibiting maximum proline content (8.69 mg g^{-1} DW) and vitamin A (0.285 IU g^{-1}), demonstrating that yield and quality are complementary traits. Narrow differences between genotypic and phenotypic correlation coefficients, as reported by Mangi et al. (2017), indicate minimal environmental influence on trait expression and presence of strong inherent associations among characters, validating phenotypic selection reliability. Collectively, these phenotypic correlation patterns establish that integrated selection for disease-resistant genotypes with superior plant architecture, high fruit-bearing capacity, extended reproductive periods, and elevated biochemical quality markers represents the optimal strategy for achieving substantial yield improvements in brinjal cultivation under diverse environmental and disease-prone conditions.

Table 4.4.1 Phenotypic correlation coefficient analysis for various traits in brinjal genotypes (pooled over seasons of the year 2022)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	**1**	0.871**	0.804**	0.809**	0.873**	0.861**	0.623**	0.383**	-0.458**	-0.395**	-0.396**	-0.402**	0.015	-0.290**	0.195	-0.226*	0.288**	-0.240*	-0.206*	-0.479**
2		**1**	0.735**	0.819**	0.835**	0.845**	0.701**	0.414**	-0.452**	-0.425**	-0.349**	-0.304**	0.043	-0.286**	0.302**	-0.257*	0.251*	-0.328**	-0.104	-0.544**
3			**1**	0.804**	0.786**	0.798**	0.634**	0.405**	-0.363**	-0.302**	-0.304**	-0.304**	0.005	-0.215*	0.246*	-0.194	0.328**	-0.223*	-0.132	-0.432**
4				**1**	0.919**	0.908**	0.846**	0.332**	-0.322**	-0.297**	-0.276**	-0.222*	0.103	-0.262**	0.068	-0.227*	0.113	-0.214*	-0.066	-0.386**
5					**1**	0.973**	0.727**	0.371**	-0.389**	-0.359**	-0.382**	-0.301**	0.025	-0.182	0.156	-0.195	0.193	-0.345**	-0.134	-0.498**
6						**1**	0.783**	0.356**	-0.388**	-0.363**	-0.381**	-0.294**	0.022	-0.169	0.159	-0.197	0.235*	-0.367**	-0.138	-0.483**
7							**1**	0.114	-0.149	-0.129	-0.167	-0.040	0.227*	-0.088	-0.074	-0.208*	0.046	-0.123	0.079	-0.204*
8								**1**	-0.533**	-0.490**	-0.439**	-0.245*	-0.166	-0.250*	0.664**	0.108	0.368**	-0.525**	-0.434**	-0.559**
9									**1**	0.804**	0.878**	0.780**	0.433**	0.588**	-0.634**	0.336**	-0.578**	0.648**	0.426**	0.809**
10										**1**	0.669**	0.662**	0.400**	0.620**	-0.581**	0.552**	-0.566**	0.615**	0.344**	0.840**
11											**1**	0.787**	0.455**	0.510**	-0.470**	0.320**	-0.444**	0.657**	0.368**	0.674**
12												**1**	0.449**	0.545**	-0.395**	0.424**	-0.491**	0.419**	0.330**	0.607**
13													**1**	0.189	-0.323**	0.451**	-0.269**	0.350**	0.312**	0.375**
14														**1**	-0.212*	0.494**	-0.298**	0.453**	0.289**	0.521**
15															**1**	-0.019	0.550**	-0.472**	-0.329**	-0.640**
16																**1**	-0.253*	0.200*	-0.158	0.384**
17																	**1**	-0.552**	-0.175	-0.650**
18																		**1**	0.441**	0.768**
19																			**1**	0.402**
20																				**1**

**** indicating 1% level of significance with R-critical value of ±0.198; * indicating 5% level of significance with R-critical value of ±0.265**

1. Percent leaf incidence (PLI) (%)
2. Percent fruit incidence (PFI) (%)
3. Percent leaf area diseased (PLAD)-eye estimation (%)
4. Percent fruit area diseased (PFAD)-eye estimation (%)
5. Percent disease index (PDI)-for leaf at 21st DAI (%)
6. Percent disease index (PDI)-for fruit 21st DAI (%)
7. Lesion size on fruits (cm^2)
8. Days to 50% seed emergence (DAS)
9. Plant height at final harvest (cm)
10. Number of primary branches $plant^{-1}$ at final harvest
11. Total number of nodes at final harvest
12. Internodal length of plant at final harvest (cm)
13. Stem diameter (cm)
14. Peduncle length (cm)
15. Petiole length (cm)
16. Leaf area (cm^2)
17. Days to 50% flowering (DAT)
18. Total number of long styled flower
19. Total number of medium styled flower
20. Fruit yield $plot^{-1}$ (kg)

Continue……

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	**1**	-0.342**	-0.313**	0.547**	0.445**	0.608**	0.165	0.639**	0.421**	0.267**	0.188	0.313**	0.198*	0.682**	0.517**	0.337**	0.269**	0.089	0.559**
2		**1**	0.829**	-0.528**	-0.567**	-0.565**	0.159	-0.558**	-0.452**	0.008	0.087	-0.129	-0.078	-0.474**	-0.196	-0.123	-0.149	-0.049	-0.557**
3			**1**	-0.640**	-0.509**	-0.560**	0.109	-0.582**	-0.612**	0.127	0.051	-0.132	-0.088	-0.385**	-0.150	-0.086	-0.069	-0.080	-0.637**
4				**1**	0.637**	0.731**	-0.027	0.836**	0.841**	0.051	0.046	0.357**	0.221*	0.683**	0.430**	0.307**	0.230*	0.100	0.895**
5					**1**	0.865**	0.236*	0.879**	0.668**	0.401**	0.159	0.268**	0.275**	0.754**	0.590**	0.483**	0.364**	0.263**	0.839**
6						**1**	0.219*	0.895**	0.698**	0.424**	0.178	0.394**	0.354**	0.807**	0.732**	0.596**	0.465**	0.368**	0.860**
7							**1**	0.144	0.087	0.228*	-0.072	0.061	0.274**	0.077	0.275**	0.216*	-0.108	0.410**	0.129
8								**1**	0.791**	0.266**	0.195	0.353**	0.322**	0.888**	0.589**	0.433**	0.304**	0.200*	0.944**
9									**1**	-0.033	0.052	0.180	0.156	0.548**	0.365**	0.257*	0.222*	0.055	0.922**
10										**1**	0.502**	0.529**	0.539**	0.403**	0.721**	0.774**	0.574**	0.518**	0.152
11											**1**	0.275**	0.247*	0.266**	0.315**	0.452**	0.260**	0.329**	0.119
12												**1**	0.553**	0.365**	0.611**	0.733**	0.427**	0.391**	0.292**
13													**1**	0.351**	0.585**	0.619**	0.618**	0.553**	0.272**
14														**1**	0.602**	0.461**	0.312**	0.217*	0.782**
15															**1**	0.789**	0.640**	0.597**	0.528**
16																**1**	0.703**	0.646**	0.393**
17																	**1**	0.331**	0.320**
18																		**1**	0.173
19																			**1**

**** indicating 1% level of significance with R-critical value of ±0.198; * indicating 5% level of significance with R-critical value of ±0.265**

1. Number of node to first fruiting
2. Days to first fruit set (DAT)
3. Days to first picking of fruits (DAT)
4. Total number of fruits plant^{-1}
5. Average fruit weight (g)
6. Fruit length (cm)
7. Fruit diameter (cm)
8. Fruit yield plant^{-1} (kg)
9. Fruit yield per hectare (q)
10. Total chlorophyll content (mg g^{-1})
11. Total soluble solids (°Brix)
12. Ascorbic acid (mg 100 g^{-1})
13. Vitamin A (IU g^{-1})
14. Total anthocyanin (mg 100 g^{-1})
15. Total protein (%)
16. Total phenols (mg GAE g^{-1} DW)
17. Proline content (mg g^{-1} DW)
18. Ash content (%)
19. Fruit yield plot^{-1} (kg)

4.4.2 Direct and indirect phenotypic path coefficient analysis for various characters in brinjal genotypes (pooled over season of the year 2022)

Direct and indirect effects of phenotypic path coefficient analysis for pooled over seasons of the year 2022 has been presented in the Table 4.4.2 for various traits in brinjal genotypes.

4.4.2.1 Percent leaf incidence (PLI) (%)

Positive direct effect (0.243) was shown by this character over the dependent character fruit yield plot^{-1}. The maximum positive indirect effect on dependent trait fruit yield plot^{-1} was seen through the parameters like PDI-for fruit at 21st DAI (0.622) followed by PFAD (0.270), total number of nodes at final harvest (0.082), days to 50% seed emergence (DAS) (0.017), leaf area (0.005) and stem diameter (0.000). Whereas the highest negative indirect effect was recorded *via* PDI-for leaf at 21st DAI (-0.883) followed by PFI (-0.228), number of primary branches plant^{-1} at final harvest (-0.147), plant height at final harvest (-0.125), PLAD (-0.111), lesion size on fruits (-0.080), total number of long styled flower (-0.067), days to 50% flowering (DAT) (-0.041), internodal length of plant at final harvest & total number of medium styled flower (-0.012), petiole length (-0.008) and peduncle length (-0.006).

4.4.2.2 Percent fruit incidence (PFI) (%)

This trait had negative direct effect (-0.261) over the dependent character fruit yield plot^{-1}. However, the highest negative indirect effect was observed in followed by PDI-for leaf at 21st DAI (-0.845) followed by number of primary branches plant^{-1} at final harvest (-0.159), plant height at final harvest (-0.123), PLAD (-0.101), total number of long styled flower (-0.091), lesion size on fruits (-0.089), days to 50% flowering (DAT) (-0.036), petiole length (-0.013), internodal length of plant at final harvest (-0.009), total number of medium styled flower (-0.006) and peduncle length (-0.005). While positive indirect effect was noticed by various characters such as, PDI-for fruit at 21st DAI (0.611) followed by PFAD (0.274), PLI (0.212), total number of nodes at final harvest

(0.073), days to 50% seed emergence (DAS) (0.019), leaf area (0.006) and stem diameter (0.002).

4.4.2.3 Percent leaf area diseased (PLAD)-eye estimation (%)

Negative direct effect was seen on the dependent character fruit yield plot^{-1}. by the independent character PLAD (-0.138). Whereas, the maximum negative indirect effects were contributed through the characters like PDI-for leaf at 21st DAI (-0.796) followed by PFI (-0.192), number of primary branches plant^{-1} at final harvest (-0.112), plant height at final harvest (-0.099), lesion size on fruits (-0.081), total number of long styled flower (-0.062), days to 50% flowering (DAT) (-0.047), petiole length (-0.010), internodal length of plant at final harvest (-0.009), total number of medium styled flower (-0.008) and peduncle length (-0.004). While the highest positive indirect effect was observed *via* PDI-for fruit at 21st DAI (0.576) followed by PFAD (0.269), PLI (0.195), total number of nodes at final harvest (0.063), days to 50% seed emergence (DAS) (0.018), leaf area (0.004) and stem diameter (0.000).

4.4.2.4 Percent fruit area diseased (PFAD)-eye estimation (%)

Positive type direct effect (0.334) was reported by PFAD over the dependent trait fruit yield plot^{-1}. Whereas, the maximum positive indirect effect was observed by PDI-for fruit at 21st DAI (0.656) followed by PLI (0.196), total number of nodes at final harvest (0.057), days to 50% seed emergence (DAS) (0.015) and stem diameter & leaf area (0.005). While, the highest negative indirect effects were observed *via* PDI-for leaf at 21st DAI (-0.930) followed by PFI (-0.214), PLAD (-0.111), number of primary branches plant^{-1} at final harvest (-0.110), lesion size on fruits (-0.107), plant height at final harvest (-0.088), total number of long styled flower (-0.060), days to 50% flowering (DAT) (-0.016), internodal length of plant at final harvest (-0.007), peduncle length (-0.005), total number of medium styled flower (-0.004) and petiole length (-0.003).

4.4.2.5 Percent disease index (PDI)-for leaf at 21st DAI (%)

Negative direct effect (-1.012) was shown by the trait PDI-for leaf at 21st DAI over the dependent character fruit yield plot^{-1}. However, the highest negative indirect effects were observed by the characters like PFI (-0.218) followed by number of primary branches plant^{-1} at final harvest (-0.134), PLAD (-0.108), plant height at final harvest (-0.106), total number of long styled flower (-0.096), lesion size on fruits (-0.092), days to 50% flowering (DAT) (-0.027), internodal length of plant at final harvest (-0.009), total number of medium styled flower (-0.008), petiole length (-0.007) and peduncle length (-0.003). While, the maximum positive indirect effect was observed through PDI-for fruit at 21st DAI (0.703) followed by PFAD (0.307), PLI (0.212), total number of nodes at final harvest (0.080), days to 50% seed emergence (DAS) (0.017), leaf area (0.004) and stem diameter (0.001).

4.4.2.6 Percent disease index (PDI)-for fruit at 21st DAI (%)

Positive direct effect (0.723) exerted by the independent trait PDI-for fruit at 21st DAI over the dependent character fruit yield plot^{-1}. While, the maximum positive indirect effect was recorded through PFAD (0.303), PLI (0.209) followed by total number of nodes at final harvest (0.079), days to 50% seed emergence (DAS) (0.016), leaf area (0.004) and stem diameter (0.001). However, the highest negative indirect effect was observed by PDI-for leaf at 21st DAI (-0.985) followed by PFI (-0.221), number of primary branches plant^{-1} at final harvest (-0.135), PLAD (-0.110), plant height at final harvest (-0.106), total number of long styled flower (-0.102), lesion size on fruits (-0.099), days to 50% flowering (DAT) (-0.033), internodal length of plant at final harvest (-0.009), total number of medium styled flower (-0.008), petiole length (-0.007) and peduncle length (-0.003).

4.4.2.7 Lesion size on fruits (cm^2)

Negative direct effect (-0.127) was shown by the trait lesion size on fruits over the dependent character fruit yield plot^{-1}. The maximum indirect negative effect was exerted *via* PDI-for leaf at 21st DAI (-0.736) followed by PFI (-0.183), PLAD (-0.087), number of primary branches plant^{-1} at final harvest (-0.048), plant height at final harvest (-0.040), total number of long styled flower (-0.034), days to 50% flowering (DAT) (-0.007), peduncle length (-0.002) and internodal length of plant at final harvest (-0.001). However, the highest positive indirect effect was noticed by PDI-for fruit at 21st DAI (0.566) followed by PFAD (0.283), PLI (0.151), total number of nodes at final harvest

(0.035), stem diameter (0.010), days to 50% seed emergence (DAS) & leaf area (0.005), total number of medium styled flower (0.004) and petiole length (0.003).

4.4.2.8 Days to 50% seed emergence (DAS)

Positive direct effect (0.045) exerted by the independent character days to 50% seed emergence (DAS) over the dependent trait fruit yield plot^{-1}. While the highest positive indirect effect was observed by PDI-for fruit at 21st DAI (0.257) followed by PFAD (0.111), PLI (0.093) and total number of nodes at final harvest (0.092). Whereas, the maximum negative indirect effect was reported by PDI-for leaf at 21st DAI (-0.376) followed by number of primary branches plant^{-1} at final harvest (-0.183), total number of long styled flower (-0.146), plant height at final harvest (-0.145), PFI (-0.108), PLAD (-0.056), days to 50% flowering (DAT) (-0.052), petiole length (-0.028), total number of medium styled flower (-0.026), lesion size on fruits (-0.014), internodal length of plant at final harvest & stem diameter (-0.008), peduncle length (-0.005) and leaf area (-0.002).

4.4.2.9 Plant height at final harvest (cm)

Positive direct effect (0.272) exerted by the trait plant height at final harvest on the dependent trait fruit yield plot^{-1}. However, the maximum positive indirect effect was seen in PDI-for leaf at 21st DAI (0.394) followed by number of primary branches plant^{-1} at final harvest (0.299), total number of long styled flower (0.180), PFI (0.118), days to 50% flowering (DAT) (0.082), PLAD (0.050), petiole length (0.027), total number of medium styled flower (0.026), internodal length of plant at final harvest (0.024), stem diameter (0.020), lesion size on fruits (0.019) and peduncle length (0.011). While the indirect negative effect was observed *via* PDI-for fruit at 21st DAI (-0.280) followed by total number of nodes at final harvest (-0.183), PLI (-0.111), PFAD (-0.108), days to 50% seed emergence (DAS) (-0.024) and leaf area (-0.008).

4.4.2.10 Number of primary branches plant^{-1} at final harvest

Positive direct effect was (0.372) noticed by the character number of primary branches plant^{-1} at final harvest over fruit yield plot^{-1} (dependent variable). The highest positive indirect effect was noticed by the traits such as, PDI-for leaf at 21^{st} DAI (0.363) followed by plant height at final harvest (0.219), total number of long styled flower (0.171), PFI (0.111), days to 50% flowering (DAT) (0.080), PLAD (0.042), petiole length (0.024), internodal length of plant at final harvest & total number of medium styled flower (0.021), stem diameter (0.018), lesion size on fruits (0.017) and peduncle length (0.012). Whereas, the maximum indirect negative effect was observed by PDI-for fruit at 21^{st} DAI (-0.262) followed by total number of nodes at final harvest (-0.140), PFAD (-0.100), PLI (-0.096), days to 50% seed emergence (DAS) (-0.022) and leaf area (-0.012).

4.4.2.11 Total number of nodes at final harvest

This trait had negative direct effect (-0.208) over the dependent character fruit yield $plot^{-1}$. However, the maximum negative indirect effect was observed in PDI-for fruit at 21^{st} DAI (-0.275) followed by PLI (-0.096), PFAD (-0.092), days to 50% seed emergence (DAS) (-0.020) and leaf area (-0.007). While, the highest positive indirect effect was recorded by PDI-for leaf at 21^{st} DAI (0.387) followed by number of primary branches $plant^{-1}$ at final harvest (0.249), plant height at final harvest (0.239), total number of long styled flower (0.183), PFI (0.091), days to 50% flowering (DAT) (0.063), PLAD (0.042), internodal length of plant at final harvest (0.024), total number of medium styled flower (0.022), lesion size on fruits & stem diameter (0.021), petiole length (0.020) and peduncle length (0.010).

4.4.2.12 Internodal length of plant at final harvest (cm)

Positive direct effect (0.031) was noticed in character internodal length of plant at final harvest over the dependent trait *i.e.,* fruit yield $plot^{-1}$. Similarly, the maximum positive indirect effect was shown by PDI-for leaf at 21^{st} DAI (0.305) followed by number of primary branches $plant^{-1}$ at final harvest (0.247), plant height at final harvest (0.212), total number of long styled flower (0.116), PFI (0.079), days to 50% flowering (DAT) (0.070), PLAD (0.042), stem diameter (0.021), total number of medium styled flower (0.020), petiole length (0.017), peduncle length (0.010) and lesion size on fruits (0.005). However, the highest negative indirect effect was observed *via* PDI-for fruit at 21^{st} DAI

(-0.212), total number of nodes at final harvest (-0.164), PLI (-0.098), PFAD (-0.074) days to 50% seed emergence (DAS) (-0.011) and leaf area (-0.010).

4.4.2.13 Stem diameter (cm)

Positive direct effect (0.046) was found in the character stem diameter over the dependent trait fruit yield plot^{-1}. However, the maximum positive indirect effect was noticed in number of primary branches plant^{-1} at final harvest (0.149) followed by plant height at final harvest (0.118), total number of long styled flower (0.097), days to 50% flowering (DAT) (0.038), PFAD (0.034), total number of medium styled flower (0.019), PDI-for fruit at 21st DAI (0.016), internodal length of plant at final harvest & petiole length (0.014) and PLI & peduncle length (0.004). While, the highest indirect negative effect was recorded in total number of nodes at final harvest (-0.095) followed by lesion size on fruits (-0.029), PDI-for leaf at 21st DAI (-0.025), PFI (-0.011), leaf area (-0.010), days to 50% seed emergence (DAS) (-0.007) and PLAD (-0.001).

4.4.2.14 Peduncle length (cm)

The magnitude of positive direct effect of the trait peduncle length over fruit yield plot^{-1} was (0.019). However, the highest positive indirect effect on the dependent trait was contributed through the trait number of primary branches plant^{-1} at final harvest (0.231) followed by PDI-for leaf at 21st DAI (0.184), plant height at final harvest (0.160), total number of long styled flower (0.126), PFI (0.075), days to 50% flowering (DAT) (0.042), PLAD (0.030), internodal length of plant at final harvest & total number of medium styled flower (0.017), lesion size on fruits (0.011) and stem diameter & petiole length (0.009). While, the maximum indirect negative effects were reported by traits like PDI-for fruit at 21st DAI (-0.122) followed by total number of nodes at final harvest (-0.106), PFAD (-0.087), PLI (-0.070) and days to 50% seed emergence (DAS) & leaf area (-0.011).

4.4.2.15 Petiole length (cm)

Negative type of direct effect (-0.043) was reported by the trait petiole length over fruit yield plot^{-1}. However, the maximum negative indirect effect was noticed *via* number of primary branches plant^{-1} at final harvest (-0.216) followed by plant height at final harvest (-0.173), PDI-for leaf at 21st DAI (-0.158), total number of long styled flower (-0.131), PFI (-0.079), days to 50% flowering (DAT) (-0.078), PLAD (-0.034), total number of medium styled flower (-0.020), stem diameter (-0.015), internodal length of plant at final harvest (-0.012) and peduncle length (-0.004). Whereas, the highest positive indirect effect was observed in PDI-for fruit at 21st DAI (0.115) followed by total number of nodes at final harvest (0.098), PLI (0.047), days to 50% seed emergence (DAS) (0.030), PFAD (0.022), lesion size on fruits (0.009) and leaf area (0.000).

4.4.2.16 Leaf area (cm^2)

Negative direct effect (-0.023) was shown by the character leaf area over the dependent character fruit yield plot^{-1}. The highest negative indirect effect on dependent trait was seen through PDI-for fruit at 21st DAI (-0.142) followed by PFAD (-0.076), total number of nodes at final harvest (-0.067), PLI (-0.055) and total number of medium styled flower (-0.010). Whereas the maximum positive indirect effect was recorded in number of primary branches plant^{-1} at final harvest (0.206) followed by PDI-for leaf at 21st DAI (0.197), plant height at final harvest (0.091), PFI (0.067), total number of long styled flower (0.056), days to 50% flowering (DAT) (0.036), PLAD (0.027), lesion size on fruits (0.026), stem diameter (0.021), internodal length of plant at final harvest (0.013), peduncle length (0.009), days to 50% seed emergence (DAS) (0.005) and petiole length (0.001).

4.4.2.17 Days to 50% flowering (DAT)

This trait had negative direct effect (-0.142) over the dependent character fruit yield plot^{-1}. However, the highest negative indirect effect was observed *via* number of primary branches plant^{-1} at final harvest (-0.211) followed by PDI-for leaf at 21st DAI (-0.195), plant height at final harvest (-0.157), total number of long styled flower (-0.153), PFI (-0.066), PLAD (-0.045), petiole length (-0.023), internodal length of plant at final harvest (-0.015), stem diameter (-0.012), total number of medium styled flower (-0.011) and lesion size on fruits & peduncle length (-0.006). However, the maximum indirect positive effect was seen by PDI-for fruit at 21st DAI (0.170) followed by total number of nodes at final harvest (0.092), PLI (0.070), PFAD (0.038), days to 50% seed emergence (DAS) (0.017) and leaf area (0.006).

4.4.2.18 Total number of long styled flower

Positive direct effect was seen on the dependent character fruit yield plot^{-1} by the independent character total number of long styled flower (0.278). Whereas, the maximum positive indirect effects were contributed through the characters like PDI-for leaf at 21st DAI (0.349) followed by number of primary branches plant^{-1} at final harvest (0.229), plant height at final harvest (0.176), PFI (0.086), days to 50% flowering (DAT) (0.078), PLAD (0.031), total number of medium styled flower (0.027), petiole length (0.020), lesion size on fruits & stem diameter (0.016), internodal length of plant at final harvest (0.013) and peduncle length (0.009). However, the highest indirect negative effect was observed in PDI-for fruit at 21st DAI (-0.265) followed by total number of nodes at final harvest (-0.137), PFAD (-0.072), PLI (-0.058), days to 50% seed emergence (DAS) (-0.024) and leaf area (-0.005).

4.4.2.19 Total number of medium styled flower

The magnitude of positive direct effect of the character total number of medium styled flower (0.060) was observed on the dependent character fruit yield plot^{-1}. Similarly, the highest positive indirect effects were recorded through the characters such as, PDI-for leaf at 21st DAI (0.136) followed by number of primary branches plant^{-1} at final harvest (0.128), total number of long styled flower (0.123), plant height at final harvest (0.116), PFI (0.027), days to 50% flowering (DAT) (0.025), PLAD (0.018), stem diameter & petiole length (0.014), internodal length of plant at final harvest (0.010), peduncle length (0.006) and leaf area (0.004). While the maximum negative indirect effects were reported in PDI-for fruit at 21st DAI (-0.100) followed by total number of nodes at final harvest (-0.077), PLI (-0.050), PFAD (-0.022), days to 50% seed emergence (DAS) (-0.020) and lesion size on fruits (-0.010).

4.4.2.20 Number of node to first fruiting

Positive direct effect (0.036) was expressed by the trait number of node to first fruiting over the dependent trait of economic importance *i.e.,* fruit yield plot^{-1}. Highest positive indirect effect was found through the trait total phenols (0.370) followed by total protein (0.207), average fruit weight (0.172), total number of fruits plant^{-1} (0.144), fruit yield hectare^{-1} (0.084), vitamin A (0.078), total anthocyanin (0.068) and days to first picking of fruits (DAT) (0.030). Whereas, the highest negative indirect effect was noted by the independent traits *viz.,* ascorbic acid (-0.163), total chlorophyll content (-0.142), proline content (-0.133), fruit length (-0.090), ash content (-0.032), fruit yield plant^{-1} (-0.029), fruit diameter (-0.023), days to first fruit set (DAT) (-0.012) and total soluble solids (-0.007).

4.4.2.21 Days to first fruit set (DAT)

Dyas to first fruit set exerted positive direct effect (0.035) on the dependent trait *i.e.,* fruit yield plot^{-1}. However, the positive indirect effects were reported through the independent traits like fruit length (0.084) followed by proline content (0.073), ascorbic acid (0.067), fruit yield plant^{-1} (0.026) and ash content (0.018). Whereas, the negative indirect effect was shown by the independent traits *viz.,* average fruit weight (-0.220) followed by total number of fruits plant^{-1} (-0.139), total phenols (-0.137), fruit yield hectare^{-1} (-0.090), days to first picking of fruits (DAT) (-0.080), total protein (-0.078), total anthocyanin (-0.047), vitamin A (-0.027), fruit diameter (-0.022), number of node to first fruiting (-0.012), total chlorophyll content (-0.004) and total soluble solids (-0.003).

4.4.2.22 Days to first picking of fruits (DAT)

Negative and direct effect was found over the dependent trait fruit yield plot^{-1} by the given independent trait days to first picking of fruits (-0.097). However, highest negative indirect effect was recorded through the trait average fruit weight (-0.197) followed by total number of fruits plant^{-1} (-0.169), fruit yield hectare^{-1} (-0.122), total phenols (-0.095), total chlorophyll content (-0.069), total protein (-0.060), total anthocyanin (-0.039), vitamin A (-0.032), fruit diameter (-0.015), number of node to first fruiting (-0.011) and total soluble solids (-0.002). Positive indirect effect values were recorded *via* the traits fruit length (0.083), ascorbic acid (0.069), proline content (0.034), days to first fruit set (DAT) & ash content (0.029) and fruit yield plant^{-1} (0.027).

4.4.2.23 Total number of fruits plant^{-1}

Direct positive effect was reported by the trait total number of fruits plant^{-1} (0.263) over fruit yield plot^{-1}. The positive indirect effects were reported through the independent traits like total phenols (0.342) followed by average fruit weight (0.247), total protein (0.171), fruit yield hectare^{-1} (0.167), vitamin A (0.080), total anthocyanin (0.068), days to first picking of fruits (DAT) (0.062), number of node to first fruiting (0.020) and fruit diameter (0.004). Negative indirect effect values were recorded *via* the traits such as, ascorbic acid (-0.186) followed by proline content (-0.113), fruit length (-0.108), fruit yield plant^{-1} (-0.038), ash content (-0.037), total chlorophyll content (-0.028), days to first fruit set (DAT) (-0.018) and total soluble solids (-0.002).

4.4.2.24 Average fruit weight (g)

Direct positive effect was reported by the trait average fruit weight (0.387) over the dependent character fruit yield plot^{-1}. The positive indirect effects were reported through the independent traits like total phenols (0.536) followed by total protein (0.236), total number of fruits plant^{-1} (0.168), fruit yield hectare^{-1} (0.133), vitamin A (0.100), total anthocyanin (0.075), days to first picking of fruits (DAT) (0.049) and number of node to first fruiting (0.016). Whereas, negative indirect effect values were recorded *via* the traits like total chlorophyll content (-0.219) followed by proline content (-0.180), ascorbic acid (-0.140), fruit length (-0.128), ash content (-0.096), fruit yield plant^{-1} (-0.040), fruit diameter (-0.033), days to first fruit set (DAT) (-0.020) and total soluble solids (-0.006).

4.4.2.25 Fruit length (cm)

Direct negative effect was reported by the trait fruit length (-0.148) over the dependent character fruit yield plot^{-1}. The negative indirect effects were reported through the independent traits like total chlorophyll content (-0.231) followed by proline content (-

0.229), ascorbic acid (-0.205), ash content (-0.134), fruit yield plant^{-1} (-0.041), fruit diameter (-0.031), days to first fruit set (DAT) (-0.020) and total soluble solids (-0.006). The positive type of indirect effects was noticed by total phenols (0.665) followed by average fruit weight (0.335), total protein (0.292), total number of fruits plant^{-1} (0.192), fruit yield hectare^{-1} (0.139), vitamin A (0.126), total anthocyanin (0.081), days to first picking of fruits (DAT) (0.054) and number of node to first fruiting (0.022).

4.4.2.26 Fruit diameter (cm)

Fruit diameter exerted negative direct effect (-0.140) on the dependent trait *i.e.,* fruit yield plot^{-1}. The negative type of indirect effects of the trait like ash content (-0.150) followed by total chlorophyll content (-0.126), ascorbic acid (-0.033), fruit length (-0.032), days to first picking of fruits (DAT) (-0.011) and total number of fruits plant^{-1} & fruit yield plant^{-1} (-0.007). However, the positive indirect effects were reported through the independent traits like total phenols (0.237), total protein (0.110), vitamin A (0.104), average fruit weight (0.091), proline content (0.053), fruit yield hectare^{-1} (0.017), total anthocyanin (0.008), number of node to first fruiting & days to first fruit set (DAT) (0.006) and total soluble solids (0.003).

4.4.2.27 Fruit yield plant^{-1} (kg)

Fruit yield plant^{-1} exerted negative direct effect (-0.046) on the dependent trait *i.e.,* fruit yield plot^{-1}. However, the negative type of indirect effect was observed by the traits such as, ascorbic acid (-0.183) followed by proline content (-0.150), total chlorophyll content (-0.147), fruit length (-0.133), ash content (-0.073), fruit diameter (-0.020), days to first fruit set (DAT) (-0.019) and total soluble solids (-0.007). The positive indirect effects were reported through the independent traits like total phenols (0.488) followed by average fruit weight (0.340), total protein (0.235), total number of fruits plant^{-1} (0.220), fruit yield hectare^{-1} (0.157), vitamin A (0.113), total anthocyanin (0.089), days to first picking of fruits (DAT) (0.056) and number of node to first fruiting (0.023).

4.4.2.28 Fruit yield hectare^{-1} (q)

The character fruit yield hectare^{-1} had positive direct effect (0.199), over the dependent trait *i.e.,* fruit yield plot^{-1}. The highest positive indirect effect was seen *via* total phenols (0.286) followed by average fruit weight (0.259), total no. of fruits plant^{-1} (0.221), total protein (0.146), number of node to first fruiting (0.015), days to first picking of fruits (DAT) (0.059), vitamin A (0.057), total anthocyanin (0.055) and total chlorophyll content (0.018). While, the negative undesirable type of indirect effects was observed through the traits *viz.,* proline content (-0.109) followed by fruit length (-0.103) ascorbic acid (-0.094), fruit yield plant^{-1} (-0.036), ash content (-0.020) days to first fruit set (DAT) (-0.016), fruit diameter (-0.012) and total soluble solids (-0.002).

4.4.2.29 Total chlorophyll content (mg g^{-1})

Direct negative effect was reported by the trait total chlorophyll content (-0.552) over the dependent character fruit yield plot^{-1}. The negative indirect effects were reported through the independent traits like ascorbic acid (-0.285) followed by proline content (-0.281), ash content (-0.189), fruit length (-0.063), fruit diameter (-0.032), total soluble solids (-0.018), fruit yield plant^{-1} & days to first picking of fruits (-0.012) and fruit yield ha^{-1} (-0.007). The positive type of indirect effects of the trait total chlorophyll content were observed *via* total phenols (0.905) followed by total protein (0.292), vitamin A (0.186), average fruit weight (0.155), total anthocyanin (0.040), total number of fruits plant^{-1} (0.013), number of nodes to first fruiting (0.009) and days to first fruit set (0.000).

4.4.2.30 Total soluble solids (°Brix)

Direct negative effect was reported by the trait total soluble solids (-0.036) over fruit yield plot^{-1}. The negative indirect effects were reported through the independent traits like total chlorophyll content (-0.273) followed by ascorbic acid (-0.145), proline content (-0.128), ash content (-0.120), fruit length (-0.026), fruit yield plant^{-1} (-0.009) and days to first picking of fruits (-0.005). The positive type of indirect effects of the trait total soluble solids were observed by the characters total phenols (0.517) followed by total protein (0.124), vitamin A (0.090), average fruit weight (0.062), total anthocyanin (0.027), total number of fruits plant^{-1} (0.012), fruit diameter & fruit yield ha^{-1} (0.010), number of nodes to first fruiting (0.007) and days to first fruit set (0.003).

4.4.2.31 Ascorbic acid (mg 100 g^{-1})

Negative type of direct effect was reported by the trait ascorbic acid (-0.521) over the dependent trait fruit yield plot^{-1}. The negative type indirect effect of the trait total chlorophyll content (-0.299) followed by proline content (-0.211), ash content (-0.143), fruit length (-0.058), fruit yield plant^{-1} (-0.016), total soluble solids (-0.010), fruit diameter (-0.009) and days to first fruit set (-0.004). While, positive indirect effects were observed through the traits *viz.,* total phenols (0.834) followed by total protein (0.242), vitamin A (0.193), average fruit weight (0.104), total number of fruits plant^{-1} (0.094), total anthocyanin (0.037), fruit yield ha^{-1} (0.036), days to first picking of fruits (0.013) and number of nodes to first fruiting (0.011).

4.4.2.32 Vitamin A (IU g^{-1})

Positive direct effect (0.306) was exerted by the independent character vitamin A over the dependent trait fruit yield plant^{-1}. The highest positive indirect effect was seen *via* the trait total phenols (0.660) followed by total protein (0.218), average fruit weight (0.105), total number of fruits plant^{-1} (0.058), total anthocyanin (0.035), fruit yield ha^{-1} (0.031), number of nodes to first fruiting (0.008) and days to first picking of fruits (0.008). While, the negative undesirable type of indirect effects was observed through the traits like proline content (-0.295) followed by total chlorophyll content (-0.278), ascorbic acid (-0.275), ash content (-0.198), fruit length (-0.051), fruit diameter (-0.040), fruit yield plant^{-1} (-0.014), total soluble solids (-0.009) and days to first fruit set (-0.003).

4.4.2.33 Total anthocyanin (mg 100 g^{-1})

The character total anthocyanin content showed the positive type of the direct effect (0.100) on the dependent character fruit yield plot^{-1}. Similarly, positive indirect effects were obtained through the traits *viz.,* total phenols (0.513) followed by average fruit weight (0.292), total protein (0.240), total number of fruits plant^{-1} (0.180), vitamin A

(0.127), fruit yield ha^{-1} (0.109), days to first picking of fruits (0.037) and number of nodes to first fruiting (0.025). Whereas, negative indirect effects on the dependent trait fruit yield plot^{-1} were observed by total chlorophyll content (-0.220) followed by ascorbic acid (-0.190), fruit length (-0.120) proline content (-0.154), ash content (-0.079), fruit yield plant^{-1} (-0.041), days to first fruit set (-0.016), fruit diameter (-0.011) and total soluble solids (-0.010).

4.4.2.34 Total protein (%)

The character total protein had positive direct effect (0.399) over the dependent trait *i.e.,* fruit yield plot^{-1}. Positive and indirect effects were observed *via* the independent characters like total phenols (0.863) followed by average fruit weight (0.228), vitamin A (0.200), total number of fruits plant^{-1} (0.113), fruit yield ha^{-1} (0.073), total anthocyanin (0.060), number of nodes to first fruiting (0.019) and days to first picking of fruits (0.015). The negative indirect effect was seen in the trait total chlorophyll content (-0.401) followed by ascorbic acid & proline content (-0.316), ash content (-0.217), fruit length (-0.108), fruit diameter (-0.039), fruit yield plant^{-1} (-0.027), total soluble solids (-0.011) and days to first fruit set (-0.007).

4.4.2.35 Total phenols (mg GAE g^{-1} DW)

Positive direct effect (1.055) was expressed by the character total phenols over the dependent trait of economic importance *i.e.,* fruit yield plot^{-1}. Whereas, the positive indirect effect was recorded *via* the characters total protein (0.310) followed by vitamin A (0.217), average fruit weight (0.187), fruit yield ha^{-1} (0.051), total anthocyanin (0.046), number of nodes to first fruiting (0.012) and days to first picking of fruits (0.008). While negative indirect effect was recorded through the traits such as total chlorophyll content (-0.445) followed by ascorbic acid (-0.390), proline content (-0.346), ash content (-0.234), fruit length (-0.088), total number of fruits plant^{-1}(0.081), fruit diameter (-0.030), fruit yield plant^{-1} (-0.020), total soluble solids (-0.017) and days to first fruit set (-0.004).

4.4.2.36 Proline content (mg g^{-1} DW)

The character proline content showed the negative type of the direct effect (-0.493) on the dependent character fruit yield $plot^{-1}$. Similarly, negative indirect effects on the dependent trait total chlorophyll content (-0.312) followed by ascorbic acid (-0.223), ash content (-0.120) fruit length (-0.069), fruit yield $plant^{-1}$ (-0.014), total soluble solids (-0.009) and days to first fruit set (-0.005). While, the positive indirect effects were obtained through the traits like total phenols (0.781) followed by total protein (0.256), vitamin A (0.220), average fruit weight (0.141), total number of fruits $plant^{-1}$ (0.060), fruit yield ha^{-1} (0.044), total anthocyanin (0.031), fruit diameter (0.015), number of nodes to first fruiting (0.010) and days to first picking of fruits (0.007).

4.4.2.37 Ash content (%)

Negative direct effect (-0.365) was expressed by the trait ash content over the dependent trait of economic importance *i.e.,* fruit yield $plot^{-1}$. The negative indirect effect was recorded total chlorophyll content (-0.284) followed by ascorbic acid (-0.205), proline content (-0.163), fruit diameter (-0.057), fruit length (-0.054), total soluble solids (-0.012), fruit yield $plant^{-1}$ (-0.009) and days to first fruit set (-0.002). While positive indirect effect was recorded through the characters total phenols (0.715) followed by total protein (0.238) vitamin A (0.199), average fruit weight (0.102), total number of fruits $plant^{-1}$(0.026), total anthocyanin (0.022), fruit yield ha^{-1} (0.011), days to first picking of fruits (0.008) and number of nodes to first fruiting (0.003).

The technique of path coefficient analysis developed by Wright (1934) and demonstrated by Dewey and Lu (1957) facilitates in splitting the correlation coefficients into the measures of direct and indirect effects. It is a standardised by partial regression coefficient analysis. As such, it measures the direct influence of one variable upon other. Such information would be of great value in enabling the breeder to specifically identify important component traits of yield and utilise the genetic stock for improvement in a planned way.

The pooled analysis of phenotypic path coefficient revealed that total phenols (1.055) showed the highest positive direct effect on fruit yield plot^{-1} followed by PDI-for fruit at 21st DAI (0.723), total proteins (0.399), average fruit weight (0.387), number of primary branches plant^{-1} (0.372), PFAD (0.334), vitamin A (0.306), total number of long styled flower (0.278), plant height at final harvest (0.272), total number of fruits plant^{-1} (0.263), PLI (0.243), fruit yield hectare^{-1} (0.199), total anthocyanin (0.100), total number of medium styled flower (0.060), stem diameter (0.046), days to 50% seed emergence (DAS) (0.045), number of node to first fruiting (0.036), days to first fruit set (DAT) (0.035), internodal length of plant at final harvest (0.031) and peduncle length (0.019). Similar results have also been reported by Patel *et al*., 2015; Sujin *et al.,* 2017; Kumar *et al.,* 2024 in brinjal genotypes.

Table 4.4.2 Direct and indirect phenotypic path coefficient analysis for various characters of brinjal genotypes (pooled over seasons of the year 2022)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	0.243	-0.228	-0.111	0.270	-0.883	0.622	-0.080	0.017	-0.125	-0.147	0.082	-0.012	0.000	-0.006	-0.008	0.005	-0.041	-0.067	-0.012
2	0.212	-0.261	-0.101	0.274	-0.845	0.611	-0.089	0.019	-0.123	-0.159	0.073	-0.009	0.002	-0.005	-0.013	0.006	-0.036	-0.091	-0.006
3	0.195	-0.192	-0.138	0.269	-0.796	0.576	-0.081	0.018	-0.099	-0.112	0.063	-0.009	0.000	-0.004	-0.010	0.004	-0.047	-0.062	-0.008
4	0.196	-0.214	-0.111	0.334	-0.930	0.656	-0.107	0.015	-0.088	-0.110	0.057	-0.007	0.005	-0.005	-0.003	0.005	-0.016	-0.060	-0.004
5	0.212	-0.218	-0.108	0.307	-1.012	0.703	-0.092	0.017	-0.106	-0.134	0.080	-0.009	0.001	-0.003	-0.007	0.004	-0.027	-0.096	-0.008
6	0.209	-0.221	-0.110	0.303	-0.985	0.723	-0.099	0.016	-0.106	-0.135	0.079	-0.009	0.001	-0.003	-0.007	0.004	-0.033	-0.102	-0.008
7	0.151	-0.183	-0.087	0.283	-0.736	0.566	-0.127	0.005	-0.040	-0.048	0.035	-0.001	0.010	-0.002	0.003	0.005	-0.007	-0.034	0.004
8	0.093	-0.108	-0.056	0.111	-0.376	0.257	-0.014	0.045	-0.145	-0.183	0.092	-0.008	-0.008	-0.005	-0.028	-0.002	-0.052	-0.146	-0.026
9	-0.111	0.118	0.050	-0.108	0.394	-0.280	0.019	-0.024	0.272	0.299	-0.183	0.024	0.020	0.011	0.027	-0.008	0.082	0.180	0.026
10	-0.096	0.111	0.042	-0.100	0.363	-0.262	0.017	-0.022	0.219	0.372	-0.140	0.021	0.018	0.012	0.024	-0.012	0.080	0.171	0.021
11	-0.096	0.091	0.042	-0.092	0.387	-0.275	0.021	-0.020	0.239	0.249	-0.208	0.024	0.021	0.010	0.020	-0.007	0.063	0.183	0.022
12	-0.098	0.079	0.042	-0.074	0.305	-0.212	0.005	-0.011	0.212	0.247	-0.164	0.031	0.021	0.010	0.017	-0.010	0.070	0.116	0.020
13	0.004	-0.011	-0.001	0.034	-0.025	0.016	-0.029	-0.007	0.118	0.149	-0.095	0.014	0.046	0.004	0.014	-0.010	0.038	0.097	0.019
14	-0.070	0.075	0.030	-0.087	0.184	-0.122	0.011	-0.011	0.160	0.231	-0.106	0.017	0.009	0.019	0.009	-0.011	0.042	0.126	0.017
15	0.047	-0.079	-0.034	0.022	-0.158	0.115	0.009	0.030	-0.173	-0.216	0.098	-0.012	-0.015	-0.004	-0.043	0.000	-0.078	-0.131	-0.020
16	-0.055	0.067	0.027	-0.076	0.197	-0.142	0.026	0.005	0.091	0.206	-0.067	0.013	0.021	0.009	0.001	-0.023	0.036	0.056	-0.010
17	0.070	-0.066	-0.045	0.038	-0.195	0.170	-0.006	0.017	-0.157	-0.211	0.092	-0.015	-0.012	-0.006	-0.023	0.006	-0.142	-0.153	-0.011
18	-0.058	0.086	0.031	-0.072	0.349	-0.265	0.016	-0.024	0.176	0.229	-0.137	0.013	0.016	0.009	0.020	-0.005	0.078	0.278	0.027
19	-0.050	0.027	0.018	-0.022	0.136	-0.100	-0.010	-0.020	0.116	0.128	-0.077	0.010	0.014	0.006	0.014	0.004	0.025	0.123	0.060

Residual effect at 0.101

1. Percent leaf incidence (PLI) (%)
2. Percent fruit incidence (PFI) (%)
3. Percent leaf area diseased (PLAD)-eye estimation (%)
4. Percent fruit area diseased (PFAD)-eye estimation (%)
5. Percent disease index (PDI)-for leaf at 21st DAI (%)
6. Percent disease index (PDI)-for fruit at 21st DAI (%)
7. Lesion size on fruits (cm^2)
8. Days to 50% seed emergence (DAS)
9. Plant height at final harvest (cm)
10. Number of primary branches plant^{-1} at final harvest
11. Total number of nodes at final harvest
12. Internodal length of plant at final harvest (cm)
13. Stem diameter (cm)
14. Peduncle length (cm)
15. Petiole length (cm)
16. Leaf area (cm^2)
17. Days to 50% flowering (DAT)
18. Total number of long styled flower
19. Total number of medium styled flower
20. Fruit yield plot^{-1} (kg)

Continue………

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0.036	-0.012	0.030	0.144	0.172	-0.090	-0.023	-0.029	0.084	-0.142	-0.007	-0.163	0.078	0.068	0.207	0.370	-0.133	-0.032
2	-0.012	0.035	-0.080	-0.139	-0.220	0.084	-0.022	0.026	-0.090	-0.004	-0.003	0.067	-0.027	-0.047	-0.078	-0.137	0.073	0.018
3	-0.011	0.029	-0.097	-0.169	-0.197	0.083	-0.015	0.027	-0.122	-0.069	-0.002	0.069	-0.032	-0.039	-0.060	-0.095	0.034	0.029
4	0.020	-0.018	0.062	0.263	0.247	-0.108	0.004	-0.038	0.167	-0.028	-0.002	-0.186	0.080	0.068	0.171	0.342	-0.113	-0.037
5	0.016	-0.020	0.049	0.168	0.387	-0.128	-0.033	-0.040	0.133	-0.219	-0.006	-0.140	0.100	0.075	0.236	0.536	-0.180	-0.096
6	0.022	-0.020	0.054	0.192	0.335	-0.148	-0.031	-0.041	0.139	-0.231	-0.006	-0.205	0.126	0.081	0.292	0.665	-0.229	-0.134
7	0.006	0.006	-0.011	-0.007	0.091	-0.032	-0.140	-0.007	0.017	-0.126	0.003	-0.033	0.104	0.008	0.110	0.237	0.053	-0.150
8	0.023	-0.019	0.056	0.220	0.340	-0.133	-0.020	-0.046	0.157	-0.147	-0.007	-0.183	0.113	0.089	0.235	0.488	-0.150	-0.073
9	0.015	-0.016	0.059	0.221	0.259	-0.103	-0.012	-0.036	0.199	0.018	-0.002	-0.094	0.057	0.055	0.146	0.286	-0.109	-0.020
10	0.009	0.000	-0.012	0.013	0.155	-0.063	-0.032	-0.012	-0.007	-0.552	-0.018	-0.285	0.186	0.040	0.292	0.905	-0.281	-0.189
11	0.007	0.003	-0.005	0.012	0.062	-0.026	0.010	-0.009	0.010	-0.273	-0.036	-0.145	0.090	0.027	0.124	0.517	-0.128	-0.120
12	0.011	-0.004	0.013	0.094	0.104	-0.058	-0.009	-0.016	0.036	-0.299	-0.010	-0.521	0.193	0.037	0.242	0.834	-0.211	-0.143
13	0.008	-0.003	0.008	0.058	0.105	-0.051	-0.040	-0.014	0.031	-0.278	-0.009	-0.275	0.306	0.035	0.218	0.660	-0.295	-0.198
14	0.025	-0.016	0.037	0.180	0.292	-0.120	-0.011	-0.041	0.109	-0.220	-0.010	-0.190	0.127	0.100	0.240	0.513	-0.154	-0.079
15	0.019	-0.007	0.015	0.113	0.228	-0.108	-0.039	-0.027	0.073	-0.401	-0.011	-0.316	0.200	0.060	0.399	0.863	-0.316	-0.217
16	0.012	-0.004	0.008	0.081	0.187	-0.088	-0.030	-0.020	0.051	-0.445	-0.017	-0.390	0.217	0.046	0.310	1.055	-0.346	-0.234
17	0.010	-0.005	0.007	0.060	0.141	-0.069	0.015	-0.014	0.044	-0.312	-0.009	-0.223	0.220	0.031	0.256	0.781	-0.493	-0.120
18	0.003	-0.002	0.008	0.026	0.102	-0.054	-0.057	-0.009	0.011	-0.284	-0.012	-0.205	0.199	0.022	0.238	0.715	-0.163	-0.365

Residual effect at 0.101

1. Number of node to first fruiting
2. Days to first fruit set (DAT)
3. Days to first picking of fruits (DAT)
4. Total number of fruits plant^{-1}
5. Average fruit weight (g)
6. Fruit length (cm)
7. Fruit diameter (cm)
8. Fruit yield plant^{-1} (kg)
9. Fruit yield ha^{-1} (q)
10. Total chlorophyll content (mg g^{-1})
11. Total soluble solids (°Brix)
12. Ascorbic acid (mg 100 g^{-1})
13. Vitamin A (IU g^{-1})
14. Total anthocyanin (mg 100 g^{-1})
15. Total protein (%)
16. Total phenols (mg GAE g^{-1} DW)
17. Proline content (mg g^{-1} DW)
18. Ash content (%)

4.4.3 Estimation of variability, heritability and genetic advance (pooled over seasons of the year 2022)

On the basis of pooled analysis, the estimate of genetic parameters *viz.,* genotypic coefficients of variance (GCV), phenotypic coefficients of variance (PCV), heritability in broad sense, genetic advance (GA) and genetic advance as per cent of mean (GAM) were estimated for various growth, yield and quality traits and are presented in Table 4.3.3.

4.4.3.1 Genotypic coefficients of variation (GCV)

The highest GCV were observed in the following traits: total anthocyanin (217.07%), lesion size on fruits (42.90%), fruit yield plant^{-1} (38.88%), fruit yield plot^{-1} (33.43%), total protein (31.75%), PLAD (28.52%), PFAD (27.87%), PDI-for fruit at 21st DAI (26.92%), PDI-for fruit at 14th DAI (26.91%), PDI-for fruit at 7th DAI (26.90%), PDI-for leaf at 14th DAI & at 21st DAI (25.98%), PFI (25.97%), PLI (25.71%), total phenols (25.08%), PDI-for leaf at 7th DAI (25.06%), total number of fruits plant^{-1} (24.63%), stem diameter (24.24%), fruit yield hectare^{-1} (23.01%), average fruit weight (22.95%), total number of long styled flower (22.78%), fruit diameter (21.51%), petiole length (21.24%) and fruit length (20.72%).

Moderate GCV were noted in traits such as the total number of medium styled flower (19.31%), leaf area (18.47%), number of primary branches plant^{-1} at final harvest (18.11%), peduncle length (17.97%), vitamin A (17.24%), ascorbic acid (16.16%), plant height at 60 DAT (13.97%), internodal length of plant at final harvest (13.37%), total chlorophyll content (12.70%), proline content (12.11%), ash content (11.98%) and number of node to first fruiting (11.96%).

Lowest GCV were recorded for the traits like plant height at 90 DAT (10.36%), days to first seed emergence (DAS) (10.19%), days taken to 50% seed emergence (DAS) (10.13%), plant height at 30 DAT (9.01%), total number of nodes at final harvest (8.55%), plant height at final harvest (7.88%), total soluble solids (6.95%), days to first picking of fruits (DAT) (5.04%), days to first fruit set (DAT) (4.31%), days to first flowering (DAT) (3.77%) and days to 50% flowering (DAT) (3.43%).

4.4.3.2 Phenotypic coefficient of variation (PCV)

The highest phenotypic coefficient of variation (PCV) was observed in the following traits: total anthocyanin (217.10%), lesion size on fruits (42.94%), fruit yield plant^{-1} (38.93%), fruit yield plot^{-1} (33.46%), total protein (31.82%), PLAD (28.61%), percent fruit area diseased (PFAD)-eye estimation (28.04%), PDI-for fruit at 7th DAI (26.98 %), PDI-for fruit at 14th DAI (26.97%), PDI-for fruit at 21st DAI (26.96%), PDI-for leaf at 14th DAI & PDI-for leaf at 21st DAI (26.05%), PFI (26.04%), PLI (25.80%), total phenols (25.22%), PDI-for leaf at 7th DAI (25.14%), total number of fruits plant^{-1} (24.70%), stem diameter (24.30%), total number of long styled flower (22.85%), fruit yield hectare^{-1} (23.09%), average fruit weight (23.02%), petiole length (21.30%), fruit diameter (21.58%) and fruit length (20.78 %).

Moderate PCV were found in traits such as total number of medium styled flower (19.40%), leaf area (18.54%), number of primary branches plant^{-1} at final harvest (18.20%), peduncle length (18.06%), vitamin A (17.24%), ascorbic acid (16.28%), plant height at 60 DAT (14.09%), internodal length of plant at final harvest (13.50%), total chlorophyll content (12.90%), proline content (12.23%), number of nodes to first fruiting (12.11%), ash content (12.10%) and plant height at 90 DAT (10.49%).

Lowest PCV were recorded for the traits like plant height at 90 DAT (10.49%), days to first seed emergence (DAS) (10.37%), days taken to 50% seed emergence (DAS) (10.32%), plant height at 30 DAT (9.22%), total number of nodes at final harvest (8.77%), plant height at final harvest (8.08%), total soluble solids (7.19%), days to first picking of fruits (DAT) (5.39%), days to first fruit set (DAT) (4.65%), days to first flowering (DAT) (4.18%) and days to 50% flowering (DAT) (3.92%).

4.4.3.3 Heritability (h^2)

Heritability estimates ranged from 76.33% to 100.00%, as shown in Table 4.3.3. All the traits were noticed the highest heritability such as vitamin A (100%), total anthocyanin (99.97%), lesion size on fruits (99.83%), fruit yield plot^{-1} (99.80%), fruit yield plant^{-1} (99.74%), PDI-for fruit at 21st DAI (99.68%), total proteins (99.57%), stem diameter (99.52%), PDI-for fruit at 14th DAI (99.56%), PDI-for leaf at 14th DAI (99.50%), PFI

(99.48%), PFAD (99.47%), petiole length & PDI-for fruit at 7th DAI (99.46%), PDI-for leaf at 21st DAI (99.45%), total number of fruits plant^{-1} (99.44%), PDI-for leaf at 7th DAI (99.41%), fruit length & PLAD (99.38%), average fruit weight (99.37%), total number of long styled flower (99.36%), PLI (99.32%), fruit diameter (99.30%), fruit yield hectare^{-1} (99.26%), leaf area (99.19%), number of primary branches plant^{-1} at final harvest (99.11%), total number of medium styled flower (99.09%), peduncle length (99.03%), total phenols (98.95%), ascorbic acid (98.54%), plant height at 60 DAT (98.33%), internodal length of plant at final harvest (98.16%), proline content (98.05%), ash content (98.04%), number of node to first fruiting (97.55%), plant height at 90 DAT (97.50%), total soluble solids (93.37%), total chlorophyll content (96.90%), days to first seed emergence (DAS) & days taken to 50% seed emergence (DAS) (96.44%), plant height at 30 DAT (95.53%), plant height at final harvest (95.26%), total number of nodes at final harvest (94.95%), days to first picking of fruits (DAT) (87.65%), days to first fruit set (DAT) (85.90%), days to first flowering (DAT) (81.42%) and days to 50% flowering (DAT) (76.33%).

The comprehensive high heritability estimates across all 47 evaluated traits indicate that this germplasm possesses substantial genetic variation with minimal environmental intervention representing optimal conditions for effective phenotypic selection. The hierarchy of heritability values with disease resistance, quality, and yield traits exhibiting near-perfect heritability (>99%) while phenological traits show relatively lower but still substantial heritability (>76%) indicates that direct selection for disease resistance, yield, and quality traits will be highly rewarding for immediate cultivar development, while phenological trait improvement may require multi-environment evaluation to reliably identify stable early-maturing types. The high heritability observed for simultaneous improvement in disease resistance (lesion size: 99.83%), yield per plant (99.74%), and quality traits (vitamin A: 100%; anthocyanin: 99.97%) in G_{32} demonstrates the feasibility of developing superior multi-trait brinjal cultivars through integrated selection strategies that capitalize on the strong genetic control of these economically and agronomically important characters.

4.4.3.4 Genetic Advancement (GA) at 5%

The highest value for genetic advance was observed in total anthocyanin (299.51), fruit yield hectare^{-1} (116.59), leaf area (68.07) and average fruit weight (32.65).

Moderate genetic advance was observed for the traits such as PLAD (23.97), PDI-for leaf at 21st DAI (22.63), PDI-for fruit at 21st DAI (21.98), PFAD (21.59), total number of long styled flower (15.80), plant height at 60 DAT (13.43), PLI (13.29), total number of fruits plant^{-1} (12.67), PDI-for leaf at 14th DAI (12.45), PFI (12.06), plant height at 90 DAT (11.92) and plant height at final harvest (10.74).

Lowest genetic advance was noted in PDI-for fruit at 14th DAI (8.24), total number of medium styled flower (8.21), plant height at 30 DAT (6.31), PDI-for leaf at 7thDAI (5.02), PDI-for fruit at 7th DAI (3.84), fruit yield plot^{-1} (7.38), days to first picking of fruits (DAT) (6.54), days to first fruit set (DAT) (4.88), days to first flowering (DAT) (3.68), days to 50% flowering (DAT) (3.63), fruit length (3.62), total number of nodes at final harvest (2.53), days taken to 50% seed emergence (DAS) (2.03), peduncle length (1.95), number of primary branches plant^{-1} at final harvest and internodal length of plant at final harvest (1.93), fruit diameter (1.88), days to first seed emergence (DAS) (1.68), proline content (1.65), ash content (1.61), petiole length (1.50), number of nodes to first fruiting (1.36), fruit yield plant^{-1} (1.35), stem diameter (1.07), lesion size on fruits (0.87), total soluble solids (0.68), ascorbic acid (0.56), total protein (0.54), total chlorophyll content (0.23), total phenol content (0.20) and vitamin A (0.07).

4.4.3.5 Genetic Advancement as percentage of Mean at 5%

The highest genetic advancement as percentage of mean was recorded in the following traits: total anthocyanin (447.10%), lesion size on fruits (88.31%), fruit yield plant^{-1} (79.99%), fruit yield plot^{-1} (68.79%), total protein (65.28%), PLAD (58.57%), PFAD (57.46%), PDI-for fruit at 21st DAI (55.37%), PDI-for fruit at 14th DAI (55.31%), PDI-for fruit at 7th DAI (55.27%), PDI-for leaf at 14th DAI (53.39%), PDI-for leaf at 21st DAI (53.37%), PFI (53.36%), PLI (52.79%), PDI-for leaf at 7thDAI (51.48%), total phenols (51.41%), total number of fruits plant^{-1} (50.60%), stem diameter (49.82%), fruit yield hectare^{-1} (47.22%), average fruit weight (47.12%), total number of long styled flower (46.77%), fruit diameter (44.15%), petiole length (43.63%), fruit length (42.54%), total number of medium styled flower (39.60%), leaf area (37.89%), number of primary branches plant^{-1} at final harvest (37.15%), peduncle length (36.84%), vitamin A (35.53%) and ascorbic acid (33.04%).

The moderate genetic advancement as percentage of mean was found in plant height at 60 DAT (28.54%), internodal length of plant at final harvest (27.29%), total chlorophyll content (25.75%), proline content (24.69%), ash content (24.43%), number of nodes to first fruiting (24.33%), plant height at 90 DAT (21.07%), days to first seed emergence (DAS) (20.60%), days taken to 50% seed emergence (DAS) (20.50%), plant height at 30 DAT (18.14%), total number of nodes at final harvest (17.16%), plant height at final harvest (15.85%) and total soluble solids (13.83%).

The lowest genetic advancement as percentage of mean was recorded in traits such as days to first picking of fruits (9.73%), days to first fruit set (DAT) (8.23%), days to first flowering (DAT) (7.01%) and days to 50% flowering (DAT) (6.17%).

In this study, the phenotypic coefficient of variation (PCV) consistently exceeded the genotypic coefficient of variation (GCV) for all traits, highlighting a minimal environmental influence on trait expression and strong resilience to environmental variations. Traits such as total anthocyanin, lesion size on fruits, fruit yield plant^{-1}, fruit yield plot^{-1}, total protein, PLAD, PFAD, PDI-for fruit at 7th DAI, PDI-for fruit at 14th DAI, PDI-for fruit at 21st DAI, PDI-for leaf at 14th DAI & PDI-for leaf at 21st DAI, PFI, PLI, total phenols, PDI-for leaf at 7th DAI, total number of fruits plant^{-1}, stem diameter, total number of long styled flower, fruit yield hectare^{-1}, average fruit weight, petiole length, fruit diameter and fruit length had notably high PCV and GCV values compared to other traits, indicating significant potential for effective selection. This indicates a substantial level of genetic variability for these traits, making them suitable candidates for effective selection, as the response to selection is directly related to the variability within the experimental population. The findings of this study align with those reported by Patel *et al.* (2015); Kasera *et al.* (2018) and Anbarasi and Haripriya (2021).

It is not possible to determine the amount of variation which is heritable with the help of phenotypic coefficient of variation and genotypic coefficient of variation alone. The heritability along with genetic advance is more meaningful and helps in predicting the resultant effect of selection on phenotypic expression.

Heritability indicates the extent to which traits are inherited in progeny, with higher values indicating reduced environmental influence and greater potential for effective selection. In this study, all the studied traits exhibited high heritability (exceeding 60%). The high heritability observed in these traits indicates a limited influence of environmental factors and a strong genetic foundation, making them suitable for direct selection to develop high-yielding varieties.

The highest value for genetic advance was observed in total anthocyanin, fruit yield hectare^{-1}, leaf area and average fruit weight whereas, the highest genetic advancement as percentage of mean was recorded in total anthocyanin, lesion size on fruits, fruit yield plant^{-1}, fruit yield plot^{-1}, total protein, PLAD, PFAD, PDI-for fruit at 21st DAI, PDI-for fruit at 14th DAI, PDI-for fruit at 7th DAI, PDI-for leaf at 14th DAI, PDI-for leaf at 21st DAI, PFI, PLI, PDI-for leaf at 7thDAI, total phenols, total number of fruits plant^{-1}, stem diameter, fruit yield hectare^{-1}, average fruit weight, total number of long styled flower, fruit diameter, petiole length, fruit length, total number of medium styled flower, leaf area, number of primary branches plant^{-1} at final harvest, peduncle length, vitamin A and ascorbic acid. These findings are consistent with the studies by Sujin *et al.* (2017) and Anbarasi and Haripriya (2021) in brinjal genotypes. Kumar *et al.* (2012); Kasera *et al.* (2018) and Manna and Paul (2012) previously documented significant heritability combined with substantial genetic gain for certain traits in brinjal and tomato, respectively.

Table 4.4.3 Estimation of coefficient of variance (GCV & PCV), heritability in broad sense (h^2b), genetic advancement (GA) and genetic advancement as percentage of mean (GAM) at 5% for various traits in brinjal genotypes (pooled over season of the year 2022)

Characters	Range		Mean	Variance		Coefficient of variance (%)		Heritability (h^2b) (%)	Genetic advancement (GA) at 5%	Genetic advancement as percentage of mean (GAM) at 5%
	Minimum	Maximum		GV	PV	GCV	PCV			
Percent leaf incidence (PLI) (%)	8.73	38.26	25.17	41.88	42.16	25.71	25.80	99.32%	13.29	52.79
Percent fruit incidence (PFI) (%)	5.71	33.64	22.60	34.45	34.63	25.97	26.04	99.48%	12.06	53.36
Percent leaf area diseased (PLAD)-eye estimation (%)	13.16	67.46	40.93	136.27	137.12	28.52	28.61	99.38%	23.97	58.57
Percent fruit area diseased (PFAD)-eye estimation (%)	12.43	64.10	37.57	110.41	111.00	27.97	28.04	99.47%	21.59	57.46
Percent disease index (PDI)-for leaf at 7^{th} DAI (%)	3.08	14.51	9.75	5.97	6.00	25.06	25.14	99.41%	5.02	51.48
Percent disease index (PDI)-for leaf at 14^{th} DAI (%)	6.99	36.86	23.33	36.73	36.91	25.98	26.05	99.50%	12.45	53.39
Percent disease index (PDI)-for leaf at 21^{st} DAI (%)	12.81	66.57	42.40	121.35	122.02	25.98	26.05	99.45%	22.63	53.37
Percent disease index (PDI)-for fruit at 7^{th} DAI (%)	1.92	11.30	6.95	3.49	3.51	26.90	26.98	99.46%	3.84	55.27
Percent disease index (PDI)-for fruit at 14^{th} DAI (%)	4.13	23.95	14.89	16.05	16.13	26.91	26.97	99.56%	8.24	55.31
Percent disease index (PDI)-for fruit at 21^{st} DAI (%)	11.03	63.36	39.70	114.21	114.57	26.92	26.96	99.68%	21.98	55.37
Lesion size on fruits (cm^2)	0.23	2.11	0.99	0.18	0.18	42.90	42.94	99.83%	0.87	88.31
Days to first seed emergence (DAS)	6.09	9.35	8.16	0.69	0.71	10.19	10.37	96.44%	1.68	20.60
Days taken to 50% seed emergence (DAS)	7.39	11.44	9.91	1.01	1.05	10.13	10.32	96.44%	2.03	20.50
Plant height at 30 DAT (cm)	30.23	44.42	34.79	9.82	10.28	9.01	9.22	95.53%	6.31	18.14
Plant height at 60 DAT (cm)	35.29	67.08	47.05	43.21	43.94	13.97	14.09	98.33%	13.43	28.54
Plant height at 90 DAT (cm)	42.80	73.05	56.59	34.36	35.24	10.36	10.49	97.50%	11.92	21.07
Plant height at final harvest (cm)	52.26	81.77	67.74	28.52	29.93	7.88	8.08	95.26%	10.74	15.85
Number of primary branches $plant^{-1}$ at final harvest	3.27	8.19	5.19	0.88	0.89	18.11	18.20	99.11%	1.93	37.15
Total number of nodes at final harvest	10.85	17.74	14.74	1.59	1.67	8.55	8.77	94.95%	2.53	17.16
Internodal length of plant at final harvest (cm)	5.24	9.08	7.07	0.89	0.91	13.37	13.50	98.16%	1.93	27.29
Stem diameter (cm)	1.24	3.04	2.15	0.27	0.27	24.24	24.30	99.52%	1.07	49.82
Peduncle length (cm)	3.49	7.44	5.31	0.91	0.92	17.97	18.06	99.03%	1.95	36.84
Petiole length (cm)	1.40	4.77	3.44	0.53	0.54	21.24	21.30	99.46%	1.50	43.63
Leaf area (cm^2)	119.38	299.88	179.65	1100.80	1109.76	18.47	18.54	99.19%	68.07	37.89
Days to first flowering (DAT)	46.41	57.20	52.48	3.92	4.81	3.77	4.18	81.42%	3.68	7.01
Days to 50% flowering (DAT)	53.47	63.68	58.78	4.06	5.32	3.43	3.92	76.33%	3.63	6.17
Total number of long styled flower	21.47	49.36	33.78	59.21	59.60	22.78	22.85	99.36%	15.80	46.77
Total number of medium styled flower	10.10	26.97	20.73	16.02	16.17	19.31	19.40	99.09%	8.21	39.60
Number of node to first fruiting	4.43	7.67	5.61	0.45	0.46	11.96	12.11	97.55%	1.36	24.33
Days to first fruit set (DAT)	54.22	65.29	59.32	6.54	7.61	4.31	4.65	85.90%	4.88	8.23
Days to first picking of fruits (DAT)	59.89	74.25	67.25	11.51	13.13	5.04	5.39	87.65%	6.54	9.73
Total number of fruits $plant^{-1}$	14.94	44.06	25.04	38.06	38.28	24.63	24.70	99.44%	12.67	50.60
Average fruit weight (g)	50.00	131.25	69.30	252.86	254.46	22.95	23.02	99.37%	32.65	47.12
Fruit length (cm)	6.81	15.46	8.52	3.11	3.13	20.72	20.78	99.38%	3.62	42.54
Fruit diameter (cm)	3.15	7.66	4.25	0.84	0.84	21.51	21.58	99.30%	1.88	44.15
Fruit yield $plant^{-1}$ (kg)	1.07	3.81	1.68	0.43	0.43	38.88	38.93	99.74%	1.35	79.99
Fruit yield $plot^{-1}$ (kg)	6.97	21.15	10.72	12.85	12.87	33.43	33.46	99.80%	7.38	68.79
Fruit yield $hectare^{-1}$ (q)	169.30	369.23	246.89	3227.02	3251.14	23.01	23.09	99.26%	116.59	47.22
Total chlorophyll content (mg g^{-1})	0.65	1.22	0.88	0.01	0.01	12.70	12.90	96.90%	0.23	25.75
Total soluble solids (°Brix)	4.20	5.55	4.92	0.12	0.13	6.95	7.19	93.37%	0.68	13.83
Ascorbic acid (mg 100 g^{-1})	1.07	2.43	1.68	0.07	0.08	16.16	16.28	98.54%	0.56	33.04
Vitamin A (IU g^{-1})	0.13	0.29	0.20	0.00	0.00	17.24	17.24	100%	0.07	35.53
Total anthocyanin (mg 100 g^{-1})	17.85	702.36	66.99	21145.08	21151.13	217.07	217.10	99.97%	299.51	447.10
Total protein (%)	0.52	1.80	0.83	0.07	0.07	31.75	31.82	99.57%	0.54	65.28
Total phenol content (mg GAE g^{-1} DW)	0.19	0.73	0.39	0.01	0.01	25.08	25.22	98.95%	0.20	51.41
Proline content (mg g^{-1} DW)	5.09	8.80	6.70	0.66	0.67	12.11	12.23	98.05%	1.65	24.69
Ash content (%)	5.15	8.33	6.60	0.63	0.64	11.98	12.10	98.04%	1.61	24.43

Study-2: Estimation of combining ability and heterosis for yield and yield attributes in parents, their crosses and comparison with a susceptible check (Year 2023)

The evaluation of brinjal parents, their crosses and a susceptible check was carried out over two consecutive seasons (spring-summer and *kharif*) during 2023 to estimate combining ability and heterosis for yield and its attributing traits. Bartlett's Chi-square test for homogeniety of error variances was applied. This test revealed that the error variances were homogeneous for all traits except PDI-for fruit at 14^{th} DAI (%) and ash content (%), therefore pooled analysis over both seasons was carried out. The obtained findings, pooled over seasons, are described under the following headings:

4.5 Analysis of variance for line × tester

The pooled ANOVA results for line × tester is represented in the Appendix-II. It revealed significant differences among the eighteen genotypes at 1% level for the forty-seven traits under the study. The replication exhibited no significant difference for all traits. The substantial variation was noticed among parents at 1% level for all traits. Whereas, for crosses all traits exhibited significant differences at various level of significance except, plant height at 30 DAT, 60 DAT and 90 DAT (cm), number of primary branches plant^{-1} at final harvest, total number of nodes at final harvest, internodal length of plant at final harvest (cm), days to first flowering (DAT), days to 50% flowering (DAT), number of node to first fruiting, days to first picking of fruits (DAT), total number of fruits plant^{-1}, fruit length (cm), fruit yield plant^{-1} (kg), plot^{-1} (kg), hectare^{-1} (q), total soluble solids (°Brix), proline content in fruits (mg g^{-1} DW) and ash content (%). While all the traits exhibited significant difference among the line vs testers at 1%, except the trait days to first seed emergence and days 50% seed emergence (DAS), which showed significant variations at 5% level. Among the parents vs crosses all the traits exhibited substantial difference, except internodal length of plant at final harvest (cm), petiole length (cm), total number of medium styled flower and number of node to first fruiting.

4.6 Mean performance studies of parents and their crosses in the year 2023

The pooled results of mean performance studies of parents and their crosses is explained under the following traits' heading;

4.6.1 Percent leaf incidence (PLI) (%)

Among parents and one check the minimum (8.07%) PLI was noticed in Pant Samrat, while the maximum (36.86%) was observed in Pant Rituraj (Table 4.6.1). Whereas, the minimum (6.18) PLI among the ten crosses was recorded in IC090146 × Pant Samrat and maximum (11.55%) in IC090781 × Pusa Bhairav (Table 4.6.2).

4.6.2 Percent fruit incidence (PFI) (%)

The PFI among parents and a check was noticed minimum (5.86%) in Pant Samrat and maximum (33.87%) in Pant Rituraj (Table 4.6.1). Among the ten crosses the lowest (4.52%) PFI was found in IC090146 × Pant Samrat and highest (8.03%) in IC090146 × Pusa Bhairav (Table 4.6.2).

4.6.3 Percent leaf area diseased (PLAD)-eye estimation (%)

The pooled mean results for the trait PLAD revealed the minimum (13.77%) scoring in Pant Samrat while maximum (64.42%) in Pant Rituraj among parents and check (stated in Table 4.6.1). Whereas, in crosses, the lowest (11.50%) PLAD was noticed in IC090146 × Pusa Bhairav and highest (17.72%) in IC090781 × Pant Samrat (Table 4.6.2).

4.6.4 Percent fruit area diseased (PFAD)-eye estimation (%)

The lowest (12.42%) PFAD was observed in Pant Samrat while highest (62.15%) in Pant Rituraj among the 7 parents and a check (Table 4.6.3). Among the derived crosses, PFAD was reported minimum (10.16%) in IC090146 × Pant Samrat and maximum (14.59%) in IC090810 × Pusa Bhairav (Table 4.6.4).

4.6.5 Percent disease index (PDI)-for leaf at 7th DAI (%)

PDI-for leaf at 7th DAI, among parents and a check was noticed minimum (3.10%) in Pant Samrat and maximum (14.16%) in Pant Rituraj (Table 4.6.3). Whereas, in crosses the minimum (2.40%) PDI-for leaf at 7th DAI was found in IC090146 × Pant Samrat and maximum (5.69%) in IC090828 × Pusa Bhairav (Table 4.6.4).

4.6.6 Percent disease index (PDI)-for leaf at 14th DAI (%)

Among the seven parents and a check, the minimum (7.10%) value for PDI-for leaf at 14th DAI observed in the Pant Samrat and maximum (34.20%) in Pant Rituraj. (Table 4.6.3). However, among crosses the lowest (5.63%) value was recorded in cross, IC090146 × Pant Samrat and highest (9.09%) in IC090887 × Pusa Bhairav (Table 4.6.4).

4.6.7 Percent disease index (PDI)-for leaf at 21st DAI (%)

Among the seven parents and check the lowest (13.12%) PDI-for leaf at 21st DAI was recorded in Pant Samrat and highest (63.72%) was in Pant Rituraj (Table 4.6.5). Among crosses the minimum (11.15%) PDI-for leaf at 21st DAI was found in IC090146 × Pant Samrat and maximum (17.05%) in IC090828 × Pusa Bhairav (Table 4.6.6).

4.6.8 Percent disease index (PDI)-for fruit at 7th DAI (%)

The pooled results of mean analysis for the trait PDI-for fruit at 7th DAI was found minimum (1.80%) in the parent, Pant Samrat and maximum (13.41%) in Pant Rituraj (Table 4.6.5). The results stated in Table 4.6.6 revealed that lowest (1.16%) PDI-for fruit at 7th DAI was observed in IC090146 × Pant Samrat and highest (2.59%) in cross IC090810 × Pusa Bhairav (Table 4.6.6).

4.6.9 Percent disease index (PDI)-for fruit at 14th DAI (%)

The PDI-for fruit at 14th DAI was noticed minimum (4.70%) in Pant Samrat and maximum (23.06%) in Pant Rituraj (Table 4.6.5). While among the crosses, the lowest (3.07%) pooled mean was recorded for the cross IC090146 × Pant Samrat and highest (6.72%) in IC090146 × Pusa Bhairav (Table 4.6.6).

4.6.10 Percent disease index (PDI)-for fruit at 21st DAI (%)

The minimum (11.28%) PDI for fruit at 21st DAI was observed in Pant Samrat and maximum (63.60%) in Pant Rituraj (Table 4.6.7). However, the PDI for fruit at 21st DAI in the evaluated crosses was found lowest (9.51%) in IC090146 × Pant Samrat and maximum (14.55%) in IC090146 × Pusa Bhairav (Table 4.6.8).

4.6.11 Lesion size on fruits (cm^2)

The smallest (0.222 cm^2) lesion size was recorded in Pant Samrat and largest (2.283 cm^2) in Pant Rituraj (Table 4.6.7). Whereas, among crosses the smallest (0.140 cm^2) lesion size was measured in IC090146 × Pant Samrat and largest (0.465 cm^2) in IC090810 × Pusa Bhairav (Table 4.6.8).

4.6.12 Days to first seed emergence (DAS)

Pooled results of mean study revealed that among parents and susceptible check the shortest (6.74 days) time to first seed emergence (DAS) was observed in IC090146 and longest (7.75 days) in Pant Rituraj (Table 4.6.7). However, in evaluated crosses, the minimum (6.23 days) duration was noticed in IC090146 × Pant Samrat and maximum (7.24 days) in IC090781 × Pant Samrat (Table 4.6.8).

Table 4.6.1 Mean performance of parents and susceptible check for percent leaf incidence (%), percent fruit incidence (%) and percent leaf area diseased (%) in the year 2023

S. No.	Parents	Percent leaf incidence (%)			Percent fruit incidence (%)			Percent leaf area diseased (%)		
		Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled
Lines										
1	**IC090146**	12.51	14.81	13.66	12.31	15.64	13.98	21.21	22.44	21.83
2	**IC090781**	17.29	17.7	17.50	16.32	19.69	18.01	26.18	28.12	27.15
3	**IC090810**	15.09	15.55	15.32	12.30	16.63	14.47	25.53	26.3	25.92
4	**IC090828**	18.10	18.93	18.52	14.66	16.75	15.71	28.39	29.31	28.85
5	**IC090887**	35.69	35.98	35.84	30.17	32.49	31.33	60.47	63.18	61.83
Testers										
6	**Pusa Bhairav**	10.48	10.03	10.26	8.71	8.86	8.79	16.89	18.09	17.49
7	**Pant Samrat**	8.52	7.61	8.07	5.74	5.98	5.86	13.28	14.26	13.77
Check										
8	**Pant Rituraj**	35.32	38.4	36.86	32.34	35.40	33.87	63.39	65.44	64.42
Overall Mean		16.81	17.23	17.02	14.32	16.58	15.45	27.42	28.81	28.12
Minimum		8.52	7.61	8.07	5.74	5.98	5.86	13.28	14.26	13.77
Maximum		35.69	38.4	36.86	32.34	35.40	33.87	63.39	65.44	64.42
S.E. (±)		0.25	0.26	0.14	0.29	0.20	0.17	0.46	0.37	0.34
C.D. (P=0.05)		0.76	0.81	0.42	0.88	0.61	0.54	1.41	1.14	1.05
C.V. (%)		2.55	2.63	1.39	3.45	2.06	1.95	2.88	2.21	2.10

Table 4.6.2 Mean performance of brinjal crosses for percent leaf incidence (%), percent fruit incidence (%) and percent leaf area diseased (%) in the year 2023

S. No.	Crosses	Percent leaf incidence (%)			Percent fruit incidence (%)			Percent leaf area diseased (%)		
		Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled
1	**IC090146 × Pusa Bhairav**	9.62	11.11	10.37	8.46	7.59	8.03	10.58	12.41	11.50
2	**IC090146 × Pant Samrat**	6.47	5.89	6.18	4.43	4.61	4.52	16.49	17.48	16.99
3	**IC090781 × Pusa Bhairav**	10.38	12.72	11.55	5.07	6.72	5.90	10.78	12.82	11.80
4	**IC090781 × Pant Samrat**	7.11	6.13	6.62	4.58	4.82	4.70	18.58	16.85	17.72
5	**IC090810 × Pusa Bhairav**	9.64	12.39	11.02	5.81	5.89	5.85	11.21	12.98	12.10
6	**IC090810 × Pant Samrat**	7.62	6.39	7.01	4.86	4.96	4.91	17.62	14.68	16.15
7	**IC090828 × Pusa Bhairav**	10.19	11.93	11.06	4.63	6.33	5.48	13.6	13.76	13.68
8	**IC090828 × Pant Samrat**	8.58	7.01	7.80	5.54	7.18	6.36	16.85	15.62	16.24
9	**IC090887 × Pusa Bhairav**	9.63	9.31	9.47	7.62	8.25	7.94	13.4	13.48	13.44
10	**IC090887 × Pant Samrat**	7.96	10.97	9.47	9.35	6.12	7.74	12.57	13.52	13.05
Overall Mean		8.72	9.39	9.05	6.04	6.25	6.14	14.17	14.36	14.26
Minimum		6.47	5.89	6.18	4.43	4.61	4.52	10.58	12.41	11.50
Maximum		10.38	12.72	11.55	9.35	8.25	8.03	18.58	17.48	17.72
S.E. (±)		0.13	0.13	0.11	0.06	0.10	0.06	0.27	0.18	0.15
C.D. (P=0.05)		0.39	0.39	0.33	0.16	0.31	0.17	0.80	0.54	0.46
C.V. (%)		2.63	2.43	2.12	1.60	2.88	1.59	3.31	2.21	1.88

Table 4.6.3 Mean performance of parents and susceptible check for percent fruit area diseased (%), percent disease index-for leaf at 7th DAI and 14th DAI (%) in the year 2023

S. No.	Parents	Percent fruit area diseased-eye estimation (%)			Percent disease index-for leaf at 7th DAI (%)			Percent disease index-for leaf at 14th DAI (%)		
		Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled
Lines										
1	**IC090146**	22.66	22.67	22.67	4.74	6.33	5.54	11.58	17.88	14.73
2	**IC090781**	25.53	27.76	26.65	6.21	6.17	6.19	13.41	19.43	16.42
3	**IC090810**	24.72	25.16	24.94	5.2	7.09	6.15	12.11	17.63	14.87
4	**IC090828**	26.63	28.49	27.56	6.03	8.49	7.26	13.7	19.54	16.62
5	**IC090887**	58.67	61.39	60.03	5.12	5.47	5.30	27.34	40.82	34.08
Testers										
6	**Pusa Bhairav**	11.3	14.63	12.97	4.16	5.24	4.70	8.31	11.62	9.97
7	**Pant Samrat**	11.56	13.27	12.42	3.07	3.13	3.10	5.76	8.43	7.10
Check										
8	**Pant Rituraj**	61.04	63.26	62.15	13.62	14.70	14.16	31.14	37.26	34.20
Overall Mean		25.87	27.62	26.75	4.93	5.99	5.46	13.17	19.34	16.25
Minimum		11.30	13.27	12.42	3.07	3.13	3.10	5.76	8.43	7.10
Maximum		61.04	63.26	62.15	13.62	14.70	14.16	31.14	40.82	34.20
S.E. (±)		0.32	0.44	0.32	0.07	0.12	0.07	0.20	0.33	0.19
C.D. (P=0.05)		0.98	1.34	0.99	0.21	0.36	0.22	0.61	1.03	0.58
C.V. (%)		2.13	2.73	2.08	2.40	3.35	2.26	2.62	3.00	2.01

Table 4.6.4 Mean performance of brinjal crosses for percent fruit area diseased (%), percent disease index-for leaf at 7th DAI and 14th DAI (%) in the year 2023

S. No.	Crosses	Percent fruit area diseased-eye estimation (%)			Percent disease index-for leaf at 7th DAI (%)			Percent disease index-for leaf at 14th DAI (%)		
		Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled
1	**IC090146 × Pusa Bhairav**	13.55	12.68	13.12	4.19	4.28	4.24	6.40	9.54	7.97
2	**IC090146 × Pant Samrat**	9.48	10.84	10.16	2.23	2.57	2.40	4.58	6.67	5.63
3	**IC090781 × Pusa Bhairav**	11.82	12.48	12.15	3.85	4.18	4.02	6.55	10.72	8.64
4	**IC090781 × Pant Samrat**	9.93	10.97	10.45	2.64	2.76	2.70	4.73	6.82	5.78
5	**IC090810 × Pusa Bhairav**	13.48	15.69	14.59	4.19	5.21	4.70	7.93	9.62	8.78
6	**IC090810 × Pant Samrat**	10.35	11.21	10.78	2.89	2.89	2.89	4.95	7.49	6.22
7	**IC090828 × Pusa Bhairav**	12.85	12.22	12.54	5.32	6.05	5.69	5.76	9.38	7.57
8	**IC090828 × Pant Samrat**	10.48	15.76	13.12	5.55	5.41	5.48	6.85	7.63	7.24
9	**IC090887 × Pusa Bhairav**	11.62	13.41	12.52	3.75	4.64	4.20	7.64	10.53	9.09
10	**IC090887 × Pant Samrat**	10.58	12.52	11.55	5.04	5.51	5.28	6.59	8.21	7.40
Overall Mean		11.41	12.78	12.78	3.97	4.35	4.16	6.20	8.66	7.43
Minimum		9.48	10.84	10.16	2.23	2.57	2.40	4.58	6.67	5.63
Maximum		13.55	15.76	14.59	5.55	6.05	5.69	7.93	10.72	9.09
S.E. (±)		0.21	0.19	0.19	0.06	0.06	0.04	0.10	0.10	0.08
C.D. (P=0.05)		0.63	0.55	0.55	0.17	0.19	0.12	0.31	0.30	0.24
C.V. (%)		3.21	2.52	1.95	2.57	2.53	1.72	2.91	2.02	1.91

Table 4.6.5 Mean performance of parents and susceptible check for percent disease index-for leaf at 21st DAI, percent disease index-for fruit at 7th DAI and 14th DAI (%) in the year 2023

S. No.	Parents	Percent disease index-for leaf at 21st DAI (%)			Percent disease index-for fruit at 7th DAI (%)			Percent disease index-for fruit at 14th DAI (%)		
		Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled
Lines										
1	**IC090146**	26.62	26.30	26.46	3.67	4.79	4.23	7.16	10.34	8.75
2	**IC090781**	29.61	29.43	29.52	3.46	5.66	4.56	8.62	12.37	10.50
3	**IC090810**	27.91	27.5	27.71	3.18	4.31	3.75	8.12	12.75	10.44
4	**IC090828**	30.46	30.63	30.55	4.38	5.57	4.98	9.24	13.64	11.44
5	**IC090887**	62.48	62.17	62.33	9.78	12.35	11.07	18.26	26.75	22.51
Testers										
6	**Pusa Bhairav**	18.32	18.26	18.29	2.82	3.27	3.05	4.88	8.62	6.75
7	**Pant Samrat**	13.18	13.06	13.12	1.41	2.18	1.80	3.91	5.48	4.70
Check										
8	**Pant Rituraj**	63.17	64.26	63.72	11.88	14.93	13.41	19.02	27.09	23.06
Overall Mean		29.80	29.67	29.73	4.10	5.45	4.77	8.60	12.85	10.72
Minimum		13.18	13.06	13.12	1.41	2.18	1.80	3.91	5.48	4.70
Maximum		63.17	64.26	63.72	11.88	14.93	13.41	19.02	27.09	23.06
S.E. (±)		0.52	0.57	0.23	0.09	0.07	0.07	0.08	0.20	0.13
C.D. (P=0.05)		1.60	1.76	0.70	0.27	0.22	0.20	0.24	0.63	0.40
C.V. (%)		3.02	3.33	1.32	3.71	2.30	2.36	1.59	2.75	2.07

Table 4.6.6 Mean performance of brinjal crosses for percent disease index-for leaf at 21st DAI, percent disease index-for fruit at 7th DAI and 14th DAI (%) in the year 2023

S. No.	Crosses	Percent disease index-for leaf at 21st DAI (%)			Percent disease index-for fruit at 7th DAI (%)			Percent disease index-for fruit at 14th DAI (%)		
		Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled
1	**IC090146 × Pusa Bhairav**	15.42	14.62	15.02	2.16	2.51	2.34	6.72	6.71	6.72
2	**IC090146 × Pant Samrat**	11.35	10.95	11.15	1.04	1.28	1.16	2.53	3.61	3.07
3	**IC090781 × Pusa Bhairav**	16.22	16.75	16.49	2.72	2.40	2.56	5.91	6.52	6.22
4	**IC090781 × Pant Samrat**	11.08	11.46	11.27	1.11	1.59	1.35	2.76	3.78	3.27
5	**IC090810 × Pusa Bhairav**	17.63	15.63	16.63	2.80	2.38	2.59	4.69	7.37	6.03
6	**IC090810 × Pant Samrat**	12.62	11.78	12.20	1.31	1.72	1.52	2.95	3.93	3.44
7	**IC090828 × Pusa Bhairav**	16.48	17.62	17.05	1.09	2.15	1.62	3.57	6.22	4.90
8	**IC090828 × Pant Samrat**	13.04	12.17	12.61	2.11	2.22	2.17	5.48	6.84	6.16
9	**IC090887 × Pusa Bhairav**	17.69	15.42	16.56	2.62	2.48	2.55	6.62	5.83	6.23
10	**IC090887 × Pant Samrat**	12.63	12.48	12.56	1.39	2.07	1.73	4.58	4.53	4.56
Overall Mean		14.42	13.89	14.15	1.84	2.08	1.96	4.58	5.53	5.06
Minimum		11.08	10.95	11.15	1.04	1.28	1.16	2.53	3.61	3.07
Maximum		17.69	17.62	17.05	2.80	2.51	2.59	6.72	7.37	6.72
S.E. (±)		0.16	0.17	0.12	0.02	0.04	0.02	0.05	0.10	0.05
C.D. (P=0.05)		0.47	0.51	0.34	0.05	0.11	0.06	0.14	0.29	0.16
C.V. (%)		1.89	2.16	1.41	1.62	3.15	1.80	1.81	3.10	1.85

Table 4.6.7 Mean performance of parents and susceptible check for percent disease index-for fruit at 21st DAI (%), lesion size on fruits (cm^2) and days to first seed emergence (DAS) in the year 2023

S. No.	Parents	Percent disease index-for fruit at 21st DAI (%)			Lesion size on fruits (cm^2)			Days to first seed emergence (DAS)		
		Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled
Lines										
1	**IC090146**	23.17	23.85	23.51	0.537	0.531	0.534	6.12	7.36	6.74
2	**IC090781**	26.85	26.43	26.64	0.635	0.638	0.637	6.29	7.46	6.88
3	**IC090810**	24.63	24.17	24.40	0.549	0.560	0.554	6.41	7.95	7.18
4	**IC090828**	29.76	29.68	29.72	0.636	0.660	0.648	7.24	6.88	7.06
5	**IC090887**	61.49	61.48	61.49	2.014	2.123	2.069	6.94	6.63	6.79
Testers										
6	**Pusa Bhairav**	16.75	16.75	16.75	0.281	0.756	0.519	6.67	7.27	6.97
7	**Pant Samrat**	11.34	11.22	11.28	0.227	0.216	0.222	6.89	7.39	7.14
Check										
8	**Pant Rituraj**	63.17	64.02	63.60	2.280	2.286	2.283	7.71	7.78	7.75
Overall Mean		27.71	27.65	27.68	0.697	0.783	0.740	6.65	7.28	6.96
Minimum		11.34	11.22	11.28	0.227	0.216	0.222	6.12	6.63	6.74
Maximum		63.17	64.02	63.60	2.280	2.286	2.283	7.71	7.95	7.75
S.E. (±)		0.52	0.29	0.26	0.021	0.01	0.01	0.11	0.10	0.06
C.D. (P=0.05)		1.61	0.91	0.79	0.064	0.03	0.04	0.33	0.30	0.19
C.V. (%)		3.27	1.84	1.61	5.135	2.26	2.66	2.78	2.32	1.55

Table 4.6.8 Mean performance of brinjal crosses for percent disease index-for fruit at 21st DAI (%), lesion size on fruits (cm^2) and days to first seed emergence (DAS) in the year 2023

S. No.	Crosses	Percent disease index (PDI)-for fruit 21st DAI (%)			Lesion size on fruits (cm^2)			Days to first seed emergence (DAS)		
		Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled
1	**IC090146 × Pusa Bhairav**	14.82	14.28	14.55	0.270	0.390	0.330	6.13	6.52	6.33
2	**IC090146 × Pant Samrat**	9.48	9.53	9.51	0.110	0.170	0.140	6.34	6.12	6.23
3	**IC090781 × Pusa Bhairav**	15.37	13.53	14.45	0.230	0.410	0.320	5.75	7.48	6.62
4	**IC090781 × Pant Samrat**	9.73	9.87	9.80	0.150	0.180	0.165	6.84	7.63	7.24
5	**IC090810 × Pusa Bhairav**	14.28	14.64	14.46	0.250	0.680	0.465	6.75	6.42	6.59
6	**IC090810 × Pant Samrat**	10.14	10.36	10.25	0.160	0.200	0.180	7.48	6.22	6.85
7	**IC090828 × Pusa Bhairav**	13.39	15.42	14.41	0.180	0.480	0.330	6.55	6.94	6.75
8	**IC090828 × Pant Samrat**	11.21	10.99	11.10	0.250	0.220	0.235	7.21	6.39	6.80
9	**IC090887 × Pusa Bhairav**	14.55	13.76	14.16	0.260	0.530	0.395	6.34	7.31	6.83
10	**IC090887 × Pant Samrat**	11.19	10.85	11.02	0.220	0.210	0.215	5.98	7.56	6.77
Overall Mean		12.42	12.32	12.37	0.208	0.347	0.278	6.54	6.86	6.70
Minimum		9.48	9.53	9.51	0.110	0.170	0.140	5.75	6.12	6.23
Maximum		15.37	15.42	14.55	0.270	0.680	0.465	7.48	7.63	7.24
S.E. (±)		0.17	0.20	0.14	0.003	0.01	0.00	0.11	0.10	0.06
C.D. (P=0.05)		0.49	0.58	0.42	0.009	0.02	0.01	0.32	0.30	0.17
C.V. (%)		2.32	2.75	1.96	2.440	2.80	2.09	2.85	2.56	1.46

4.6.13 Days to 50% seed emergence (DAS)

The days to 50% seed emergence (DAS) among the parents and check was found shortest (7.39 days) for the parent IC090887 and longest (9.96 days) for Pant Rituraj (Table 4.6.9). While in the derived crosses it was observed minimum (7.13 days) in IC090146 × Pant Samrat and maximum (8.17 days) in IC090887 × Pusa Bhairav (Table 4.6.10).

4.6.14 Plant height at 30 DAT (cm)

The pooled results revealed that the maximum (45.03 cm) plant height at 30 DAT was measured in Pant Samrat and minimum (39.74 cm) height in IC090146 among the parents and check (Table 4.6.9). However, among 10-crosses, the tallest (57.65 cm) plant was recorded for IC090810 × Pant Samrat and shortest (51.02 cm) for IC090146 × Pusa Bhairav (Table 4.6.10).

4.6.15 Plant height at 60 DAT (cm)

The plant height at 60 DAT among the parents and check was found highest (67.30 cm) in Pant Samrat and lowest (53.94 cm) in IC090887 (Table 4.6.9). Whereas, in the crosses, IC090781 × Pant Samrat was noticed with the maximum (83.08 cm) and minimum (74.85 cm) plant height in IC090146 × Pusa Bhairav (Table 4.6.10).

4.6.16 Plant height at 90 DAT (cm)

The longest (74.30 cm) plant height at 90 DAT was recorded in Pant Samrat and shortest (62.92 cm) in IC090828, among parents and check (Table 4.6.11). However, in the derived crosses the maximum (92.86 cm) plant height was measured in IC090810 × Pant Samrat and minimum (87.45 cm) in IC090887 × Pusa Bhairav (Table 4.6.12).

4.6.17 Plant height at final harvest (cm)

The pooled results revealed that among parents and check, the highest (84.88 cm) plant height at final harvest was noticed in Pant Samrat and lowest (72.86 cm) in IC090810 (Table 4.6.11). Whereas, in the evaluated crosses, the maximum (110.09 cm) plant height at final harvest was observed in IC090146 × Pant Samrat and minimum (96.19 cm) in IC090828 × Pusa Bhairav.

4.6.18 Total number of primary branches plant^{-1} at final harvest

The total number of primary branches plant^{-1} at final harvest was found maximum (8.65) in Pant Samrat and minimum (5.29) in IC090781 among parents and check (Table 4.6.11). Whereas, in crosses, the highest no. of primary branches (11.91) was recorded in IC090146 × Pant Samrat and lowest (8.95) in IC090828 × Pusa Bhairav (Table 4.6.12).

4.6.19 Total number of nodes at final harvest

The total no. of nodes at final harvest among parents and check, Pant Samrat exhibited the maximum number of nodes (17.88), while IC090887 had the minimum number of nodes (14.61) (Table 4.6.13). However, the highest no. of nodes was observed in IC090146 × Pant Samrat (22.51) and lowest no. of total nodes (18.59) was in IC090887 × Pusa Bhairav (Table 4.6.14).

4.6.20 Internodal length of plant at final harvest (cm)

The pooled results stated in Table 4.6.13 revealed that the minimum (6.73 cm) internodal length of plants at final harvest was noticed in IC090828 and maximum (9.16 cm) in Pant Samrat among parents and check. While, in the derivative crosses the shortest (4.76 cm) internodal length was recorded in IC090146 × Pant Samrat and longest (8.45 cm) in IC090810 × Pusa Bhairav (Table 4.6.14).

4.6.21 Stem diameter (cm)

Among parents and check, the stem diameter was recorded maximum (3.01 cm) in Pant Samrat and minimum (1.20 cm) in IC090828 (Table 4.6.13). In brinjal crosses, the thickest (4.68 cm) stem diameter was measured in IC090146 × Pant Samrat and thinnest (2.21 cm) in IC090828 × Pusa Bhairav (Table 4.6.14).

4.6.22 Peduncle length (cm)

The pooled results related to peduncle length among parents and check revealed that the shortest (4.20 cm) peduncle was found in IC090781and longest (7.27 cm) in Pant Samrat (Table 4.6.15). Whereas, in crosses the minimum (5.34 cm) peduncle length was recorded in IC090781 × Pusa Bhairav and maximum (8.14 cm) in IC090781 × Pant Samrat (Table 4.6.16).

4.6.23 Petiole length (cm)

Among the parents and check, Pant Samrat recorded the minimum petiole length (1.64 cm), whereas Pusa Bhairav exhibited the maximum (3.22 cm) petiole length (Table 4.6.15). The shortest petiole length (2.82 cm) was observed in IC090828 × Pusa Bhairav and longest (3.98 cm) in IC090810 × Pant Samrat among brinjal crosses (Table 4.6.16).

4.6.24 Leaf area (cm^2)

The pooled results revealed that among parents and check, Pusa Bhairav had the largest leaf area (287.75 cm^2) leaf area and smallest (128.49 cm^2) was recorded in IC090146 (Table 4.6.15). Among brinjal crosses the maximum (307.98 cm^2) leaf area was noticed in IC090810 × Pant Samrat and minimum (235.48 cm^2) was in IC090828 × Pusa Bhairav (Table 4.6.16).

4.6.25 Days to first flowering (DAT)

The pooled results of the trait days to first flowering indicated that Pant Samrat had the earliest flowering (48.74 days) and Pant Rituraj exhibited the latest (54.05 days) first flowering among parents and check (Table 4.6.17). However, in crosses the earliest (39.83) first flowering occurred in IC090146 × Pant Samrat, while the latest (44.46) first flowering was recorded in IC090810 × Pusa Bhairav (Table 4.6.18).

4.6.26 Days to 50% flowering (DAT)

For the trait days to 50% flowering, the minimum (53.37 days) duration was observed in Pant Samrat while, maximum (59.73 days) in Pant Rituraj among parents and check (Table 4.6.17). Whereas, in brinjal crosses the earliest 50% flowering (42.24 days) was observed in IC090828 × Pant Samrat, while the latest 50% flowering (47.82 days) occurred in IC090810 × Pusa Bhairav (Table 4.6.18).

4.6.27 Total no. of long styled flower

Among parents and check, the highest (50.44) no. of long-styled flowers was noticed in Pusa Bhairav whereas, lowest (32.93) in IC090810 (Table 4.6.17). While, in the derivative brinjal crosses, the maximum (63.03) count of long styled flowers was recorded in IC090146 × Pant Samrat and minimum (54.41) in IC090810 × Pusa Bhairav (Table 4.6.18).

4.6.28 Total number of medium styled flower

The maximum (26.57) no. of medium styled flowers was reported in IC090828 and minimum (17.26) in Pusa Bhairav among parents and check (Table 4.6.19). Whereas, in crosses the highest (30.53) number of medium styled flowers was observed in IC090781 × Pant Samrat and lowest (26.47) in IC090887 × Pusa Bhairav (Table 4.6.20).

4.6.29 Number of node to first fruiting

Among parents and check the minimum (4.93) number of nodes to first fruiting was recorded in IC090146 while, maximum (7.90) was found in Pant Samrat (Table 4.6.19). However, in the brinjal crosses the lowest (7.37) no. node to first fruiting was observed in IC090810 × Pusa Bhairav, whereas the highest (9.11) was recorded in IC090146 × Pant Samrat (Table 4.6.20).

Table 4.6.9 Mean performance of parents and susceptible check for days to 50% seed emergence (DAS), plant height at 30 DAT and 60 DAT (cm) in the year 2023

S. No.	Parents	Days to 50% seed emergence (DAS)			Plant height at 30 DAT (cm)			Plant height at 60 DAT (cm)		
		Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled
Lines										
1	**IC090146**	7.44	9.21	8.33	39.12	40.35	39.74	51.34	58.34	54.84
2	**IC090781**	7.92	9.64	8.78	39.42	41.62	40.52	52.24	59.34	55.79
3	**IC090810**	8.53	9.41	8.97	38.62	43.14	40.88	50.32	57.63	53.98
4	**IC090828**	7.63	7.34	7.49	38.41	41.62	40.02	50.64	57.34	53.99
5	**IC090887**	7.36	7.41	7.39	38.41	41.35	39.88	50.34	57.53	53.94
Testers										
6	**Pusa Bhairav**	7.28	9.31	8.30	42.14	46.32	44.23	62.34	69.62	65.98
7	**Pant Samrat**	7.21	8.39	7.80	43.21	46.84	45.03	63.15	71.44	67.30
Check										
8	**Pant Rituraj**	9.86	10.05	9.96	39.15	41.63	40.39	59.44	64.82	62.13
Overall Mean		7.62	8.67	8.15	39.90	43.03	41.47	54.34	61.61	57.97
Minimum		7.21	7.34	7.39	38.41	40.35	39.74	50.32	57.34	53.94
Maximum		9.86	10.05	9.96	43.21	46.84	45.03	63.15	71.44	67.30
S.E. (±)		0.13	0.09	0.06	0.59	0.51	0.35	1.05	1.02	0.64
C.D. (P=0.05)		0.40	0.29	0.18	1.81	1.58	1.08	3.23	3.16	1.96
C.V. (%)		2.96	1.85	1.23	2.56	2.06	1.47	3.34	2.88	1.90

Table 4.6.10 Mean performance of brinjal crosses for days to 50% seed emergence (DAS), plant height at 30 DAT and 60 DAT (cm) in the year 2023

S. No.	Crosses	Days to 50% seed emergence (DAS)			Plant height at 30 DAT (cm)			Plant height at 60 DAT (cm)		
		Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled
1	**IC090146 × Pusa Bhairav**	7.62	7.43	7.53	44.36	57.68	51.02	65.35	84.35	74.85
2	**IC090146 × Pant Samrat**	6.63	7.63	7.13	53.72	60.63	57.18	76.47	87.21	81.84
3	**IC090781 × Pusa Bhairav**	5.97	8.88	7.43	51.23	58.71	54.97	73.35	85.19	79.27
4	**IC090781 × Pant Samrat**	7.42	8.69	8.06	53.14	60.81	56.98	77.74	88.41	83.08
5	**IC090810 × Pusa Bhairav**	7.63	6.98	7.31	50.56	56.44	53.50	74.64	84.11	79.38
6	**IC090810 × Pant Samrat**	8.71	7.59	8.15	54.24	61.06	57.65	76.41	87.88	82.15
7	**IC090828 × Pusa Bhairav**	7.62	8.09	7.86	49.73	57.51	53.62	73.75	83.61	78.68
8	**IC090828 × Pant Samrat**	8.58	7.51	8.05	50.81	58.04	54.43	72.43	84.24	78.34
9	**IC090887 × Pusa Bhairav**	7.61	8.72	8.17	49.03	56.82	52.93	73.35	82.02	77.69
10	**IC090887 × Pant Samrat**	6.74	8.46	7.60	51.32	59.15	55.24	74.57	85.14	79.86
Overall Mean		7.45	8.00	7.73	50.81	58.69	54.75	73.81	85.22	79.51
Minimum		5.97	6.98	7.13	44.36	56.44	51.02	65.35	82.02	74.85
Maximum		8.71	8.88	8.17	54.24	61.06	57.65	77.74	88.41	83.08
S.E.(±)		0.12	0.13	0.08	0.93	0.91	0.59	0.79	1.12	0.68
C.D. (P=0.05)		0.37	0.37	0.22	2.74	2.70	1.76	2.32	3.31	2.00
C.V. (%)		2.88	2.71	1.69	3.16	2.69	1.88	1.84	2.28	1.47

Table 4.6.11 Mean performance of parents and susceptible check for plant height at 90 DAT (cm), at final harvest (cm) and total no. of primary branches plant^{-1} at final harvest in the year 2023

S. No.	Parents	Plant height at 90 DAT (cm)			Plant height at final harvest (cm)			Total no. of primary branches plant^{-1} at final harvest		
		Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled
Lines										
1	**IC090146**	62.48	69.81	66.15	72.63	78.64	75.64	6.03	6.21	6.12
2	**IC090781**	63.24	69.27	66.26	71.37	79.51	75.44	5.11	5.47	5.29
3	**IC090810**	61.35	68.62	64.99	66.35	79.37	72.86	5.87	5.88	5.88
4	**IC090828**	60.35	65.48	62.92	70.37	77.34	73.86	4.81	6.01	5.41
5	**IC090887**	60.49	66.53	63.51	71.42	74.62	73.02	5.21	6.21	5.71
Testers										
6	**Pusa Bhairav**	67.48	76.28	71.88	77.54	84.31	80.93	8.24	8.12	8.18
7	**Pant Samrat**	69.77	78.83	74.30	81.13	88.63	84.88	8.63	8.67	8.65
Check										
8	**Pant Rituraj**	66.15	71.60	68.88	74.86	79.90	77.38	7.56	7.48	7.52
Overall Mean		63.59	70.69	67.14	72.97	80.35	76.66	6.27	6.65	6.46
Minimum		60.35	65.48	62.92	66.35	74.62	72.86	4.81	5.47	5.29
Maximum		69.77	78.83	74.30	81.13	88.63	84.88	8.63	8.67	8.65
S.E. (±)		0.88	1.18	0.73	0.89	1.32	0.86	0.06	0.11	0.06
C.D. (P=0.05)		2.72	3.62	2.25	2.75	4.06	2.66	0.17	0.34	0.17
C.V. (%)		2.41	2.88	1.89	2.12	2.84	1.95	1.53	2.84	1.49

Table 4.6.12 Mean performance of brinjal crosses for plant height at 90 DAT (cm), at final harvest (cm) and total no. of primary branches plant^{-1} at final harvest in the year 2023

S. No.	Crosses	Plant height at 90 DAT (cm)			Plant height at final harvest (cm)			Total no. of primary branches plant^{-1} at final harvest		
		Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled	Spring Summer	*Kharif*	Pooled
1	**IC090146 × Pusa Bhairav**	84.64	93.62	89.13	96.35	101.63	98.99	9.35	9.46	9.41
2	**IC090146 × Pant Samrat**	85.47	97.64	91.56	104.67	115.51	110.09	11.72	12.09	11.91
3	**IC090781 × Pusa Bhairav**	83.25	94.99	89.12	91.89	105.47	98.68	10.67	9.11	9.89
4	**IC090781 × Pant Samrat**	86.35	98.25	92.30	104.33	113.47	108.90	11.51	11.77	11.64
5	**IC090810 × Pusa Bhairav**	83.62	93.64	88.63	94.61	104.62	99.62	9.82	8.81	9.32
6	**IC090810 × Pant Samrat**	86.88	98.84	92.86	101.94	112.61	107.28	10.70	11.05	10.88
7	**IC090828 × Pusa Bhairav**	83.64	92.74	88.19	92.47	99.91	96.19	8.88	9.01	8.95
8	**IC090828 × Pant Samrat**	80.75	95.50	88.13	98.74	105.67	102.21	9.67	10.48	10.08
9	**IC090887 × Pusa Bhairav**	81.48	93.42	87.45	90.47	108.81	99.64	8.97	9.71	9.34
10	**IC090887 × Pant Samrat**	85.04	94.82	89.93	97.66	103.68	100.67	10.47	10.61	10.54
Overall Mean		84.11	95.35	89.73	97.31	107.14	102.23	10.18	10.21	10.19
Minimum		80.75	92.74	87.45	90.47	99.91	96.19	8.88	8.81	8.95
Maximum		86.88	98.84	92.86	104.67	115.51	110.09	11.72	12.09	11.91
S.E. (±)		1.18	1.16	0.58	1.18	1.32	0.70	0.16	0.11	0.10
C.D. (P=0.05)		3.49	3.45	1.71	3.51	3.89	2.06	0.48	0.33	0.31
C.V. (%)		2.42	2.11	1.11	2.11	2.13	1.18	2.76	1.92	1.77

Table 4.6.13 Mean performance of parents and susceptible check for total no. of nodes at final harvest, internodal length of plant at final harvest (cm) and stem diameter (cm) in the year 2023

S. No.	Parents	Total no. of nodes at final harvest			Internodal length of plant at final harvest (cm)			Stem diameter (cm)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
Lines										
1	**IC090146**	14.35	17.62	15.99	6.62	7.14	6.88	1.67	2.24	1.96
2	**IC090781**	13.43	17.77	15.60	7.01	7.22	7.12	1.98	2.45	2.22
3	**IC090810**	14.32	17.34	15.83	7.58	8.03	7.81	1.17	1.39	1.28
4	**IC090828**	12.36	17.93	15.15	6.32	7.14	6.73	1.19	1.21	1.20
5	**IC090887**	13.75	15.46	14.61	6.43	7.46	6.95	2.28	2.99	2.64
Testers										
6	**Pusa Bhairav**	15.04	19.71	17.38	8.67	9.01	8.84	2.68	3.13	2.91
7	**Pant Samrat**	15.73	20.03	17.88	8.81	9.50	9.16	2.68	3.07	3.01
Check										
8	**Pant Rituraj**	14.68	16.76	15.72	8.27	8.21	8.24	2.72	2.95	2.84
Overall Mean		14.14	17.98	16.06	7.35	7.93	7.64	1.99	2.35	2.17
Minimum		12.36	15.46	14.61	6.32	7.14	6.73	1.17	1.21	1.20
Maximum		15.73	20.03	17.88	8.81	9.50	9.16	2.95	3.13	3.01
S.E. (±)		0.19	0.24	0.10	0.13	0.11	0.08	0.02	0.04	0.02
C.D. (P=0.05)		0.60	0.75	0.30	0.39	0.33	0.24	0.06	0.12	0.07
C.V. (%)		2.38	2.36	1.05	2.98	2.32	1.77	1.62	2.84	1.75

Table 4.6.14 Mean performance of brinjal crosses for total no. of nodes at final harvest, internodal length of plant at final harvest (cm) and stem diameter (cm) in the year 2023

S. No.	Crosses	Total no. of nodes at final harvest			Internodal length of plant at final harvest (cm)			Stem diameter (cm)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
1	**IC090146 × Pusa Bhairav**	18.64	20.15	19.40	8.34	6.37	7.36	2.73	1.97	2.35
2	**IC090146 × Pant Samrat**	20.26	24.76	22.51	4.31	5.21	4.76	4.51	4.84	4.68
3	**IC090781 × Pusa Bhairav**	19.55	19.11	19.33	7.61	7.43	7.52	1.73	3.82	2.78
4	**IC090781 × Pant Samrat**	20.08	23.98	22.03	5.62	5.82	5.72	4.29	4.66	4.48
5	**IC090810 × Pusa Bhairav**	19.00	21.57	20.29	8.59	8.31	8.45	1.69	2.84	2.27
6	**IC090810 × Pant Samrat**	19.61	23.19	21.40	5.88	6.06	5.97	3.98	3.79	3.89
7	**IC090828 × Pusa Bhairav**	17.59	19.82	18.71	7.62	8.18	7.90	1.81	2.61	2.21
8	**IC090828 × Pant Samrat**	19.08	21.62	20.35	6.71	7.62	7.17	3.58	1.59	2.59
9	**IC090887 × Pusa Bhairav**	16.60	20.58	18.59	7.62	6.42	7.02	2.64	2.91	2.78
10	**IC090887 × Pant Samrat**	19.12	22.46	20.79	6.09	7.11	6.60	3.15	3.11	3.13
Overall Mean		18.95	21.72	20.34	6.84	6.85	6.85	3.01	3.21	3.11
Minimum		16.60	19.11	18.59	4.31	5.21	4.76	1.69	1.59	2.21
Maximum		20.26	24.76	22.51	8.59	8.31	8.45	4.51	4.84	4.68
S.E. (±)		0.33	0.43	0.27	0.08	0.08	0.06	0.02	0.06	0.03
C.D. (P=0.05)		0.98	1.27	0.79	0.25	0.25	0.19	0.06	0.17	0.10
C.V. (%)		3.02	3.43	2.27	2.14	2.13	1.63	1.22	3.15	1.93

4.6.30 Days to first fruit set (DAT)

The pooled results presented in Table 4.6.19 demonstrated that the days to first fruit set was counted minimum (52.98 days) in Pusa Bhairav and maximum (61.09 days) in Pant Rituraj among parents and check. Whereas, in the crosses the earliest (41.84 days) fruit set was observed in IC090146 × Pant Samrat and the latest (54.41 days) in IC090146 × Pusa Bhairav (Table 4.6.20).

4.6.31 Days to first picking of fruits (DAT)

Among the seven parents and one check, the earliest days to first picking of fruits (60.05 days) was exhibited by Pusa Bhairav and the most delayed (67.09 days) was by Pant Rituraj (Table 4.6.21). In brinjal crosses the fewest days to first picking (50.11 days) were recorded in IC090146 × Pant Samrat, while the highest (60.75 days) was observed in IC090146 × Pusa Bhairav (Table 4.6.22).

4.6.32 Total number of fruits plant^{-1}

Among parents and check, Pant Samrat had the highest number of fruits plant^{-1}, with 42.92 fruits, while the lowest count with 29.68 fruits was observed in IC090781 (Table 4.6.21). This suggests that Pant Samrat had superior fruit production, while IC09078 had lower fruiting efficiency across the seasons. However, in crosses, the maximum (49.49) no. of fruits plant^{-1} was noticed in IC090146 × Pant Samrat and minimum (40.11) in IC090146 × Pusa Bhairav (Table 4.6.22).

4.6.33 Average fruit weight (g)

The pooled results for average fruit weight among parents and check revealed that Pusa Bhairav recorded the heaviest fruits, with an average of 126.38 g, while IC090828 had the lightest fruit weight, with 61.20 g (Table 4.6.21). Whereas, in the derivative crosses the maximum (149.43 g) average fruit weight was recorded in IC090810 × Pant Samrat, and the minimum (131.81 g) was observed in IC090810 × Pusa Bhairav (Table 4.6.22).

4.6.34 Fruit length (cm)

Among the parents and the check, the longest fruit (15.38 cm) was measured for Pusa Bhairav and shortest fruit length (8.88 cm) was noticed in IC090810 (Table 4.6.23). For crosses the average fruit length recorded maximum (17.93 cm) in IC090810 × Pant Samrat and minimum (12.84 cm) in IC090781 × Pusa Bhairav (Table 4.6.24).

4.6.35 Fruit diameter (cm)

The pooled results for the trait fruit diameter among parents and check exhibited that the maximum (6.53 cm) fruit diameter was found in Pusa Bhairav and minimum (3.63 cm) in IC090146 (Table 4.6.23). However, in brinjal crosses the thickest (7.00 cm) fruits were noticed in IC090810 × Pant Samrat, while thinnest (4.60 cm) was observed in IC090828 × Pant Samrat (Table 4.6.24).

4.6.36 Fruit yield plant^{-1} (kg)

For fruit yield plant^{-1}, Pant Samrat had the highest yield plant^{-1} (3.70 kg) and IC090887 observed with the lowest fruit yield plant^{-1} (1.70 kg) among parents and check (Table 4.6.23). In crosses the maximum (4.82 kg) fruit yield plant^{-1} was noticed in IC090146 × Pant Samrat and minimum (3.16 kg) was recorded for the cross IC090146 × Pusa Bhairav (Table 4.6.24).

4.6.37 Fruit yield plot^{-1} (kg)

Among the seven parents and one check, the highest fruit yield plot^{-1} (26.41 kg) was recorded in Pant Samrat, while lowest (13.01 kg) was observed in IC090887 (Table 4.6.25). In case of crosses the maximum (35.04 kg) fruit yield plot^{-1} was noticed in IC090146 × Pant Samrat and minimum (19.95 kg) in IC090146 × Pusa Bhairav (Table 4.5.26).

4.6.38 Fruit yield hectare^{-1} (q)

Pant Samrat recorded the highest yield hectare^{-1} with 652.06 q and IC090887 noticed with the lowest yield hectare^{-1} with 321.09 q among parents and check (Table 4.6.25). In the derived brinjal crosses the maximum (865.01 q) fruit yield hectare^{-1} was observed in IC090146 × Pant Samrat whereas minimum (492.44 q) recorded in IC090146 × Pusa Bhairav (Table 4.6.26).

Table 4.6.15 Mean performance of parents and susceptible check for peduncle length (cm), petiole length (cm) and leaf area (cm^2) in the year 2023

S. No.	Parents	Peduncle length (cm)			Petiole length (cm)			Leaf area (cm^2)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
Lines										
1	**IC090146**	5.63	6.13	5.88	2.88	3.04	2.96	124.63	132.34	128.49
2	**IC090781**	4.12	4.27	4.20	2.57	2.64	2.61	136.62	142.64	139.63
3	**IC090810**	6.41	6.38	6.40	2.73	2.92	2.83	137.34	152.24	144.79
4	**IC090828**	4.92	4.76	4.84	2.63	2.57	2.60	122.52	151.19	136.86
5	**IC090887**	5.38	5.62	5.50	2.23	2.12	2.18	135.61	137.41	136.51
Testers										
6	**Pusa Bhairav**	6.98	7.21	7.10	3.16	3.27	3.22	281.12	294.38	287.75
7	**Pant Samrat**	7.17	7.36	7.27	1.49	1.78	1.64	248.57	265.21	256.89
Check										
8	**Pant Rituraj**	6.80	6.92	6.86	2.31	2.44	2.38	216.48	213.29	214.89
Overall Mean		5.80	5.96	5.88	2.53	2.62	2.57	169.49	182.20	175.84
Minimum		4.12	4.27	4.20	1.49	1.78	1.64	122.52	132.34	128.49
Maximum		7.17	7.36	7.27	3.16	3.27	3.22	281.12	294.38	287.75
S.E. (±)		0.08	0.10	0.07	0.04	0.04	0.03	3.04	2.00	1.90
C.D. (P=0.05)		0.24	0.31	0.21	0.12	0.12	0.08	9.36	6.17	5.84
C.V. (%)		2.28	2.89	2.03	2.64	2.51	1.71	3.10	1.90	1.87

Table 4.6.16 Mean performance of brinjal crosses for peduncle length (cm), petiole length (cm) and leaf area (cm^2) in the year 2023

S. No.	Crosses	Peduncle length (cm)			Petiole length (cm)			Leaf area (cm^2)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
1	**IC090146 × Pusa Bhairav**	6.45	5.61	6.03	3.55	3.22	3.39	261.27	272.64	266.96
2	**IC090146 × Pant Samrat**	7.94	8.05	8.00	3.70	3.41	3.56	301.62	307.61	304.62
3	**IC090781 × Pusa Bhairav**	5.94	4.73	5.34	2.84	3.19	3.02	270.59	244.62	257.61
4	**IC090781 × Pant Samrat**	8.11	8.16	8.14	3.86	3.88	3.87	295.48	302.69	299.09
5	**IC090810 × Pusa Bhairav**	5.37	5.61	5.49	3.10	2.97	3.04	298.84	301.25	300.05
6	**IC090810 × Pant Samrat**	7.84	7.90	7.87	4.03	3.93	3.98	304.19	311.77	307.98
7	**IC090828 × Pusa Bhairav**	6.66	7.15	6.91	2.52	3.11	2.82	212.32	258.64	235.48
8	**IC090828 × Pant Samrat**	5.76	6.85	6.31	3.01	3.26	3.14	288.31	247.36	267.84
9	**IC090887 × Pusa Bhairav**	6.49	5.91	6.20	2.88	4.02	3.45	274.76	299.73	287.25
10	**IC090887 × Pant Samrat**	4.71	6.58	5.65	3.07	3.21	3.14	254.63	251.91	253.27
Overall Mean		6.53	6.66	6.59	3.26	3.42	3.34	276.20	279.82	278.01
Minimum		4.71	4.73	5.34	2.52	2.97	2.82	212.32	244.62	235.48
Maximum		8.11	8.16	8.14	4.03	4.02	3.98	304.19	311.77	307.98
S.E. (±)		0.12	0.09	0.08	0.06	0.06	0.05	4.30	3.75	3.30
C.D. (P=0.05)		0.34	0.26	0.23	0.17	0.18	0.13	12.74	11.11	9.76
C.V. (%)		3.08	2.31	2.02	2.98	3.06	2.36	2.70	2.32	2.05

Table 4.6.17 Mean performance of parents and susceptible check for days to first flowering (DAT), days to 50% flowering (DAT) and total no. of long styled flower in the year 2023

S. No.	Parents	Days to first flowering (DAT)			Days to 50% flowering (DAT)			Total no. of long styled flower		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
Lines										
1	**IC090146**	50.71	51.76	51.24	53.67	55.24	54.46	48.42	48.01	48.22
2	**IC090781**	51.34	52.24	51.79	55.63	54.64	55.14	39.62	44.85	42.24
3	**IC090810**	51.88	52.64	52.26	53.42	55.43	54.43	35.42	30.43	32.93
4	**IC090828**	52.03	47.43	49.73	56.35	53.62	54.99	36.83	37.88	37.36
5	**IC090887**	50.72	49.61	50.17	53.24	54.85	54.05	52.05	46.32	49.19
Testers										
6	**Pusa Bhairav**	49.77	48.63	49.20	56.62	53.32	54.97	47.15	53.73	50.44
7	**Pant Samrat**	48.14	49.34	48.74	52.46	54.27	53.37	45.62	51.97	48.80
Check										
8	**Pant Rituraj**	54.36	53.73	54.05	59.19	60.26	59.73	42.59	45.67	44.13
Overall Mean		50.66	50.24	50.45	54.48	54.48	54.48	43.59	44.74	44.16
Minimum		48.14	47.43	48.74	52.46	53.32	53.37	35.42	30.43	32.93
Maximum		52.03	52.64	52.26	56.62	55.43	55.14	52.05	53.73	50.44
S.E. (±)		0.77	0.59	0.37	0.58	0.58	0.47	0.62	0.61	0.33
C.D. (P=0.05)		2.37	1.81	1.14	1.77	1.80	1.44	1.92	1.89	1.03
C.V. (%)		2.63	2.02	1.27	1.83	1.86	1.48	2.48	2.37	1.31

Table 4.6.18 Mean performance of brinjal crosses for days to first flowering (DAT), days to 50% flowering (DAT) and total no. of long styled flower in the year 2023

S. No.	Crosses	Days to first flowering (DAT)			Days to 50% flowering (DAT)			Total no. of long styled flower		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
1	**IC090146 × Pusa Bhairav**	44.08	42.67	43.38	47.28	46.18	46.73	56.28	58.35	57.32
2	**IC090146 × Pant Samrat**	40.35	39.31	39.83	44.30	43.76	44.03	60.72	65.34	63.03
3	**IC090781 × Pusa Bhairav**	42.49	44.10	43.30	46.31	47.67	46.99	54.76	60.48	57.62
4	**IC090781 × Pant Samrat**	41.35	39.67	40.51	42.36	42.73	42.55	60.18	64.82	62.50
5	**IC090810 × Pusa Bhairav**	43.69	45.22	44.46	47.08	48.55	47.82	53.19	55.63	54.41
6	**IC090810 × Pant Samrat**	41.88	41.02	41.45	43.72	44.19	43.96	58.37	62.62	60.50
7	**IC090828 × Pusa Bhairav**	43.61	42.16	42.89	45.88	46.38	46.13	55.61	60.91	58.26
8	**IC090828 × Pant Samrat**	41.92	41.34	41.63	42.12	42.36	42.24	58.83	57.28	58.06
9	**IC090887 × Pusa Bhairav**	44.33	42.62	43.48	47.62	46.56	47.09	56.51	58.44	57.48
10	**IC090887 × Pant Samrat**	42.63	41.52	42.08	44.49	45.33	44.91	57.38	61.75	59.57
Overall Mean		42.63	41.96	42.30	45.12	45.37	45.24	57.18	60.56	58.87
Minimum		40.35	39.31	39.83	42.12	42.36	42.24	53.19	55.63	54.41
Maximum		44.33	45.22	44.46	47.62	48.55	47.82	60.72	65.34	63.03
S.E. (±)		0.68	0.64	0.52	0.61	0.51	0.32	0.55	0.84	0.42
C.D. (P=0.05)		2.02	1.90	1.53	1.82	1.52	0.96	1.64	2.47	1.24
C.V. (%)		2.77	2.65	2.12	2.36	1.96	1.24	1.67	2.39	1.23

Table 4.6.19 Mean performance of parents and susceptible check for total no. of medium styled flower, no. of node to first fruiting and days to first fruit set (DAT) in the year 2023

S. No.	Parents	Total no. of medium styled flower			No. of node to first fruiting			Days to first fruit set (DAT)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
Lines										
1	**IC090146**	22.71	25.81	24.26	4.12	5.74	4.93	57.14	59.41	58.28
2	**IC090781**	25.94	26.37	26.16	4.74	5.14	4.94	57.32	60.28	58.80
3	**IC090810**	25.00	27.61	26.31	6.60	5.64	6.12	58.43	57.92	58.18
4	**IC090828**	26.52	26.61	26.57	6.04	6.78	6.41	57.37	58.06	57.72
5	**IC090887**	20.42	23.42	21.92	6.17	5.84	6.01	55.63	57.68	56.66
Testers										
6	**Pusa Bhairav**	16.09	18.42	17.26	6.83	7.62	7.23	52.76	53.19	52.98
7	**Pant Samrat**	18.43	18.64	18.54	7.64	8.16	7.90	55.07	54.96	55.02
Check										
8	**Pant Rituraj**	24.38	25.43	24.91	7.05	6.98	7.02	61.12	61.06	61.09
Overall Mean		22.16	23.84	23.00	6.02	6.42	6.22	56.25	57.36	56.80
Minimum		16.09	18.42	17.26	4.12	5.14	4.93	52.76	53.19	52.98
Maximum		26.52	27.61	26.57	7.64	8.16	7.90	58.43	60.28	58.80
S.E. (±)		0.46	0.45	0.35	0.09	0.12	0.09	0.80	0.82	0.62
C.D. (P=0.05)		1.40	1.38	1.07	0.26	0.36	0.28	2.47	2.54	1.92
C.V. (%)		3.56	3.26	2.62	2.47	3.19	2.52	2.47	2.49	1.90

Table 4.6.20 Mean performance of brinjal crosses for total no. of medium styled flower, no. of node to first fruiting and days to first fruit set (DAT) in the year 2023

S. No.	Crosses	Total no. of medium styled flower			No. of node to first fruiting			Days to first fruit set (DAT)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
1	**IC090146 × Pusa Bhairav**	28.38	28.55	28.47	7.63	7.92	7.78	53.28	55.53	54.41
2	**IC090146 × Pant Samrat**	29.34	30.27	29.81	8.79	9.42	9.11	42.41	41.27	41.84
3	**IC090781 × Pusa Bhairav**	29.01	27.32	28.17	7.19	7.81	7.50	49.08	52.48	50.78
4	**IC090781 × Pant Samrat**	29.53	31.52	30.53	8.42	9.33	8.88	44.72	43.07	43.90
5	**IC090810 × Pusa Bhairav**	28.39	30.08	29.24	8.01	6.73	7.37	48.56	51.31	49.94
6	**IC090810 × Pant Samrat**	29.19	30.11	29.65	8.37	9.07	8.72	45.68	45.24	45.46
7	**IC090828 × Pusa Bhairav**	28.34	29.41	28.88	7.61	8.67	8.14	46.73	48.32	47.53
8	**IC090828 × Pant Samrat**	27.88	29.34	28.61	8.14	8.77	8.46	50.48	51.46	50.97
9	**IC090887 × Pusa Bhairav**	25.31	27.63	26.47	7.58	7.48	7.53	48.57	49.76	49.17
10	**IC090887 × Pant Samrat**	28.61	28.46	28.54	7.83	8.34	8.09	49.63	50.17	49.90
Overall Mean		28.40	29.27	28.83	7.96	8.35	8.16	47.91	48.86	48.39
Minimum		25.31	27.32	26.47	7.19	6.73	7.37	42.41	41.27	41.84
Maximum		29.53	31.52	30.53	8.79	9.42	9.11	53.28	55.53	54.41
S.E. (±)		0.45	0.38	0.37	0.13	0.07	0.07	0.44	0.89	0.43
C.D. (P=0.05)		1.33	1.11	1.10	0.38	0.20	0.20	1.29	2.63	1.26
C.V. (%)		2.74	2.22	2.23	2.81	1.40	1.41	1.57	3.15	1.53

Table 4.6.21 Mean performance of parents and susceptible check for days to first picking of fruits (DAT), total no. of fruits plant^{-1} and average fruit weight (g) in the year 2023

S. No.	Parents	Days to first picking of fruits (DAT)			Total no. of fruits plant^{-1}			Average fruit weight (g)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
Lines										
1	**IC090146**	62.25	64.25	63.25	30.44	29.13	29.79	78.63	72.66	75.65
2	**IC090781**	63.82	65.33	64.58	28.11	31.24	29.68	65.33	69.46	67.40
3	**IC090810**	66.95	66.88	66.92	40.58	36.51	38.55	84.73	78.62	81.68
4	**IC090828**	63.42	63.04	63.23	33.45	36.67	35.06	61.64	60.76	61.20
5	**IC090887**	60.76	62.31	61.54	29.55	30.88	30.22	64.81	60.57	62.69
Testers										
6	**Pusa Bhairav**	60.12	59.97	60.05	35.24	39.25	37.25	127.81	124.95	126.38
7	**Pant Samrat**	61.19	62.64	61.92	42.73	43.11	42.92	114.93	111.53	113.23
Check										
8	**Pant Rituraj**	67.24	66.94	67.09	33.80	33.02	33.41	95.68	95.61	95.65
Overall Mean		62.64	63.49	63.07	34.30	35.26	34.78	85.41	82.65	84.03
Minimum		60.12	59.97	60.05	28.11	29.13	29.68	61.64	60.57	61.20
Maximum		66.95	66.88	66.92	42.73	43.11	42.92	127.81	124.95	126.38
S.E. (±)		1.01	0.86	0.60	0.63	0.57	0.47	1.54	1.19	0.86
C.D. (P=0.05)		3.11	2.66	1.86	1.94	1.74	1.44	4.75	3.67	2.65
C.V. (%)		2.79	2.36	1.66	3.18	2.78	2.34	3.12	2.50	1.77

Table 4.6.22 Mean performance of brinjal crosses for days to first picking of fruits (DAT), total no. of fruits plant^{-1} and average fruit weight (g) in the year 2023

S. No.	Crosses	Days to first picking of fruits (DAT)			Total no. of fruits plant^{-1}			Average fruit weight (g)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
1	**IC090146 × Pusa Bhairav**	60.15	61.34	60.75	38.38	41.83	40.11	140.26	139.55	139.91
2	**IC090146 × Pant Samrat**	50.87	49.35	50.11	49.62	49.35	49.49	142.77	145.48	144.13
3	**IC090781 × Pusa Bhairav**	56.48	58.31	57.40	39.62	41.63	40.63	132.11	137.80	134.96
4	**IC090781 × Pant Samrat**	51.62	48.71	50.17	48.59	49.66	49.13	143.28	147.69	145.49
5	**IC090810 × Pusa Bhairav**	56.58	57.28	56.93	43.51	40.35	41.93	130.34	133.28	131.81
6	**IC090810 × Pant Samrat**	52.49	53.22	52.86	48.21	48.75	48.48	146.75	152.10	149.43
7	**IC090828 × Pusa Bhairav**	52.46	53.84	53.15	42.59	42.31	42.45	141.83	137.42	139.63
8	**IC090828 × Pant Samrat**	58.62	56.49	57.56	44.62	46.52	45.57	135.75	139.27	137.51
9	**IC090887 × Pusa Bhairav**	54.14	55.63	54.89	39.58	43.75	41.67	142.13	140.81	141.47
10	**IC090887 × Pant Samrat**	55.58	56.09	55.84	41.26	45.41	43.34	139.57	143.09	141.33
Overall Mean		54.90	55.03	54.96	43.60	44.96	44.28	139.48	141.65	140.56
Minimum		50.87	48.71	50.11	38.38	40.35	40.11	130.34	133.28	131.81
Maximum		60.15	61.34	60.75	49.62	49.66	49.49	146.75	152.10	149.43
S.E. (±)		1.03	0.56	0.58	0.45	0.66	0.42	2.10	1.84	1.57
C.D. (P=0.05)		3.05	1.66	1.73	1.33	1.97	1.25	6.22	5.43	4.64
C.V. (%)		3.25	1.76	1.84	1.78	2.56	1.65	2.61	2.24	1.93

Table 4.6.23 Mean performance of parents and susceptible check for fruit length (cm), fruit diameter (cm) and fruit yield plant^{-1} (kg) in the year 2023

S. No.	Parents	Fruit length (cm)			Fruit diameter (cm)			Fruit yield plant^{-1} (kg)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
Lines										
1	**IC090146**	10.47	10.34	10.41	3.61	3.64	3.63	1.78	1.71	1.75
2	**IC090781**	9.44	9.66	9.55	3.54	3.93	3.74	1.80	1.91	1.86
3	**IC090810**	8.95	8.80	8.88	4.46	3.81	4.14	2.89	2.29	2.59
4	**IC090828**	9.38	9.27	9.33	4.30	4.21	4.26	1.82	1.93	1.88
5	**IC090887**	9.55	9.72	9.64	4.68	3.89	4.29	1.67	1.72	1.70
Testers										
6	**Pusa Bhairav**	15.45	15.31	15.38	6.69	6.37	6.53	3.39	3.45	3.42
7	**Pant Samrat**	15.31	15.14	15.23	3.71	4.21	3.96	3.64	3.75	3.70
Check										
8	**Pant Rituraj**	10.39	10.53	10.46	4.10	4.16	4.13	3.20	3.31	3.26
Overall Mean		11.12	11.10	11.11	4.43	4.29	4.36	2.43	2.39	2.41
Minimum		8.95	8.80	8.88	3.54	3.64	3.63	1.67	1.71	1.70
Maximum		15.45	15.31	15.38	6.69	6.37	6.53	3.64	3.75	3.70
S.E. (±)		0.15	0.23	0.19	0.07	0.06	0.05	0.04	0.03	0.03
C.D. (P=0.05)		0.46	0.68	0.55	0.21	0.20	0.16	0.11	0.10	0.09
C.V. (%)		2.31	2.38	2.12	2.71	2.59	2.10	2.57	2.43	2.05

Table 4.6.24 Mean performance of brinjal crosses for fruit length (cm), fruit diameter (cm) and fruit yield plant^{-1} (kg) in the year 2023

S. No.	Crosses	Fruit length (cm)			Fruit diameter (cm)			Fruit yield plant^{-1} (kg)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
1	**IC090146 × Pusa Bhairav**	15.73	14.34	15.04	5.71	5.57	5.64	3.20	3.12	3.16
2	**IC090146 × Pant Samrat**	16.82	17.95	17.39	6.57	7.05	6.81	4.85	4.78	4.82
3	**IC090781 × Pusa Bhairav**	12.35	13.32	12.84	4.98	5.19	5.09	3.88	4.05	3.97
4	**IC090781 × Pant Samrat**	17.41	18.07	17.74	6.31	6.68	6.50	4.38	4.45	4.42
5	**IC090810 × Pusa Bhairav**	11.38	14.66	13.02	5.46	5.63	5.55	3.15	3.30	3.23
6	**IC090810 × Pant Samrat**	17.73	18.12	17.93	6.87	7.13	7.00	4.32	4.75	4.54
7	**IC090828 × Pusa Bhairav**	15.75	15.42	15.59	5.22	5.72	5.47	3.96	3.85	3.91
8	**IC090828 × Pant Samrat**	16.11	16.33	16.22	4.69	4.51	4.60	3.45	3.60	3.53
9	**IC090887 × Pusa Bhairav**	14.34	15.75	15.05	6.04	6.11	6.08	3.20	3.30	3.25
10	**IC090887 × Pant Samrat**	15.75	14.62	15.19	5.47	5.24	5.36	4.10	4.18	4.14
Overall Mean		15.34	15.86	15.60	5.73	5.88	5.81	3.85	3.94	3.89
Minimum		11.38	13.32	12.84	4.69	4.51	4.60	3.15	3.12	3.16
Maximum		17.73	18.12	17.93	6.87	7.13	7.00	4.85	4.78	4.82
S.E. (±)		0.20	0.32	0.19	0.10	0.08	0.06	0.05	0.06	0.04
C.D. (P=0.05)		0.58	0.95	0.55	0.29	0.24	0.18	0.15	0.18	0.12
C.V. (%)		2.22	3.51	2.06	2.91	2.37	1.78	2.32	2.61	1.75

4.6.39 Total chlorophyll content (mg g^{-1})

The pooled results of total chlorophyll content revealed that among parents and check, Pusa Bhairav had the highest chlorophyll content (1.204 mg g^{-1}) and lowest (0.648 mg g^{-1}) was observed in IC090146 (Table 4.6.25). In case of crosses the total chlorophyll content was recorded maximum (1.289 mg g^{-1}) in IC090781 × Pant Samrat and minimum (1.125 mg g^{-1}) was noticed in IC090828 × Pusa Bhairav (Table 4.6.26).

4.6.40 Total soluble solids (°Brix)

Among the seven parents and one check, the highest (5.50 °Brix) total soluble solids were recorded in IC090828, and lowest (4.59 °Brix) total soluble solids were observed in IC090810 (Table 4.6.27). However, in crosses the total soluble solids was found maximum (5.76 °Brix) for the cross IC090781 × Pant Samrat and minimum (4.17 °Brix) for IC090810 × Pusa Bhairav (Table 4.6.28).

4.6.41 Ascorbic acid (mg 100 g^{-1})

The pooled results of ascorbic acid content among parents and check revealed that Pant Samrat exhibited the highest (2.42 mg 100 g^{-1}) ascorbic acid content and lowest (1.13 mg 100 g^{-1}) value was noticed in Pant Rituraj (Table 4.6.27). While in crosses the ascorbic acid content was observed in maximum (2.85 mg 100 g^{-1}) in IC090810 × Pant Samrat, while the minimum (1.66 mg 100 g^{-1}) values were recorded in IC090146 × Pusa Bhairav (Table 4.6.28).

4.6.42 Vitamin A (IU g^{-1})

In the seven parents and one check, the vitamin A content was found maximum (0.290 IU g^{-1}) in Pant Samrat, minimum (0.144 IU g^{-1}) in IC090887 among parents and check (Table 4.6.27). While in case of crosses highest (0.321 IU g^{-1}) vitamin A content was observed in IC090781 × Pant Samrat and lowest (0.119 IU g^{-1}) was recorded in IC090810 × Pusa Bhairav (Table 4.6.28).

4.6.43 Total anthocyanin (mg 100 g^{-1})

Total anthocyanin content among parents and check was reported maximum (693.09 mg 100 g^{-1}) in Pant Samrat and minimum (18.53 mg 100 g^{-1}) in IC090887 (Table 4.6.29). However, in brinjal crosses the highest (709.64 mg 100 g^{-1}) total anthocyanin content was recorded in IC090810 × Pant Samrat and lowest (351.47 mg 100 g^{-1}) was observed in IC090781 × Pusa Bhairav (Table 4.6.30).

4.6.44 Total protein (%)

For total protein content, the maximum (1.77%) recorded value was found in Pusa Bhairav and minimum (0.48%) was observed in Pant Rituraj among parents and check (Table 4.6.29). In crosses, the highest (1.90%) total protein content was noticed in IC090828 × Pusa Bhairav and lowest (1.27%) was observed in IC090887 × Pusa Bhairav (Table 4.6.30).

4.6.45 Total phenol content (mg GAE g^{-1} DW)

Among parents and check the highest (0.756 mg GAE g^{-1} DW) level of total phenols was recorded in Pant Samrat and lowest (0.172 mg GAE g^{-1} DW) was noticed in Pant Rituraj (Table 4.6.29). In brinjal crosses, maximum (0.830 mg GAE g^{-1} DW) level of total phenol was observed in the cross IC090146 × Pant Samrat and minimum (0.438 mg GAE g^{-1} DW) was recorded in IC090810 × Pusa Bhairav (Table 4.6.30).

4.6.46 Proline content (mg g^{-1} DW)

The highest (8.78 mg g^{-1} DW) proline content among parents and one check was noticed in Pant Samrat and lowest (5.35 mg g^{-1} DW) was observed in Pant Rituraj (Table 4.6.31). In crosses, the maximum proline content (9.65 mg g^{-1} DW) was recorded for IC090146 × Pant Samrat and minimum (6.17 mg g^{-1} DW) was found in IC090781 × Pusa Bhairav (Table 4.6.32).

4.6.47 Ash content (%)

The pooled results for ash content among the seven parents and one check revealed that the maximum value (8.29%) was recorded for Pusa Bhairav and minimum (5.31%) was noticed in IC090887 (Table 4.6.31). While in derived crosses, the highest (8.92%) was observed for IC090146 × Pant Samrat and lowest (5.73%) was measured in IC090887 × Pusa Bhairav (Table 4.6.32).

Table 4.6.25 Mean performance of parents and susceptible check for fruit yield plot^{-1} (kg), fruit yield hectare^{-1} (q) and total chlorophyll content (mg g^{-1}) in the year 2023

S. No.	Parents	Fruit yield plot^{-1} (kg)			Fruit yield hectare^{-1} (q)			Total chlorophyll content (mg g^{-1})		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
Lines										
1	**IC090146**	14.93	13.33	14.13	368.62	329.12	348.87	0.623	0.672	0.648
2	**IC090781**	14.32	13.82	13.73	353.56	341.22	338.87	0.764	0.692	0.728
3	**IC090810**	18.37	18.17	18.27	453.56	448.62	451.09	0.762	0.764	0.763
4	**IC090828**	12.39	14.12	13.26	305.91	348.62	327.27	0.651	0.655	0.653
5	**IC090887**	12.19	13.13	13.01	300.97	324.18	321.09	0.715	0.673	0.694
Testers										
6	**Pusa Bhairav**	25.41	23.57	24.49	627.37	581.94	604.66	1.266	1.142	1.204
7	**Pant Samrat**	27.22	25.60	26.41	672.06	632.06	652.06	1.175	1.170	1.173
Check										
8	**Pant Rituraj**	24.10	19.02	21.56	595.03	469.60	532.32	0.674	0.679	0.677
Overall Mean		18.62	17.60	18.11	459.64	434.42	447.03	0.85	0.824	0.837
Minimum		12.19	13.13	13.01	300.97	324.18	321.09	0.623	0.655	0.648
Maximum		27.22	25.60	26.41	672.06	632.06	652.06	1.266	1.170	1.204
S.E. (±)		0.22	0.24	0.16	8.17	5.98	5.10	0.01	0.01	0.01
C.D. (P=0.05)		0.69	0.75	0.48	25.18	18.44	15.71	0.03	0.03	0.02
C.V. (%)		2.17	2.44	1.54	3.22	2.41	2.03	1.93	1.98	1.56

Table 4.6.26 Mean performance of brinjal crosses for fruit yield plot^{-1} (kg), fruit yield hectare^{-1} (q) and total chlorophyll content (mg g^{-1}) in the year 2023

S. No.	Crosses	Fruit yield plot^{-1} (kg)			Fruit yield hectare^{-1} (q)			Total chlorophyll content (mg g^{-1})		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
1	**IC090146 × Pusa Bhairav**	19.89	20.00	19.95	491.08	493.80	492.44	1.191	1.193	1.192
2	**IC090146 × Pant Samrat**	34.89	35.18	35.04	861.43	868.59	865.01	1.279	1.271	1.275
3	**IC090781 × Pusa Bhairav**	21.49	20.89	21.19	530.59	515.77	523.18	1.173	1.176	1.175
4	**IC090781 × Pant Samrat**	33.12	33.48	33.30	817.73	826.62	822.18	1.291	1.287	1.289
5	**IC090810 × Pusa Bhairav**	23.47	24.12	23.80	579.47	595.52	587.50	1.207	1.204	1.206
6	**IC090810 × Pant Samrat**	31.89	32.45	32.17	787.36	801.19	794.28	1.213	1.206	1.210
7	**IC090828 × Pusa Bhairav**	26.48	27.1	26.79	653.79	669.10	661.45	1.121	1.129	1.125
8	**IC090828 × Pant Samrat**	25.10	24.85	24.98	619.72	613.55	616.63	1.201	1.195	1.198
9	**IC090887 × Pusa Bhairav**	24.68	25.44	25.06	609.35	628.11	618.73	1.179	1.174	1.177
10	**IC090887 × Pant Samrat**	26.32	26.78	26.55	649.84	661.20	655.52	1.186	1.191	1.189
Overall Mean		26.73	27.03	26.88	660.04	667.35	663.69	1.204	1.203	1.203
Minimum		19.89	20.00	19.95	491.08	493.80	492.44	1.121	1.129	1.125
Maximum		34.89	35.18	35.04	861.43	868.59	865.01	1.291	1.287	1.289
S.E. (±)		0.31	0.41	0.24	11.88	11.74	5.39	0.02	0.01	0.01
C.D. (P=0.05)		0.93	1.23	0.72	35.16	34.76	15.97	0.05	0.03	0.03
C.V. (%)		2.03	2.66	1.57	3.12	3.05	1.41	2.41	1.59	1.55

Table 4.6.27 Mean performance of parents and susceptible check for total soluble solids (°Brix), ascorbic acid (mg 100 g^{-1}) and vitamin A (IU g^{-1}) in the year 2023

S. No.	Parents	Total soluble solids (°Brix)			Ascorbic acid (mg 100 g^{-1})			Vitamin A (IU g^{-1})		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
Lines										
1	**IC090146**	4.72	4.61	4.67	1.75	1.69	1.72	0.247	0.176	0.212
2	**IC090781**	4.34	4.85	4.60	1.54	1.78	1.66	0.234	0.212	0.223
3	**IC090810**	4.52	4.66	4.59	1.99	1.80	1.90	0.227	0.189	0.208
4	**IC090828**	5.43	5.57	5.50	1.82	1.83	1.83	0.183	0.177	0.180
5	**IC090887**	4.90	4.64	4.77	1.28	1.09	1.19	0.145	0.143	0.144
Testers										
6	**Pusa Bhairav**	5.27	5.43	5.35	2.32	2.08	2.20	0.239	0.259	0.249
7	**Pant Samrat**	5.33	5.40	5.37	2.51	2.32	2.42	0.287	0.292	0.290
Check										
8	**Pant Rituraj**	4.86	4.90	4.88	1.16	1.09	1.13	0.173	0.177	0.175
Overall Mean		4.93	5.02	4.98	1.89	1.80	1.84	0.223	0.207	0.215
Minimum		4.34	4.61	4.59	1.28	1.09	1.19	0.145	0.143	0.144
Maximum		5.43	5.57	5.50	2.51	2.32	2.42	0.287	0.292	0.290
S.E. (±)		0.06	0.05	0.04	0.03	0.02	0.02	0.00	0.00	0.00
C.D. (P=0.05)		0.19	0.15	0.12	0.10	0.08	0.06	0.01	0.01	0.01
C.V. (%)		2.16	1.70	1.38	3.08	2.35	1.81	1.55	3.48	2.06

Table 4.6.28 Mean performance of brinjal crosses for total soluble solids (°Brix), ascorbic acid (mg 100 g^{-1}) and vitamin A (IU g^{-1}) in the year 2023

S. No.	Crosses	Total soluble solids (°Brix)			Ascorbic acid (mg 100 g^{-1})			Vitamin A (IU g^{-1})		
		Spring Summer 2023	***Kharif* 2023**	**Pooled**	**Spring Summer 2023**	***Kharif* 2023**	**Pooled**	**Spring Summer 2023**	***Kharif* 2023**	**Pooled**
1	**IC090146 × Pusa Bhairav**	4.87	4.79	4.83	1.72	1.59	1.66	0.252	0.248	0.250
2	**IC090146 × Pant Samrat**	5.55	5.74	5.65	2.76	2.83	2.80	0.311	0.317	0.314
3	**IC090781 × Pusa Bhairav**	5.08	5.10	5.09	2.18	2.08	2.13	0.214	0.209	0.212
4	**IC090781 × Pant Samrat**	5.62	5.89	5.76	2.72	2.66	2.69	0.315	0.326	0.321
5	**IC090810 × Pusa Bhairav**	4.19	4.14	4.17	1.87	1.93	1.90	0.121	0.117	0.119
6	**IC090810 × Pant Samrat**	5.43	5.43	5.43	2.81	2.89	2.85	0.303	0.308	0.306
7	**IC090828 × Pusa Bhairav**	5.22	5.17	5.20	2.43	2.52	2.48	0.156	0.152	0.154
8	**IC090828 × Pant Samrat**	5.14	5.16	5.15	2.70	2.71	2.71	0.248	0.243	0.246
9	**IC090887 × Pusa Bhairav**	4.86	4.80	4.83	1.74	1.67	1.71	0.267	0.262	0.265
10	**IC090887 × Pant Samrat**	5.68	5.62	5.65	2.26	2.32	2.29	0.258	0.250	0.254
Overall Mean		5.16	5.18	5.17	2.32	2.32	2.32	0.244	0.243	0.244
Minimum		4.19	4.14	4.17	1.72	1.59	1.66	0.121	0.117	0.119
Maximum		5.68	5.89	5.76	2.81	2.89	2.85	0.315	0.326	0.321
S.E. (±)		0.08	0.07	0.05	0.03	0.03	0.02	0.00	0.00	0.00
C.D. (P=0.05)		0.25	0.21	0.16	0.09	0.08	0.06	0.01	0.01	0.01
C.V. (%)		2.79	2.34	1.83	2.38	2.10	1.50	1.70	2.34	1.37

Table 4.6.29 Mean performance of parents and susceptible check for total anthocyanin (mg 100 g^{-1}), total protein (%) and total phenol content (mg GAE g^{-1} DW) in the year 2023

S. No.	Parents	Total anthocyanin (mg 100 g^{-1})			Total protein (%)			Total phenol content (mg GAE g^{-1} DW)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
Lines										
1	**IC090146**	26.31	26.31	26.31	0.71	0.76	0.74	0.362	0.392	0.377
2	**IC090781**	27.01	27.01	27.01	0.59	0.72	0.66	0.342	0.368	0.355
3	**IC090810**	24.62	24.62	24.62	0.75	0.88	0.82	0.362	0.393	0.378
4	**IC090828**	24.63	24.63	24.63	0.82	0.83	0.83	0.384	0.338	0.361
5	**IC090887**	18.53	18.53	18.53	0.52	0.61	0.57	0.173	0.211	0.192
Testers										
6	**Pusa Bhairav**	322.44	322.44	322.44	1.67	1.86	1.77	0.655	0.672	0.664
7	**Pant Samrat**	693.09	693.09	693.09	1.69	1.82	1.76	0.78	0.731	0.756
Check										
8	**Pant Rituraj**	475.88	475.92	475.90	0.50	0.46	0.48	0.174	0.169	0.172
Overall Mean		162.38	162.38	162.38	0.96	1.07	1.02	0.437	0.444	0.440
Minimum		18.53	18.53	18.53	0.52	0.61	0.57	0.173	0.211	0.192
Maximum		693.09	693.09	693.09	1.69	1.86	1.77	0.78	0.731	0.756
S.E. (±)		5.00	1.51	1.87	0.02	0.01	0.01	0.01	0.01	0.00
C.D. (P=0.05)		15.41	4.66	5.78	0.06	0.04	0.04	0.02	0.02	0.01
C.V. (%)		5.34	1.61	2.00	3.53	2.29	2.39	2.04	2.50	1.23

Table 4.6.30 Mean performance of brinjal crosses for total anthocyanin (mg 100 g^{-1}), total protein (%) and total phenol content (mg GAE g^{-1} DW) in the year 2023

S. No.	Crosses	Total anthocyanin (mg 100 g^{-1})			Total protein (%)			Total phenols (mg GAE g^{-1} DW)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
1	**IC090146 × Pusa Bhairav**	647.69	648.37	648.03	1.68	1.72	1.70	0.471	0.480	0.476
2	**IC090146 × Pant Samrat**	700.69	707.48	704.09	1.83	1.90	1.87	0.797	0.862	0.830
3	**IC090781 × Pusa Bhairav**	348.62	354.31	351.47	1.53	1.61	1.57	0.524	0.528	0.526
4	**IC090781 × Pant Samrat**	699.35	697.62	698.49	1.75	1.81	1.78	0.792	0.845	0.819
5	**IC090810 × Pusa Bhairav**	436.82	488.49	462.66	1.62	1.69	1.66	0.428	0.447	0.438
6	**IC090810 × Pant Samrat**	706.62	712.66	709.64	1.71	1.83	1.77	0.789	0.828	0.809
7	**IC090828 × Pusa Bhairav**	591.37	587.37	589.37	1.87	1.92	1.90	0.458	0.655	0.557
8	**IC090828 × Pant Samrat**	697.18	614.75	655.97	1.48	1.41	1.45	0.586	0.582	0.584
9	**IC090887 × Pusa Bhairav**	638.19	685.28	661.74	1.17	1.37	1.27	0.519	0.535	0.527
10	**IC090887 × Pant Samrat**	548.22	562.36	555.29	1.34	1.33	1.34	0.658	0.661	0.660
Overall Mean		601.48	605.87	603.67	1.60	1.66	1.63	0.602	0.642	0.622
Minimum		348.62	354.31	351.47	1.17	1.33	1.27	0.428	0.447	0.438
Maximum		706.62	712.66	709.64	1.87	1.92	1.90	0.797	0.862	0.830
S.E. (±)		8.11	3.45	3.91	0.02	0.02	0.01	0.01	0.01	0.01
C.D. (P=0.05)		24.00	10.20	11.58	0.06	0.06	0.04	0.03	0.02	0.02
C.V. (%)		2.33	0.99	1.12	2.24	2.09	1.47	2.64	1.52	1.60

Table 4.6.31 Mean performance of parents and susceptible check for proline content (mg g^{-1} DW) and ash content (%) in the year 2023

S. No.	Parents	Proline content (mg g^{-1} DW)			Ash content (%)		
		Spring Summer 2023	*Kharif* 2023	Pooled	Spring Summer 2023	*Kharif* 2023	Pooled
Lines							
1	**IC090146**	6.48	6.87	6.68	5.55	7.07	6.31
2	**IC090781**	6.39	6.91	6.65	6.62	6.93	6.78
3	**IC090810**	6.77	6.44	6.61	6.57	6.65	6.61
4	**IC090828**	6.60	6.69	6.65	6.16	6.49	6.33
5	**IC090887**	5.22	5.54	5.38	5.47	5.14	5.31
Testers							
6	**Pusa Bhairav**	8.36	8.56	8.46	8.11	8.47	8.29
7	**Pant Samrat**	8.67	8.88	8.78	7.57	8.35	7.96
Check							
8	**Pant Rituraj**	5.34	5.36	5.35	5.40	5.48	5.44
Overall Mean		6.93	7.13	7.03	6.58	7.01	6.80
Minimum		5.22	5.54	5.38	5.47	5.14	5.31
Maximum		8.67	8.88	8.78	8.11	8.47	8.29
S.E. (±)		0.09	0.07	0.05	0.08	0.10	0.07
C.D. (P=0.05)		0.29	0.22	0.17	0.26	0.31	0.21
C.V. (%)		2.36	1.77	1.32	2.19	2.51	1.74

Table 4.6.32 Mean performance of brinjal crosses for proline content (mg g^{-1} DW) and ash content (%) in the year 2023

S. No.	Crosses	Proline content (mg g^{-1} DW)			Ash content (%)		
		Spring Summer 2023	***Kharif* 2023**	**Pooled**	**Spring Summer 2023**	***Kharif* 2023**	**Pooled**
1	**IC090146 × Pusa Bhairav**	7.65	7.59	7.62	7.62	7.69	7.66
2	**IC090146 × Pant Samrat**	9.81	9.48	9.65	8.93	8.92	8.92
3	**IC090781 × Pusa Bhairav**	6.16	6.18	6.17	7.48	7.60	7.54
4	**IC090781 × Pant Samrat**	9.65	9.21	9.43	8.84	8.89	8.87
5	**IC090810 × Pusa Bhairav**	6.36	6.53	6.44	6.81	6.93	6.87
6	**IC090810 × Pant Samrat**	9.24	9.08	9.16	8.45	8.55	8.50
7	**IC090828 × Pusa Bhairav**	7.26	7.13	7.19	6.87	6.92	6.90
8	**IC090828 × Pant Samrat**	6.66	6.81	6.74	7.68	7.87	7.78
9	**IC090887 × Pusa Bhairav**	8.35	8.57	8.46	5.63	5.84	5.73
10	**IC090887 × Pant Samrat**	9.16	8.91	9.04	7.62	7.86	7.74
Overall Mean		8.03	7.95	7.99	7.59	7.71	7.65
Minimum		6.16	6.18	6.17	5.63	5.84	5.73
Maximum		9.81	9.48	9.65	8.93	8.92	8.92
S.E. (±)		0.09	0.09	0.08	0.12	0.13	0.07
C.D. (P=0.05)		0.27	0.27	0.24	0.36	0.39	0.20
C.V. (%)		1.96	2.02	1.75	2.78	2.94	1.57

4.7 Combining ability studies

4.7.1 Percent leaf incidence (PLI) (%)

The results related to general combining ability (GCA) effect for the trait PLI (%) indicated that among lines, IC090146 exhibited the most desired negative and significant at -0.78 GCA followed by IC090810 as -0.04 and the minimum positive effect was recorded in IC090781 with 0.03 (Table 4.7.1). Conversely, IC090887 showed a highly significant and positive GCA effect of 0.41 followed by IC090828 as 0.37. Among the testers, Pant Samrat recorded a desired negative GCA effect with -1.64, while Pusa Bhairav exhibited a positive effect of 1.64. The results regarding the specific combining ability (SCA) to this trait is presented under Table 4.7.2 which revealed that among eggplant crosses the most negative and significant SCA was noticed in IC090887 × Pusa Bhairav at -1.97 followed by IC090781 × Pant Samrat with -1.16 and IC090146 × Pant Samrat -0.79.

4.7.2 Percent fruit incidence (PFI) (%)

The GCA results regarding PFI (%) depicted in Table 4.7.1, stated that among lines, IC090781 had the most negative and significant GCA value of -0.84 followed by IC090810 at -0.76 and IC090828 with -0.22. Whereas, for the testers the highest favourable and significant GCA was recorded in Pant Samrat at -0.50 as compared to Pusa Bhairav. However, the SCA results regarding PFI (%) stated in Table 4.7.2, demonstrated that the maximum and considerable reduction was observed in cross IC090146 × Pant Samrat with -1.36 followed by IC090828 × Pusa Bhairav with -1.04 and IC090887 × Pusa Bhairav with -0.50, among eggplant crosses.

4.7.3 Percent leaf area diseased (PLAD)-eye estimation (%)

The results of GCA for PLAD (%) (depicted in Table 4.7.1) revealed the top performing lines which have been showed the maximum reduction with substantial variability are IC090887 followed by IC090810 and IC090146 with -1.02, -0.14 and -0.02, respectively. For testers, the most reduction in GCA was observed in Pusa Bhairav with -1.76 over the Pant Samrat. On the other side, the top performing crosses with highest reduction and considerable change for SCA include IC090887 × Pant Samrat, IC090781 × Pusa Bhairav and IC090146 × Pusa Bhairav with -2.06, -1.29 and -1.08 (Table 4.7.2).

4.7.4 Percent fruit area diseased (PFAD)-eye estimation (%)

The results related to GCA effect of lines for the trait PFAD (%) indicated that among lines, IC090146 exhibited the most desired negative and significant at -0.80 followed by IC090828 as -0.46 and IC090887 with -0.06 (Table 4.7.1). Other side, among the testers, Pant Samrat recorded with the desired negative and considerable GCA of -0.88 over Pusa Bhairav. The results of SCA showed negative and significant variations for most of the crosses (Table 4.7.2). However, the cross IC090828 × Pusa Bhairav demonstrated substantial and the most favourable SCA of -1.86 followed by IC090810 × Pant Samrat with -1.70 and IC090146 × Pant Samrat at -1.28 for this trait.

4.7.5 Percent disease index (PDI)-for leaf at 7th DAI (%)

The GCA results regarding PDI-for leaf at 7th DAI (%) are depicted in Table 4.7.1, which stated that among lines, IC090146 showed the most significant negative GCA impact of -0.84 closely followed by IC090781 at -0.80 and IC090810 with -0.36. Whereas, for the testers the maximum favourable and significant GCA was recorded in Pant Samrat at -0.41 as compared to Pusa Bhairav. However, the SCA results presented in Table 4.7.2, demonstrated that the highest and considerable reduction for the cross IC090887 × Pusa Bhairav with -1.14 followed by IC090146 × Pant Samrat with -0.70 and IC090810 × Pant Samrat with -0.69, among eggplant crosses for this trait.

4.7.6 Percent disease index (PDI)-for leaf at 14th DAI (%)

The results of GCA for PDI-for leaf at 14th DAI (%) (depicted in Table 4.7.1) revealed the top performing lines with the maximum desirable negative change and substantial variability are IC090146 followed by IC090781 and IC090828 with -0.63, -0.22 and -0.02, respectively. For testers, the most significant reduction in GCA was observed in Pant Samrat with -0.98 over the Pusa Bhairav. On the other side, the top performing crosses with highest reduction and considerable change for SCA include IC090828 ×

Pusa Bhairav, IC090781 × Pant Samrat and IC090810 × Pant Samrat with -2.04, -1.68 and -1.53 for the same trait (Table 4.7.2).

4.7.7 Percent disease index (PDI)-for leaf at 21st DAI (%)

The results related to GCA for PDI-for leaf at 21st DAI (%) indicated that among lines, IC090146 exhibited the largest negative and considerable GCA of -1.07 followed by IC090781 with -0.27. However, the minimum positive and significant GCA was noticed in IC090810 at 0.26 (Table 4.7.1). The results of GCA in between the testers revealed that Pant Samrat continued to exhibit the highest negative and substantial GCA effect with -2.20 as compared to Pusa Bhairav. The results regarding the SCA stated in Table 4.7.2 revealed that among eggplant crosses, the IC090781 × Pant Samrat was the only which showed the maximum negative and significant SCA at -0.15. Whereas, the lowest positive and considerable variability was noticed in IC090146 × Pusa Bhairav as 0.00 followed by IC090887 × Pusa Bhairav with 0.07 for this parameter.

4.7.8 Percent disease index (PDI)-for fruit at 7th DAI (%)

The GCA results regarding PDI-for fruit at 7th DAI (%) depicted in Table 4.7.1, showed that among lines, IC090146 had the most negative and significant GCA of value -0.21 followed by IC090828 at -0.07. While, the parent IC090781 exhibited the lowest positive and considerable GCA of 0.00. Whereas, for testers the maximum and significant reduction was found in Pant Samrat at -0.37 over Pusa Bhairav which shared the same value in positive direction with high significance. However, the SCA results for this character presented in Table 4.7.2, demonstrated that the maximum and considerable reduction was found in cross IC090828 × Pusa Bhairav with -0.77 followed by IC090781 × Pant Samrat with -0.35 and IC090146 × Pant Samrat with -0.34, among eggplant crosses.

4.7.9 Percent disease index (PDI)-for fruit at 14th DAI (%)

The results of GCA for PDI-for fruit at 14th DAI (%) suggested the top performing lines having the maximum reduction with substantial variability are IC090781 and IC090810 sharing the GCA of -0.32 followed by IC090146 with -0.16. Whereas, in testers, the most negative and considerable GCA was observed in Pant Samrat with -0.96 as compared to Pusa Bhairav (Table 4.7.1). On the other side, the top performing crosses with maximum favourable change and substantial variability for SCA include IC090828 × Pusa Bhairav, IC090146 × Pant Samrat and IC090781 × Pant Samrat with -2.07, -1.34 and -0.99 regarding the same parameter (Table 4.7.2).

4.7.10 Percent disease index (PDI)-for fruit at 21st DAI (%)

The results related to GCA effect for the trait PDI-for fruit at 21st DAI (%) indicated that among lines, IC090146 exhibited the most desired negative and significant GCA effect at -0.34 followed by IC090781 as -0.24 and IC090810 with -0.01. The GCA results for testers, exhibited that Pant Samrat had the most desired and significant GCA of -2.03 over Pusa Bhairav (Table 4.7.1). The results of SCA for this character (as shown in Table 4.7.2) revealed that among eggplant crosses the most negative and significant SCA was noticed in IC090146 × Pant Samrat at -0.44, closely followed by IC090887 × Pusa Bhairav with -0.42 and IC090828 × Pusa Bhairav at -0.34.

4.7.11 Lesion size on fruits (cm^2)

The results of GCA for parents regarding the trait lesion size on fruits (cm^2) revealed that line IC090146 exhibited the most negative and substantial variability as -0.043 followed by IC090781 with -0.035. Conversely, the minimum positive and significant GCA was noticed in IC090828 with 0.004. Whereas, in testers the lowest negatively significant GCA was recorded in Pant Samrat with -0.091 as compared to Pusa Bhairav for lesion size on brinjal fruits (Table 4.7.3). On the other side, the top performing crosses with highest reduction and considerable change for SCA include IC090810 × Pant Samrat, IC090828 × Pusa Bhairav and IC090781 × Pusa Bhairav with -0.122, -0.113 and -0.083 for this character (Table 4.7.4).

4.7.12 Days to first seed emergence (DAS)

The GCA results regarding days to first seed emergence (DAS) as depicted in Table 4.7.3, demonstrated that among lines, only IC090146 showed the most negative and significant GCA of -0.42, suggesting its genetic potential for early seed emergence. In contrast, line IC090810 exhibited with the minimum positive and substantial change of 0.02 followed by IC090828 with 0.07. Whereas, for the testers the highest favourable and highly significant GCA was seen for Pant Samrat at -0.05 over Pusa Bhairav. However, the SCA results for this parameter (stated in Table 4.7.4), showed that the biggest and considerable reduction was observed in cross IC090781 × Pusa Bhairav with -0.39 followed by IC090146 × Pant Samrat with -0.29 and IC090887 × Pant Samrat with -0.27, among eggplant crosses.

4.7.13 Days to 50% seed emergence (DAS)

The results related to GCA for trait days to 50% seed emergence (DAS) indicated that IC090146 again showed the highest negative and significant GCA alone with -0.40. Whereas, the other lines like IC090810 and IC090781 were noticed with the lowest positive and considerable GCA of 0.00 and 0.01, respectively. For the GCA of testers, Pusa Bhairav had the maximum desired significant negative GCA with -0.07 as compared to Pant Samrat (Table 4.7.3). On the other hand, the SCA results for crosses revealed that IC090887 × Pant Samrat showed the maximum negative and significant value of -0.63 closely followed by IC090810 × Pusa Bhairav at -0.62 and IC090146 × Pant Samrat as -0.54 for this parameter (Table 4.7.4).

4.7.14 Plant height at 30 DAT (cm)

The results of GCA regarding plant height at 30 DAT (cm) for parents are presented in Table 4.7.3. The obtained findings suggested that the maximum favourable and highly significant change of was observed in IC090781 with 1.22 followed by IC090810 with 0.83. However, the lowest negative and considerable change of -0.65 was noticed in IC090146. Among testers, Pant Samrat exhibited the largest positive and highly significant GCA of 1.54, promoting taller plants over Pusa Bhairav (Table 4.7.3). The results of SCA in eggplant crosses showed that IC090146 × Pusa Bhairav recorded with the minimum negative and considerable SCA of -2.40, closely followed by IC090828 × Pusa Bhairav with -2.80 and IC090781 × Pusa Bhairav & IC090810 × Pant Samrat shared the same level as -3.40 for this trait (Table 4.7.4).

4.7.15 Plant height at 60 DAT (cm)

The GCA results of lines and testers regarding plant height at 60 DAT (cm) demonstrated that the most positive and highly significant GCA of 1.66 was noticed in IC090781 followed by IC090810 with 1.25. While the lowest negative significant GCA was observed for IC090887 at -0.74. The GCA results of testers stated that Pant Samrat contributed to increased plant height with highly significant and most positive GCA of 1.54 as compared to Pusa Bhairav (Table 4.7.3). On the other side, the minimum adverse but considerable SCA impact of -3.75 was seen by IC090146 × Pant Samrat, closely followed by IC090828 × Pusa Bhairav with -3.99 and IC090887 × Pusa Bhairav with -5.25 for this character (Table 4.7.4).

4.7.16 Plant height at 90 DAT (cm)

The results of GCA regarding plant height at 90 DAT (cm) for parents are presented in Table 4.7.3. The obtained findings revealed the existence of the most favourable and significant GCA in IC090810 with 1.02 followed by IC090781 with 0.98 and IC090146 with 0.61 among lines. Whereas, in case of testers, Pant Samrat exhibited the largest positive and highly significant GCA of 1.23, suggesting more taller plants over Pusa Bhairav. The results of SCA in eggplant crosses showed that IC090828 × Pusa Bhairav had the minimum adverse but considerable SCA of -4.36, closely followed by IC090810 × Pant Samrat with -4.73 and IC090781 × Pant Samrat at -5.25 for this parameter (Table 4.7.4).

4.7.17 Plant height at final harvest (cm)

The GCA results of lines and testers regarding plant height at final harvest (cm) demonstrated that the most positive and highly significant GCA of 2.31 was noticed in IC090146 followed by IC090781 with 1.56 and IC090810 with 1.22. While, the GCA of testers stated that Pant Samrat positively and very significantly contributed to increase plant height with a GCA of 3.60 as compared to Pusa Bhairav (Table 4.7.3). On the other side, the minimum adverse but considerable SCA impact of -1.83 was seen by IC090887 × Pusa Bhairav followed by IC090146 × Pant Samrat with -2.97 and IC090781 × Pant Samrat with -3.40 for this trait (Table 4.7.4).

4.7.18 Total number of primary branches plant^{-1} at final harvest

The GCA for total no. of primary branches plant^{-1} demonstrated that IC090781 showed the most favourable and highly considerable GCA of 0.57 followed by IC090146 with 0.46. While the minimum adverse and significant GCA was exhibited by IC090810 at -0.10. Among testers, Pant Samrat was reported with the maximum positive and highly significant GCA of 0.81 over Pusa Bhairav (Table 4.7.3). The SCA results for brinjal crosses revealed that IC090146 × Pant Samrat had the most positive and highly considerable SCA impact of 0.42 followed by IC090828 × Pusa Bhairav with 0.23 and IC090887 × Pusa Bhairav with 0.20, suggesting improved number of primary branches in these crosses (Table 4.7.4).

4.7.19 Total number of nodes at final harvest

The results of GCA regarding total no. of nodes at final harvest for parents are presented in Table 4.7.3. The obtained findings revealed the existence of very significantly and the most favourable GCA in IC090146 with 0.61 followed by IC090810 with 0.50 and IC090781with 0.34 among lines. However, for testers, Pant Samrat contributed positively with high substantial change in GCA with 1.08 as compared to Pusa Bhairav. The SCA results for this character stated that IC090810 × Pusa Bhairav had the lowest negative but substantial SCA of -0.87 followed by IC090146 × Pant Samrat with -0.91 and IC090781 × Pant Samrat as -1.11, indicated less nodes at final harvest (Table 4.7.4).

4.7.20 Internodal length of plant at final harvest (cm)

The results related to GCA for trait internodal length at final harvest (cm) indicated that IC090146 showed the highest significant reduction in GCA with -0.79 followed by IC090781 with -0.23 and IC090887 with -0.04. Whereas, the GCA for testers demonstrated that Pant Samrat was noticed with the most favourable and considerable GCA value of -0.80 over Pusa Bhairav, suggesting decreased internodal length (Table 4.7.3). On the other hand, the SCA results for crosses revealed that IC090887 × Pusa Bhairav showed the maximum negative and significant value of -0.60 closely followed by IC090146 × Pant Samrat at -0.50 and IC090810 × Pant Samrat & IC090828 × Pusa Bhairav shared the same SCA of -0.44 for this parameter (Table 4.7.4).

4.7.21 Stem diameter (cm)

The results related to GCA of lines and testers for the character stem diameter (cm) are presented in Table 4.7.5. Among the lines, the most positively significant GCA was observed in IC090781 with 0.51 followed by IC090146 with 0.40. Conversely, the minimum adverse but considerable GCA was recorded for IC090810 at -0.04. The GCA results of testers stated that Pant Samrat exhibited the most positive and highly significant GCA of value 0.64 as compared to Pusa Bhairav. However, the SCA results of brinjal crosses revealed that IC090146 × Pant Samrat exhibited the largest positive and highly substantial SCA impact with 0.42 followed by IC090887 × Pusa Bhairav with 0.36 and IC090828 × Pusa Bhairav at 0.35 for stem diameter, suggesting that it was larger in these crosses than others (Table 4.7.6).

4.7.22 Peduncle length (cm)

The GCA results of parents for peduncle length (cm) demonstrated that highest negative and considerable GCA was only noticed in IC090887 at -0.67. While, the lowest positive and substantial GCA was found in IC090828 with 0.01 followed by IC090810 with 0.09. Whereas, Pusa Bhairav exhibited the most negative and significant GCA effect of -0.60 over Pant Samrat, indicating reduced peduncle length (Table 4.7.5). The superior crosses which showed the maximum significant reduction in peduncle length were IC090828× Pant Samrat, closely followed by IC090887 × Pant Samrat and IC090781 × Pusa Bhairav with having the SCA effect of -0.96, -0.94 and -0.87, respectively (Table 4.7.6).

4.7.23 Petiole length (cm)

The results related to the trait petiole length (cm) revealed that the most negative and considerable GCA was recorded in IC090828 with -0.36, followed by IC090887 with -0.04. While, the minimum positive and highly significant GCA was observed for IC090781 with 0.10. Whereas, Pusa Bhairav reported with the maximum reduced but significant GCA of -0.20 as compared to Pant Samrat (Table 4.7.5). On the other side the SCA results of crosses stated that IC090887 × Pant Samrat showed the most favourable and significant SCA effect with -0.44 followed by IC090810 × Pusa Bhairav with -0.36 and IC090781 × Pusa Bhairav with -0.31 for this character (Table 4.7.6).

4.7.24 Leaf area (cm^2)

The results related to GCA of lines and testers for the character leaf area (cm^2) are presented in Table 4.7.5. Among the lines, the most positive and highly significant GCA was observed in IC090810 with 26.00 followed by IC090146 with 7.77 and IC090781 with 0.33. The GCA results of testers stated that Pant Samrat exhibited the most positive and highly significant result with 8.55 over Pusa Bhairav. However, the SCA results of brinjal crosses revealed that IC090887 × Pusa Bhairav exhibited the largest positive and highly substantial SCA impact with 23.72 followed by IC090781 × Pant Samrat with 10.38 and IC090146 × Pant Samrat at 8.47, suggesting of having larger leaf area in these crosses (Table 4.7.6).

4.7.25 Days to first flowering (DAT)

The GCA results of parents regarding days to first flowering (DAT) (depicted in Table 4.7.5), demonstrated that among lines, IC090146 showed the most negative and significant GCA of -0.70 followed by IC090781 with -0.40 and IC090828 with -0.04. Whereas, for the testers the highest favourable and highly significant GCA was seen for Pant Samrat at -1.20 as compared to Pusa Bhairav, indicating early flower emergence. However, the SCA results for this parameter showed that the biggest and considerable reduction was observed in IC090146 × Pant Samrat and IC090828 × Pusa Bhairav both crosses with sharing the same impact of -0.24 followed by IC090887 × Pusa Bhairav with -0.16, among eggplant crosses (Table 4.7.6).

4.7.26 Days to 50% flowering (DAT)

The results related to GCA for trait days to 50% flowering (DAT) indicated that IC090828 exhibited the most negative but significant GCA of -1.06 followed by IC090781 as -0.48. In contrast, IC090146 was noticed with the lowest positive and considerable GCA of 0.14. The GCA of testers revealed that Pant Samrat had the maximum desired significant negative GCA with -1.71 over Pusa Bhairav (Table 4.7.5).

On the other hand, the SCA results for crosses revealed that IC090887 × Pusa Bhairav showed the maximum negative and significant value of -0.75 followed by IC090781 × Pant Samrat at -0.64 and IC090146 × Pusa Bhairav as -0.48 for this parameter (Table 4.7.6).

4.7.27 Total number of long styled flower

The results of GCA regarding total number of long styled flower for parents are presented in Table 4.7.5. The obtained findings revealed the existence of highly significant and the most favourable GCA impact of 1.30 in IC090146 followed by IC090781 with 1.19. In contrast, the minimum adverse but substantial GCA was noticed in IC090887 with -0.35. However, for testers, Pant Samrat contributed positively with high substantial change in GCA with 1.86 as compared to Pusa Bhairav. The SCA results of crosses for this character stated that IC090828 × Pusa Bhairav was the only reported cross which had the highest positive and substantial SCA of value 0.27. However, the other crosses having minimum adverse but considerable effects include IC090810 × Pant Samrat and IC090146 × Pant Samrat with -0.50 and -0.69, respectively (Table 4.7.6).

4.7.28 Total number of medium styled flower

The GCA for trait total number of medium styled flower demonstrated that IC090810 showed the most positive and considerable GCA of 0.61 followed by IC090781 with 0.51 and IC090146 with 0.30. The results of GCA in testers showed that Pant Samrat observed with the maximum positive and highly significant GCA of 0.59 over Pusa Bhairav (Table 4.7.5). The SCA results for brinjal crosses revealed that IC090828 × Pusa Bhairav had the largest positive and considerable SCA impact of 0.29 followed by IC090781 × Pant Samrat with 0.15 and IC090887 × Pant Samrat with 0.01, indicating enhanced number of medium styled flowers in these crosses (Table 4.7.6).

4.7.29 Number of node to first fruiting

The results related to GCA for trait number of node to first fruiting indicated that IC090887 observed with the highest significant reduction in GCA with -0.35 followed by IC090810 with -0.11. Conversely, the lowest adverse and substantial GCA was noticed in IC090781 with 0.03. Whereas, the GCA for testers demonstrated that Pusa Bhairav was found with the most favourable and considerable SCA value of -0.49 as compare to Pant Samrat, suggesting fruiting at the lower number of node (Table 4.7.3). On the other hand, the SCA results for crosses revealed that IC090828 × Pant Samrat reported with the maximum reduction with significant value of -0.53 followed by IC090887 × Pant Samrat at -0.41 and IC090781 × Pusa Bhairav with -0.39 for this parameter (Table 4.7.6).

Table 4.7.1 General combining ability studies for percent leaf incidence (%), percent fruit incidence (%), percent leaf area diseased (%), percent fruit area diseased (%) and percent disease index for leaf and fruit at 7th, 14th & 21st DAI in the year 2023

S. No.	Parents	Percent leaf incidence (%)	Percent fruit incidence (%)	Percent leaf area diseased (%)	Percent fruit area diseased (%)	Percent disease index for leaf at 7th DAI	Percent disease index for leaf at 14th DAI	Percent disease index for leaf at 21st DAI	Percent disease index for fruit at 7th DAI	Percent disease index for fruit at 14th DAI	Percent disease index for fruit at 21st DAI
Lines											
1	IC090146	-0.78*	0.13*	-0.02*	-0.46*	-0.84*	-0.63*	-1.07*	-0.21*	-0.16*	-0.34*
2	IC090781	0.03*	-0.84*	0.49**	-0.80*	-0.80*	-0.22*	-0.27*	0.00*	-0.32*	-0.24*
3	IC090810	-0.04*	-0.76*	-0.14*	0.59**	-0.36*	0.07*	0.26*	0.09**	-0.32*	-0.01*
4	IC090828	0.37**	-0.22*	0.69**	0.73**	1.43**	-0.02*	0.68**	-0.07*	0.47**	0.38*
5	IC090887	0.41**	1.69**	-1.02*	-0.06*	0.58**	0.81**	0.40**	0.18**	0.33**	0.22*
Testers											
6	Pusa Bhairav	1.64**	0.50**	-1.76*	0.88**	0.41**	0.98**	2.20**	0.37**	0.96**	2.03**
7	Pant Samrat	-1.64*	-0.50*	1.76**	-0.88*	-0.41*	-0.98*	-2.20*	-0.37*	-0.96*	-2.03*
S.E. (±) (gi) Lines		0.08	0.08	0.17	0.16	0.04	0.10	0.13	0.03	0.06	0.14
S.E. (±) (gj) Testers		0.05	0.05	0.11	0.10	0.02	0.06	0.08	0.02	0.04	0.09

Table 4.7.2 Specific combining ability studies for percent leaf incidence (%), percent fruit incidence (%), percent leaf area diseased (%), percent fruit area diseased (%) and percent disease index for leaf and fruit at 7th, 14th & 21st DAI in the year 2023

S. No.	Crosses	Percent leaf incidence (%)	Percent fruit incidence (%)	Percent leaf area diseased (%)	Percent fruit area diseased (%)	Percent disease index for leaf at 7th DAI	Percent disease index for leaf at 14th DAI	Percent disease index for leaf at 21st DAI	Percent disease index for fruit at 7th DAI	Percent disease index for fruit at 14th DAI	Percent disease index for fruit at 21st DAI
1	IC090146 × Pusa Bhairav	0.12*	1.15**	-1.08*	-0.09*	0.32**	-1.04*	0.00*	0.09*	0.39**	0.53*
2	IC090146 × Pant Samrat	-0.79*	-1.36*	0.89**	-1.28*	-0.70*	-1.43*	0.53**	-0.34*	-1.34*	-0.44*
3	IC090781 × Pusa Bhairav	0.49**	0.00*	-1.29*	-0.72*	0.06*	-0.78*	0.68**	0.11*	0.04*	0.34*
4	IC090781 × Pant Samrat	-1.16*	-0.21*	1.10**	-0.65*	-0.44*	-1.68*	-0.15*	-0.35*	-0.99*	-0.24*
5	IC090810 × Pusa Bhairav	0.03*	-0.13*	-0.36*	0.34*	0.30**	-0.93*	0.28*	0.04*	-0.14*	0.12*
6	IC090810 × Pant Samrat	-0.70*	-0.08*	0.17*	-1.70*	-0.69*	-1.53*	0.25*	-0.29*	-0.81*	-0.02*
7	IC090828 × Pusa Bhairav	-0.34*	-1.04*	0.39*	-1.86*	-0.50*	-2.04*	0.29*	-0.77*	-2.07*	-0.34*
8	IC090828 × Pant Samrat	-0.33*	0.83**	-0.58*	0.49*	0.11*	-0.42*	0.24*	0.52**	1.11**	0.43*
9	IC090887 × Pusa Bhairav	-1.97*	-0.50*	1.86**	-1.08*	-1.14*	-1.37*	0.07*	-0.09*	-0.60*	-0.42*
10	IC090887 × Pant Samrat	1.30**	0.29*	-2.06*	-0.28*	0.76**	-1.10*	0.46*	-0.16*	-0.35*	0.51*
C.D. (P=0.05) SCA		0.34	0.33	0.71	0.65	0.16	0.39	0.51	0.13	0.26	0.58
S.E. (±) (Sij)		0.12	0.12	0.25	0.23	0.05	0.14	0.18	0.04	0.09	0.20
S.E. (±) (Sij-Sik)		0.12	0.12	0.25	0.23	0.05	0.14	0.18	0.04	0.09	0.20
S.E.(±) (Sij-Skj)		0.17	0.16	0.35	0.32	0.08	0.19	0.25	0.06	0.13	0.28

Table 4.7.3 General combining ability studies for lesion size on fruits (cm^2), days to first seed emergence (DAS), days to 50% seed emergence (DAS), plant height at 30 DAT, 60 DAT, 90 DAT & at final harvest (cm), total no. of primary branches $plant^{-1}$, total no. of nodes and internodal length (cm) at final harvest in the year 2023

S. No.	Parents	Lesion size on fruits (cm^2)	Days to first seed emergence (DAS)	Days to 50% seed emergence (DAS)	Plant height at 30 DAT (cm)	Plant height at 60 DAT (cm)	Plant height at 90 DAT (cm)	Plant height at final harvest (cm)	Total no. of primary branches $plant^{-1}$	Total no. of nodes	Internodal length (cm)
Lines											
1	**IC090146**	-0.043*	-0.42*	-0.40*	-0.65*	-1.17*	0.61*	2.31**	0.46**	0.61**	-0.79*
2	**IC090781**	-0.035*	0.23**	0.01*	1.22**	1.66**	0.98*	1.56**	0.57**	0.34*	-0.23*
3	**IC090810**	0.045**	0.02*	0.00*	0.83*	1.25*	1.02*	1.22*	-0.10*	0.50**	0.36**
4	**IC090828**	0.004*	0.07*	0.22**	-0.73*	-1.00*	-1.57*	-3.03*	-0.68*	-0.81*	0.69**
5	**IC090887**	0.028**	0.10*	0.16**	-0.67*	-0.74*	-1.04*	-2.07*	-0.25*	-0.65*	-0.04*
Testers											
6	**Pusa Bhairav**	0.091**	0.05*	-0.07*	-1.54*	-1.54*	-1.23*	-3.60*	-0.81*	-1.08*	0.80**
7	**Pant Samrat**	-0.091*	-0.05**	0.07*	1.54**	1.54**	1.23**	3.60**	0.81**	1.08**	-0.80*
S.E.(±) (gi) Lines		0.00	0.00	0.00	0.40	0.50	0.53	0.55	0.06	0.15	0.05
S.E.(±) (gj) Testers		0.00	0.00	0.00	0.20	0.30	0.33	0.35	0.04	0.09	0.03

Table 4.7.4 Specific combining ability studies for lesion size on fruits (cm^2), days to first seed emergence (DAS), days to 50% seed emergence (DAS), plant height at 30 DAT, 60 DAT, 90 DAT & at final harvest (cm), total no. of primary branches plant^{-1}, total no. of nodes and internodal length (cm) at final harvest in the year 2023

S. No.	Crosses	Lesion size on fruits (cm^2)	Days to first seed emergence (DAS)	Days to 50% seed emergence (DAS)	Plant height at 30 DAT (cm)	Plant height at 60 DAT (cm)	Plant height at 90 DAT (cm)	Plant height at final harvest (cm)	Total no. of primary branches plant^{-1}	Total no. of nodes	Internodal length (cm)
1	IC090146 × Pusa Bhairav	-0.065*	-0.03*	0.00*	-5.47*	-7.66*	-5.60*	-6.86*	-0.45*	-1.87*	0.49**
2	IC090146 × Pant Samrat	-0.074*	-0.29*	-0.54*	-2.40*	-3.75*	-5.63*	-2.97*	0.42**	-0.91*	-0.50*
3	IC090781 × Pusa Bhairav	-0.083*	-0.39*	-0.52*	-3.40*	-6.07*	-5.98*	-6.42*	-0.08*	-1.66*	0.09*
4	IC090781 × Pant Samrat	-0.057*	0.07*	-0.03*	-4.48*	-5.34*	-5.25*	-3.40*	0.04*	-1.11*	-0.10*
5	IC090810 × Pusa Bhairav	-0.018*	-0.21*	-0.62*	-4.47*	-5.55*	-6.51*	-5.14*	0.02*	-0.87*	0.43**
6	IC090810 × Pant Samrat	-0.122*	-0.11*	0.08*	-3.40*	-5.86*	-4.73*	-4.69*	-0.05*	-1.91*	-0.44*
7	IC090828 × Pusa Bhairav	-0.113*	-0.11*	-0.30*	-2.80*	-3.99*	-4.36*	-4.32*	0.23*	-1.13*	-0.44*
8	IC090828 × Pant Samrat	-0.027*	-0.21*	-0.25*	-5.08*	-7.42*	-6.87*	-5.51*	-0.27*	-1.64*	0.43**
9	IC090887 × Pusa Bhairav	-0.070*	-0.05*	0.08*	-3.55*	-5.25*	-5.63*	-1.83*	0.20*	-1.41*	-0.60*
10	IC090887 × Pant Samrat	-0.069*	-0.27*	-0.63*	-4.32*	-6.16*	-5.60*	-8.00*	-0.23*	-1.36*	0.59**
C.D. (P=0.05) SCA		0.02	0.17	0.20	1.52	1.88	2.15	2.25	0.25	0.62	0.20
S.E.(±) (Sij)		0.01	0.06	0.07	0.53	0.65	0.75	0.78	0.09	0.21	0.07
S.E.(±) (Sij-Sik)		0.01	0.06	0.07	0.53	0.65	0.75	0.78	0.09	0.21	0.07
S.E.(±) (Sij-Skj)		0.01	0.08	0.10	0.74	0.92	1.06	1.11	0.13	0.30	0.10

Table 4.7.5 General combining ability studies for stem diameter (cm), peduncle length (cm), petiole length (cm), leaf area (cm^2), days to first flowering (DAT), days to 50% flowering (DAT), total no. of long styled flower and total no. of medium styled flower, no. of node to first fruiting and days to first fruit set (DAT) in the year 2023

S. No.	Parents	Stem diameter (cm)	Peduncle length (cm)	Petiole length (cm)	Leaf area (cm^2)	Days to first flowering (DAT)	Days to 50% flowering (DAT)	Total no. of long styled flower	Total no. of medium styled flower	No. of node to first fruiting	Days to first fruit set (DAT)
Lines											
1	**IC090146**	0.40**	0.42**	0.13**	7.77**	-0.70*	0.14*	1.30**	0.30*	0.28**	-0.26*
2	**IC090781**	0.51**	0.14**	0.10**	0.33*	-0.40*	-0.48*	1.19**	0.51*	0.03*	-1.05*
3	**IC090810**	-0.04*	0.09*	0.17**	26.00**	0.65*	0.64*	-1.42*	0.61*	-0.11*	-0.69*
4	**IC090828**	-0.72*	0.01*	-0.36*	-26.35*	-0.04*	-1.06*	-0.71*	-0.09*	0.14*	0.86*
5	**IC090887**	-0.16*	-0.67*	-0.04*	-7.75*	0.48*	0.76**	-0.35*	-1.33*	-0.35*	1.15**
Testers											
6	**Pusa Bhairav**	-0.64*	-0.60*	-0.20*	-8.55*	1.20**	1.71**	-1.86*	-0.59*	-0.49*	1.97**
7	**Pant Samrat**	0.64**	0.60**	0.20**	8.55**	-1.20*	-1.71*	1.86**	0.59**	0.49**	-1.97*
S.E.(±) (gi) Lines		0.02	0.05	0.03	2.07	0.35	0.27	0.28	0.25	0.05	0.38
S.E.(±) (gj) Testers		0.01	0.03	0.02	1.31	0.22	0.17	0.18	0.16	0.03	0.24

Table 4.7.6 Specific combining ability studies for stem diameter (cm), peduncle length (cm), petiole length (cm), leaf area (cm^2), days to first flowering (DAT), days to 50% flowering (DAT), total no. of long styled flower and total no. of medium styled flower, no. of node to first fruiting and days to first fruit set (DAT) in the year 2023

S. No.	Crosses	Stem diameter (cm)	Peduncle length (cm)	Petiole length (cm)	Leaf area (cm^2)	Days to first flowering (DAT)	Days to 50% flowering (DAT)	Total no. of long styled flower	Total no. of medium styled flower	No. of node to first fruiting	Days to first fruit set (DAT)
1	IC090146 × Pusa Bhairav	-0.63*	-0.45*	0.03*	-12.10*	0.91*	-0.48*	-2.69*	-0.51*	-0.37*	3.83**
2	IC090146 × Pant Samrat	0.42**	0.32**	-0.20*	8.47**	-0.24*	0.23*	-0.69*	-0.36*	-0.03*	-4.78*
3	IC090781 × Pusa Bhairav	-0.31*	-0.87*	-0.31*	-14.01*	0.53*	0.39*	-2.27*	-1.02*	-0.39*	0.99*
4	IC090781 × Pant Samrat	0.11**	0.74**	0.15**	10.38**	0.14*	-0.64*	-1.11*	0.15*	0.00*	-1.94*
5	IC090810 × Pusa Bhairav	-0.27*	-0.66*	-0.36*	2.77*	0.64*	0.09*	-2.88*	-0.05*	-0.38*	-0.21*
6	IC090810 × Pant Samrat	0.07*	0.53**	0.19**	-6.39*	0.03*	-0.35*	-0.50*	-0.82*	-0.02*	-0.74*
7	IC090828 × Pusa Bhairav	0.35**	0.84**	-0.04*	-9.44*	-0.24*	0.11*	0.27*	0.29*	0.14*	-4.17*
8	IC090828 × Pant Samrat	-0.55*	-0.96*	-0.12*	5.82*	0.91*	-0.36*	-3.65*	-1.16*	-0.53*	3.22**
9	IC090887 × Pusa Bhairav	0.36**	0.81**	0.27**	23.72**	-0.16*	-0.75*	-0.88*	-0.88*	0.02*	-2.82*
10	IC090887 × Pant Samrat	-0.56*	-0.94*	-0.44*	-27.34*	0.83*	0.49*	-2.50*	0.01*	-0.41*	1.87**
C.D. (P=0.05) SCA		0.09	0.21	0.11	8.43	1.42	1.11	1.13	1.03	0.22	1.56
S.E.(±) (Sij)		0.03	0.07	0.04	2.93	0.49	0.39	0.39	0.36	0.08	0.54
S.E.(±) (Sij-Sik)		0.03	0.07	0.04	2.93	0.49	0.39	0.39	0.36	0.08	0.54
S.E.(±) (Sij-Skj)		0.04	0.10	0.05	4.14	0.70	0.55	0.56	0.51	0.11	0.77

4.7.30 Days to first fruit set (DAT)

The results related to GCA for trait days to first fruit set (DAT) indicated that IC090781 exhibited the strongest negative and significant GCA of -1.05 followed by IC090810 as -0.69 and IC090146 with -0.26. The GCA results for testers revealed that Pant Samrat had the maximum desired significant negative GCA of -1.97 over Pusa Bhairav (Table 4.7.5). On the other hand, the SCA results for crosses revealed that IC090146 × Pant Samrat showed the maximum negative and significant value of -4.78 closely followed by IC090828 × Pusa Bhairav at -4.17 and IC090887 × Pusa Bhairav as -2.82 for this parameter, suggesting earlier fruit set in these crosses (Table 4.7.6).

4.7.31 Days to first picking of fruits (DAT)

The GCA results of parents related to days to first picking of fruits (DAT) revealed that IC090781 exhibited the most significant reduction of -1.18 followed by IC090810 as -0.07. However, the lowest adverse considerable GCA was noticed in IC090828 at 0.39. The GCA for testers stated that Pant Samrat showed the maximum desired and substantial GCA of -1.66 as compared to Pusa Bhairav (Table 4.7.7). On the other side, the SCA results for eggplant crosses revealed that cross IC090828 × Pusa Bhairav observed with the highest negative and considerable SCA of -3.92 closely followed by IC090146 × Pant Samrat at -3.72 and IC090887 × Pusa Bhairav as -2.20, indicating advancement in fruit picking in these crosses (Table 4.7.8).

4.7.32 Total number of fruits plant^{-1}

The GCA results for total number of fruits plant^{-1} demonstrated that IC090810 showed the greatest positive and considerable GCA effect of 0.93 followed by IC090781 with 0.60 and IC090146 with 0.52. Whereas, the results of GCA in testers showed that Pant Samrat had the maximum positive and highly significant GCA effect of 2.92 over Pusa Bhairav (Table 4.7.7). The SCA results for brinjal crosses revealed that IC090887 × Pusa Bhairav had the largest positive and highly considerable SCA impact of 1.41 closely followed by IC090146 × Pant Samrat with 1.09 and IC090828 × Pusa Bhairav with 0.68, indicating increased fruits' count in these crosses (Table 4.7.8).

4.7.33 Average fruit weight (g)

The results related to GCA of lines and testers for the character average fruit weight (g) are presented in Table 4.7.7. Among the lines, the most positive and substantial GCA effect was observed in IC090146 with 1.45 followed by IC090887 with 0.84 and IC090810 with 0.05. The GCA results of testers stated that Pant Samrat exhibited the greatest positive and highly significant result with 3.01 as compared to Pusa Bhairav. However, the SCA results of brinjal crosses revealed that IC090810 × Pant Samrat reported with the largest positive and highly substantial SCA impact of 4.71 followed by IC090828 × Pusa Bhairav with 2.98 and IC090887 × Pusa Bhairav at 2.00, denoting heavier fruits in these crosses (Table 4.7.8).

4.7.34 Fruit length (cm)

The GCA results of parents related to fruit length (cm) revealed that IC090146 exhibited the greatest positive and highly significant GCA of 0.61 followed by IC090828 as 0.30. However, the lowest adverse but considerable GCA was noticed in IC090810 at -0.12. While, the GCA for testers showed that Pant Samrat had the maximum desired and highly substantial GCA impact of 1.29 over Pusa Bhairav (Table 4.7.7). On the other side, the SCA results for crosses stated that IC090887 × Pusa Bhairav observed with the maximum and highly considerable SCA effect of -0.96 closely followed by IC090810 × Pant Samrat & IC090781 × Pant Samrat sharing the same value as -0.90 and IC090828 × Pusa Bhairav as -0.72, suggesting greater fruit length in these crosses (Table 4.7.8).

4.7.35 Fruit diameter (cm)

The results related to GCA for trait days to first fruit set (DAT) indicated that IC090810 exhibited the strongest positive and highly significant GCA of 0.47 closely followed by IC090146 as 0.42. In contrast, the minimum opposite but significant GCA was observed in IC090781 with -0.02. Whereas, the results of GCA for testers revealed that Pant Samrat noticed with the maximum desired and highly considerable GCA of 0.24 as compared to Pusa Bhairav (Table 4.7.7). On the other side, the SCA results of crosses stated that IC090828 × Pusa Bhairav recorded with the maximum positive and highly significant SCA of 0.60 closely followed by IC090887 × Pusa Bhairav at 0.53 and IC090810 × Pant Samrat with 0.41 for this parameter, indicating existence of greater diameter fruits in these brinjal crosses (Table 4.7.8).

4.7.36 Fruit yield plant^{-1} (kg)

The results of GCA regarding fruit yield plant^{-1} (kg) in brinjal parents stated that line IC090781 showed the highest positive and highly significant GCA effect of 0.30, followed by IC090146 at 0.09. However, the line IC090810 observed with the lowest adverse and substantial GCA of -0.01. In the testers, Pant Samrat had a highly significant and positive GCA effect as 0.39 over Pusa Bhairav, suggesting a higher fruit yield plant^{-1} (Table 4.7.7). On the other hand, top performing brinjal crosses for fruit yield plant^{-1} on the basis of SCA results include IC090828 × Pusa Bhairav, IC090146 × Pant Samrat and IC090810 × Pant Samrat. These were noted with the maximum positive and highly considerable SCA impact of 0.54, 0.39 and 0.22, respectively (Table 4.7.8).

4.7.37 Fruit yield plot^{-1} (kg)

The GCA results for fruit yield plot^{-1} (kg) demonstrated that IC090146 had the greatest positive and highly considerable GCA impact as 1.23 followed by IC090810 at 1.10. In contrast, IC090781 noticed with the minimum adverse but having substantial GCA effect of -0.26 among eggplant lines. While the GCA for testers stated that Pant Samrat observed with the highly considerable positive GCA of 3.53 as compared to Pusa Bhairav (Table 4.7.7). Whereas, the SCA results for crosses revealed the top performing crosses reported with the highest positive and highly significant impact like IC090828 × Pusa Bhairav, IC090146 × Pant Samrat and IC090781 × Pant Samrat with value 4.28, 3.25 and 3.00, respectively (Table 4.7.8). These results indicate enhanced yield per plot over other crosses.

4.7.38 Fruit yield hectare^{-1} (q)

The results of GCA related to this trait revealed that IC090146 found with the maximum positive and highly significant GCA impact of 30.41, followed by IC090810 at 27.20.

However, the line IC090781 showed the minimum opposite and considerable GCA impact as -6.38. Whereas, the GCA results for testers stated that Pant Samrat had the most favourable and highly substantial GCA at 87.03 in comparison to Pusa Bhairav (Table 4.7.7). On the other side, the SCA results for diverse brinjal crosses stated that IC090828 × Pusa Bhairav recorded with the greatest positive and highly significant SCA impact of 105.78 followed by IC090146 × Pant Samrat at 80.23 and IC090781 × Pant Samrat as 74.18, suggesting improved fruit yield per hectare in these eggplant crosses (Table 4.7.8).

4.7.39 Total chlorophyll content (mg g^{-1})

The GCA results of parents related to total chlorophyll content (mg g^{-1}) revealed that lines like IC090146 and IC090781 exhibited the greatest positive and highly significant GCA of 0.03 followed by IC090810 as 0.00. While, the GCA for testers showed that Pant Samrat had the maximum desired and highly substantial GCA impact of 0.03 over Pusa Bhairav (Table 4.7.7). On the other side, the SCA results stated that among crosses, the maximum positive SCA was seen in IC090781 × Pant Samrat and IC090810 × Pusa Bhairav with 0.03 sharing the differential significance level closely followed by IC090887 × Pusa Bhairav as 0.02, suggesting more synthesis of chlorophyll in these brinjal crosses over others (Table 4.7.8).

4.7.40 Total soluble solids (°Brix)

The results of GCA for the trait total soluble solids (°Brix) demonstrated that IC090781 showed the highest positive and highly considerable GCA impact of 0.25 followed by IC090887 with 0.07 and IC090146 with 0.06. Whereas, GCA results for testers showed that Pant Samrat had the maximum positive and highly significant GCA effect of 0.35 in comparison to Pusa Bhairav (Table 4.7.7). The SCA results for brinjal crosses revealed that IC090828 × Pusa Bhairav had the greatest positive and highly considerable SCA impact of 0.36 followed by IC090810 × Pant Samrat with 0.27 and IC090146 × Pant Samrat & IC090887 × Pant Samrat sharing the same with 0.05, suggesting improved concentration of soluble solids in these crosses (Table 4.7.8).

4.7.41 Ascorbic acid (mg 100 g^{-1})

The GCA results for ascorbic acid (mg 100 g^{-1}) demonstrated that IC090828 had the greatest positive and highly considerable GCA impact as 0.27 followed by IC090781 at 0.09 and IC090810 as 0.06. While the GCA results for testers stated that Pant Samrat recorded with the highly considerable positive GCA of 0.35 as compared to Pusa Bhairav (Table 4.7.9). Whereas, the SCA results for crosses revealed the top performing crosses reported with the highest positive and highly significant impact include IC090828 × Pusa Bhairav, IC090146 × Pant Samrat and IC090810 × Pant Samrat with value 0.23, 0.22 and 0.13, respectively. These results suggest that these crosses could effective in terms of ascorbic acid synthesis, potentially extending their use in nutritional enhancement (Table 4.7.10).

4.7.42 Vitamin A (IU g^{-1})

The GCA results of parents related to this parameter revealed that lines like IC090146 exhibited the greatest positive and highly significant GCA of 0.038 followed by IC090781 as 0.022 and IC090887 with 0.015. While, the GCA for testers showed that Pant Samrat had the maximum desired and highly substantial GCA impact of 0.044 over Pusa Bhairav (Table 4.7.9). On the other side, the SCA results stated that among crosses, the maximum positive and highly considerable SCA was seen in IC090887 × Pusa Bhairav with 0.050 closely followed by IC090810 × Pant Samrat at 0.049 and IC090146 × Pusa Bhairav with 0.013, indicating more vitamin A content in these brinjal crosses (Table 4.7.10).

4.7.43 Total anthocyanin (mg 100 g^{-1})

The results of GCA for the trait total anthocyanin (mg 100 g^{-1}) demonstrated that IC090146 exhibited the highest positive and highly considerable GCA impact of 72.39 followed by IC090828 with 19.00 and IC090887 with 4.84. Whereas, GCA results for testers showed that Pant Samrat had the highest positive and highly significant GCA effect of 61.02 in comparison to Pusa Bhairav (Table 4.7.9). Whereas, the SCA results for crosses revealed the top performing crosses reported with the highest positive and highly significant impact include IC090887 × Pusa Bhairav, IC090781 × Pant Samrat and IC090810 × Pant Samrat with value 112.05, 110.29 and 60.27, respectively. These crosses show potential for increased total anthocyanin (Table 4.7.10).

4.7.44 Total protein (%)

The GCA results for total protein (%) demonstrated that IC090146 had the greatest positive and highly considerable GCA impact as 0.15 followed by IC090810 at 0.08 and IC090781 as 0.05. While the GCA results for testers stated that Pant Samrat recorded with the considerable positive GCA of 0.01 as compared to Pusa Bhairav (Table 4.7.9). Whereas, the SCA results for crosses revealed the top performing crosses reported with the highest positive and highly significant impact include IC090828 × Pusa Bhairav, IC090781 × Pant Samrat and IC090146 × Pant Samrat with value 0.21, 0.06 and 0.04, respectively. These results suggest that these crosses could effective in terms of protein synthesis, potentially extending their use in nutritional enhancement and stress tolerance (Table 4.7.10).

4.7.45 Total phenol content (mg GAE g^{-1} DW)

The GCA results of parents related to this parameter revealed that lines like IC090781 exhibited the greatest positive and highly significant GCA of 0.050 followed by IC090146 as 0.030 and IC090810 with 0.000. While, the GCA results for testers showed that Pant Samrat had the maximum desired and highly substantial GCA impact of 0.118 over Pusa Bhairav (Table 4.7.9). On the other side, the SCA results stated that among crosses, the maximum positive SCA was seen in IC090828 × Pusa Bhairav with 0.084 followed by IC090810 × Pant Samrat at 0.047 and IC090146 × Pant Samrat with 0.039 (Table 4.7.10). These crosses show potential for increased phenolic content, which is important for antioxidant activity and health benefits.

Table 4.7.7 General combining ability studies for days to first picking of fruits (DAT), total no. of fruits plant^{-1}, average fruit weight (g), fruit length (cm), fruit diameter (cm), fruit yield plant^{-1} (kg), fruit yield plot^{-1} (kg), fruit yield hectare^{-1} (q), total chlorophyll content (mg g^{-1}) and total soluble solids (°Brix) in the year 2023

S. No.	Parents	Days to first picking of fruits (DAT)	Total no. of fruits plant^{-1}	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield plant^{-1} (kg)	Fruit yield Plot^{-1} (kg)	Fruit yield hectare^{-1} (q)	Total chlorophyll content (mg g^{-1})	Total soluble solids (°Brix)
Lines											
1	**IC090146**	0.46*	0.52*	1.45*	0.61**	0.42**	0.09**	1.23**	30.41**	0.03**	0.06*
2	**IC090781**	-1.18*	0.60*	-0.34*	-0.31*	-0.02*	0.30**	-0.26*	-6.38*	0.03**	0.25**
3	**IC090810**	-0.07*	0.93**	0.05*	-0.12*	0.47**	-0.01*	1.10**	27.20**	0.00*	-0.38*
4	**IC090828**	0.39*	-0.27*	-2.00*	0.30*	-0.77*	-0.18*	-1.00*	-24.65*	-0.04*	0.00*
5	**IC090887**	0.40*	-1.78*	0.84*	-0.48*	-0.09*	-0.20*	-1.08*	-26.57*	-0.02*	0.07*
Testers											
6	**Pusa Bhairav**	1.66**	-2.92*	-3.01*	-1.29*	-0.24*	-0.39*	-3.53*	-87.03*	-0.03*	-0.35*
7	**Pant Samrat**	-1.66*	2.92**	3.01**	1.29**	0.24**	0.39**	3.53**	87.03**	0.03**	0.35**
S.E.(±) (gi) Lines		0.41	0.31	0.96	0.12	0.04	0.03	0.16	3.71	0.01	0.04
S.E.(±) (gj) Testers		0.26	0.20	0.61	0.08	0.03	0.02	0.10	2.35	0.00	0.02

Table 4.7.8 Specific combining ability studies for days to first picking of fruits (DAT), total no. of fruits plant^{-1}, average fruit weight (g), fruit length (cm), fruit diameter (cm), fruit yield plant^{-1} (kg), fruit yield plot^{-1} (kg), fruit yield hectare^{-1} (q), total chlorophyll content (mg g^{-1}) and total soluble solids (°Brix) in the year 2023

S. No.	Crosses	Days to first picking of fruits (DAT)	Total no. of fruits plant^{-1}	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield plant^{-1} (kg)	Fruit yield plot^{-1} (kg)	Fruit yield hectare^{-1} (q)	Total chlorophyll content (mg g^{-1})	Total soluble solids (°Brix)
1	IC090146 × Pusa Bhairav	3.60**	-2.45*	-0.18*	-0.14*	-0.42*	-0.48*	-3.55*	-87.54*	-0.01*	-0.07*
2	IC090146 × Pant Samrat	-3.72*	1.09*	-1.99*	-0.38*	0.26**	0.39**	3.25**	80.23**	0.01*	0.05*
3	IC090781 × Pusa Bhairav	1.89**	-2.01*	-3.34*	-1.42*	-0.54*	0.12**	-3.30*	-81.49*	-0.03*	0.01*
4	IC090781 × Pant Samrat	-2.02*	0.65*	1.17*	0.90**	0.39**	-0.21*	3.00**	74.18**	0.03**	-0.03*
5	IC090810 × Pusa Bhairav	0.32*	-1.03*	-6.88*	-1.42*	-0.56*	-0.31*	-0.81*	-20.01*	0.03*	-0.29*
6	IC090810 × Pant Samrat	-0.44*	-0.33*	4.71**	0.90**	0.41**	0.22**	0.51*	12.70*	-0.03*	0.27**
7	IC090828 × Pusa Bhairav	-3.92*	0.68*	2.98*	0.72**	0.60**	0.54**	4.28**	105.78**	-0.01*	0.36**
8	IC090828 × Pant Samrat	3.80**	-2.04*	-5.15*	-1.24*	-0.75*	-0.63*	-4.58*	-113.09*	0.01*	-0.38*
9	IC090887 × Pusa Bhairav	-2.20*	1.41**	2.00*	0.96**	0.53**	-0.10*	2.63**	64.98**	0.02*	-0.07*
10	IC090887 × Pant Samrat	2.07**	-2.77*	-4.17*	-1.48*	-0.68*	0.01*	-2.93*	-72.29*	-0.02*	0.05*
C.D. (P=0.05) SCA		1.69	1.26	3.92	0.49	0.17	0.10	0.63	15.11	0.03	0.14
S.E.(±) (Sij)		0.59	0.44	1.36	0.17	0.06	0.04	0.22	5.25	0.01	0.05
S.E.(±) (Sij-Sik)		0.59	0.44	1.36	0.17	0.06	0.04	0.22	5.25	0.01	0.05
S.E.(±) (Sij-Skj)		0.83	0.62	1.93	0.24	0.08	0.05	0.31	7.42	0.01	0.07

Table 4.7.9 General combining ability studies for ascorbic acid (mg 100 g^{-1}), vitamin A (IU g^{-1}), total anthocyanin (mg 100 g^{-1}), total protein (%), total phenol content (mg GAE g^{-1} DW), proline content (mg g^{-1} DW) and ash content (%) in the year 2023

S. No.	Parents	Ascorbic acid (mg 100 g^{-1})	Vitamin A (IU g^{-1})	Total anthocyanin (mg 100 g^{-1})	Total protein (%)	Total phenol content (mg GAE g^{-1} DW)	Proline content (mg g^{-1} DW)	Ash content (%)
Lines								
1	**IC090146**	-0.09*	0.038**	72.39**	0.15**	0.030**	0.64**	0.64**
2	**IC090781**	0.09**	0.022**	-78.70*	0.05**	0.050**	-0.19*	0.55**
3	**IC090810**	0.06**	-0.032*	-17.52*	0.08**	0.000*	-0.19*	0.04*
4	**IC090828**	0.27**	-0.044*	19.00**	0.04**	-0.052*	-1.03*	-0.31*
5	**IC090887**	-0.32*	0.015**	4.84*	-0.33*	-0.029*	0.76**	-0.91*
Testers								
6	**Pusa Bhairav**	-0.35*	-0.044*	-61.02*	-0.01*	-0.118*	-0.81*	-0.71*
7	**Pant Samrat**	0.35**	0.044**	61.02**	0.01*	0.118**	0.81**	0.71**
S.E.(±) (gi) Lines		0.01	0.00	2.52	0.01	0.00	0.05	0.05
S.E.(±) (gj) Testers		0.01	0.00	1.59	0.01	0.00	0.03	0.03

Table 4.7.10 Specific combining ability studies for ascorbic acid (mg 100 g^{-1}), vitamin A (IU g^{-1}), total anthocyanin (mg 100 g^{-1}), total protein (%), total phenol content (mg GAE g^{-1} DW), proline content (mg g^{-1} DW) and ash content (%) in the year 2023

S. No.	Crosses	Ascorbic acid (mg 100 g^{-1})	Vitamin A (IU g^{-1})	Total anthocyanin (mg 100 g^{-1})	Total protein (%)	Total phenol content (mg GAE g^{-1} DW)	Proline content (mg g^{-1} DW)	Ash content (%)
1	IC090146 × Pusa Bhairav	-0.22*	0.013**	30.80**	-0.10*	-0.079*	-0.16*	0.02*
2	IC090146 × Pant Samrat	0.22**	-0.011*	-35.19*	0.04**	0.039**	0.24**	-0.14*
3	IC090781 × Pusa Bhairav	0.07**	-0.010*	-114.69*	-0.13*	-0.049*	-0.78*	-0.01*
4	IC090781 × Pant Samrat	-0.07*	0.011**	110.29**	0.06**	0.008*	0.86**	-0.10*
5	IC090810 × Pusa Bhairav	-0.13*	-0.049*	-64.67*	-0.08*	-0.088*	-0.51*	-0.16*
6	IC090810 × Pant Samrat	0.13**	0.049**	60.27**	0.02*	0.047**	0.59**	0.05*
7	IC090828 × Pusa Bhairav	0.23**	0.001*	25.53**	0.21**	0.084**	1.08**	0.21**
8	IC090828 × Pant Samrat	-0.23*	0.002*	-29.92*	-0.27*	-0.124*	-1.00*	-0.33*
9	IC090887 × Pusa Bhairav	0.05*	0.050**	112.05**	-0.05*	0.031**	0.56**	-0.35*
10	IC090887 × Pant Samrat	-0.05*	-0.049*	-116.44*	-0.01*	-0.071*	-0.48*	0.24**
C.D. (P=0.05) SCA		0.06	0.01	10.26	0.04	0.01	0.21	0.20
S.E.(±) (Sij)		0.02	0.00	3.56	0.01	0.01	0.07	0.07
S.E.(±) (Sij-Sik)		0.02	0.00	3.56	0.01	0.01	0.07	0.07
S.E.(±) (Sij-Skj)		0.03	0.00	5.04	0.02	0.01	0.10	0.10

4.7.46 Proline content (mg g^{-1} DW)

The GCA results of parents regarding proline content (mg g^{-1} DW) revealed that IC090887 exhibited the greatest positive and highly significant GCA of 0.76 followed by IC090146 as 0.64. While the minimum adverse but considerable impact was showed by IC090781 & IC090810 with -0.19. While, the GCA for testers stated that Pant Samrat had the maximum desired and highly substantial GCA impact of 0.81 over Pusa Bhairav (Table 4.7.9). On the other side, the SCA results among crosses stated that the maximum positive and highly significant SCA impact was seen in IC090781 × Pant Samrat with 0.86 followed by IC090810 × Pant Samrat at 0.59 and IC090887 × Pusa Bhairav with 0.56, indicating enhanced level of prolines in these brinjal crosses. These findings suggest that these crosses may be ideal for improving proline accumulation, hence providing stress resilience (Table 4.7.10).

4.7.47 Ash content (%)

The GCA results of parents related to ash content (%) demonstrated that IC090146 exhibited the greatest positive and highly significant GCA of 0.64 followed by IC090781 as 0.55 and IC090810 with 0.04. While, the GCA for testers showed that Pant Samrat had the maximum desired and highly substantial GCA impact of 0.71 over Pusa Bhairav (Table 4.7.9). Whereas, the SCA results stated that among crosses, the maximum positive and highly significant SCA was seen in IC090887 × Pant Samrat with 0.24 closely followed by IC090828 × Pusa Bhairav at 0.21 and IC090810 × Pant Samrat with 0.05, showcasing the improved mineral quality of these crosses (Table 4.7.10).

The study of combining ability (analysis of GCA and SCA variances), plays a critical role in understanding the genetic inheritance of various traits in breeding programs. The GCA and SCA variances offer insights into additive and non-additive gene actions, respectively. The significance of these variances indicates the contribution of both genetic components to the traits being studied. Several researches have contributed significantly to the understanding of these genetic components in crop breeding.

For instance, studies accomplished by Dubey *et al*. (2014) and Desai *et al*. (2017) reported greater magnitude of SCA as compared to GCA for various economic traits in eggplant genotypes, suggesting dominance of non-additive gene action. Ansari and Singh (2014) noticed that Pant Rituraj exhibited the best GCA effects for parameters *viz.,* no. of infested fruits plant^{-1}, average fruit weight and fruit diameter. Whereas, Pant Samrat showed it for characters like yield/plant and total no. of healthy fruits/plant. However, the best reported crosses regarding SCA include BARI × Pant Samrat, BARI × Pant Rituraj and BARI × PB-66 for most of the traits. Reddy and Patel (2014) have confirmed both additive as well as non-additive effects were important in the inheritance of the studied parameters. However, the non-additive gene action often plays a larger role in fruit yield and its components, as indicated by the greater SCA variances compared to GCA. These findings are consistent with those of earlier works by Sawant *et al*. (1991), Kale *et al*. (1992), and Patel *et al*. (1994), who noted the dominance of non-additive genetic effects for various traits. Kasera *et al*. (2020) found that GCA variance was significant for traits such as plant height and leaf width, indicating that additive genetic effects play a major role in these traits. Additionally, SCA variance, reflecting non-additive genetic effects, was significant for traits like average fruit weight and total yield per plot, suggesting the influence of dominance and epistasis on these traits.

Further studies, such as those by Dubey *et al*. (2014) and Naresh *et al*. (2014), have emphasized the importance of understanding the GCA and SCA effects in different environments. They found that female parents, particularly JBL-08-08 and GBL-1, exhibited higher GCA effects, suggesting greater genetic diversity among the females. This was also seen in the interaction between GCA and environmental factors, particularly for traits like flowering time. Mishra *et al*. (2023) identified BBSR-08-2, BBSR-10-26, and BBSR-195-3 as good general combiners for traits such as plant height, fruit weight, number of fruits per plant, and bacterial wilt tolerance. Superior SCA effects were observed in crosses like BBSR-08-2 × BBSR-10-25 and BBSR-08-2 × BBSR-10-26. Dudhatra *et al*. (2024) recognized AB 15-08, ABSR 2, and AB 20-13 as good general combiners for fruit yield, fruits plant^{-1} and total soluble solids. Rahul *et al*. (2022) reported significant general combining ability among brinjal genotypes, making them suitable candidates for further genetic analysis and targeted breeding efforts.

Sidhu *et al*. (2022) and Siva *et al*. (2020) both observed that GCA effects were significant for traits such as fruit girth and yield-related traits. Gangadhara *et al*. (2021) noticed that L2 (IC-433678), L5 (Raidurg Local), and T3 (Pusa Purple Cluster) were as the best general combiners for fruit yield plant^{-1} and associated traits like fruits plant^{-1} and fruit length. Samatha *et al*. (2021b) identified RCBG-2 as a good general combiner for multiple yield traits, including fruit weight and yield plant^{-1}. The similar patterns were also recorded by the Mondal *et al*. (2021) who found that the parental line Garia exhibited the highest significant GCA effects for seven traits followed by BCB-40, BCB-50, and Punjab Sadabahar for six traits. While, BCB-40 was emerged as the best parent for combining high marketable fruit yield and low borer infestation, making it a promising parent for breeding.

On the other hand, several studies, including those by Anvesh *et al*. (2024) and Mahesha *et al*. (2024), revealed that non-additive genetic effects, as indicated by significant specific combining ability (SCA), were predominant for traits like fruit yield, fruit length, and pest resistance. Similar findings were reported by Sao and Mehta (2010), Nalini *et al.* (2011), Ramireddy *et al.* (2011), Kumar *et al* (2012); Biswas *et al.* (2013); Reddy and Patel (2014); Makani *et al.* (2013); Deshmukh *et al.* (2015); Ramani *et al*. (2015); James *et al.* (2017); Dhillon *et al.* (2021) and Soresa (2022).

Both additive and non-additive gene actions contribute significantly to the inheritance of brinjal traits, with GCA highlighting the importance of parental selection and SCA identifying superior cross combinations for improving yield and resistance traits (Naresh *et al*., 2014; Kamalakkannan *et al*., 2007). Non-additive gene actions were more pronounced for traits like fruit yield and disease resistance, suggesting that heterosis breeding strategies could be particularly effective in enhancing these traits (Pramila *et al*., 2020; Dubey *et al*., 2014).

4.8 Magnitude of heterosis

Estimates of heterosis for 10 crosses in this study over the better parent, mid-parent (MPH), and over susceptible check (Pant Rituraj) are presented in Tables 4.8.1 to 4.8.16. The relative merits of the superior crosses are discussed below.

4.8.1 Percent leaf incidence (PLI) (%)

The obtained results related to heterosis for PLI is presented in the Table 4.8.1. Among crosses IC090887 × Pusa Bhairav exhibited the most negative mid-parent heterosis (MPH), with a value of -58.91% followed by IC090887 × Pant Samrat closely with -56.88% and IC090781 × Pant Samrat with -48.2%. This indicates a reduction in PLI compared to the average of the two parents. In better parent heterosis (BPH), the cross IC090146 × Pant Samrat leads with the highest negative heterosis of -23.37% followed by IC090781 × Pant Samrat with -17.92% and IC090810 × Pant Samrat with -13.14%. Similarly, for heterosis over susceptible check (HSC) all crosses showed negative heterosis. The cross IC090146 × Pant Samrat showed the highest negative heterosis at -82.5% closely followed by IC090781 × Pant Samrat with -81.26% and IC090810 × Pant Samrat with -80.17%. These findings collectively demonstrate the potential of selected crosses for enhancing resistance traits and developing superior cultivars.

4.8.2 Percent fruit incidence (PFI) (%)

The heterosis result for PFI in brinjal crosses is presented in the Table 4.8.1. Among crosses IC090781 × Pant Samrat exhibited the most negative MPH, with a value of -60.61% closely followed by IC090887 × Pusa Bhairav with -60.44% and IC090887 × Pant Samrat with -58.4%. However, in case of BPH the cross IC090828 × Pusa Bhairav reported with the maximum negative heterosis with value of -37.62%, stating an improvement over the better parent *i.e.,* Pusa Bhairav. Whereas, IC090810 × Pusa Bhairav observed with -33.41% closely followed by IC090781 × Pusa Bhairav with -32.9%. The results regarding HSC depicted negative heterosis for all the brinjal crosses. However, the crosses like IC090146 × Pant Samrat exhibited the maximum negative heterosis at -86.02 closely followed by IC090781 × Pant Samrat at -85.47% and IC090810 × Pant Samrat with -84.82% over Pant Rituraj. These results underscore the crosses' potential to minimize fruit incidence under stress conditions, emphasizing their improved tolerance.

4.8.3 Percent leaf area diseased (PLAD)-eye estimation (%)

The heterosis results for PLAD as shown in Table 4.8.1 revealed the cross IC090887 × Pusa Bhairav exhibited the most negative MPH with -66.11% closely followed by -65.49% in IC090887 × Pant Samrat and IC090781 × Pusa Bhairav with -47.13%. On the other side, highest negative heterosis over better parent was reported in IC090828 × Pusa Bhairav with -34.28% closely followed by -32.53% and IC090781 × Pant Samrat with -30.85%, showcasing an improvement over their better parents. In contrast, the negative HSC was seen in all the crosses, demonstrating a decrease in PLAD over Pant Rituraj. Crosses such as IC090146 × Pant Samrat showed the maximum negative heterosis at -81.87%, closely followed by IC090810 × Pant Samrat with -81.39% and –80.92% in IC090810 × Pusa Bhairav compared to Pant Rituraj. These crosses demonstrate disease resistance, underscoring their potential for reducing leaf area diseased under stress conditions.

4.8.4 Percent fruit area diseased (PFAD)-eye estimation (%)

The heterosis results (as stated in Table 4.8.2) for PFAD showed notable improvements in disease resistance for most crosses. The cross IC090887 × Pant Samrat observed with the maximum negative MPH of -68.11% followed by IC090887 × Pusa Bhairav with the value -65.71% and IC090781 × Pant Samrat with -46.49%. In case of BPH, most of the crosses exhibited negative heterosis. However, the highest negative BPH was noticed in IC090146 × Pant Samrat with a value of -18.16% followed by IC090781 × Pant Samrat with -15.83% and IC090810 × Pant Samrat with -13.17% stating an improvement over the better parents. While negative HSC was found for all the brinjal crosses. In this IC090146 × Pant Samrat showed the maximum negative heterosis of -83.36%, closely followed by IC090781 × Pant Samrat with -82.88 and IC090810 × Pant Samrat with having -82.34% as compared to Pant Rituraj, reflecting their strong disease resistance. These results highlight the crosses' strong potential for enhancing disease resistance and reducing fruit area diseased under stress conditions.

4.8.5 Percent disease index (PDI)-for leaf at 7th DAI (%)

The heterosis results for PDI for leaf at 7th DAI indicated in Table 4.8.2 varying degrees of disease resistance across the cross combinations. The cross of IC090146 × Pant Samrat showed the most negative MPH, of -44.41% followed by IC090781 × Pant Samrat with -41.87% and IC090810 × Pant Samrat with of -37.48%. Whereas, the maximum improvement over the better parent was noticed in IC090146 × Pant Samrat with values of -22.58% followed by IC090781 × Pusa Bhairav with -14.57% and IC090781 × Pant Samrat observed with -12.9%. In contrast the HSC results showed that the crosses like IC090146 × Pant Samrat exhibited the maximum negative heterosis at -82.38%, closely followed by IC090781 × Pant Samrat at -80.18% and IC090810 × Pant Samrat with a negative heterosis of -78.78% over Pant Rituraj. These results underscore the crosses' potential for enhanced disease resistance at critical early stages.

4.8.6 Percent disease index (PDI)-for leaf at 14th DAI (%)

The heterosis results for PDI for leaf at 14th DAI presented in Table 4.8.2 indicated significant improvements in disease resistance across most crosses. The cross combination of IC090887 × Pant Samrat showed the highest improvement with -64.06% followed by IC090887 × Pusa Bhairav at -58.75% and IC090781 × Pant Samrat with of -50.88% for the trait PDI for leaf at 14th DAI in MPH. Whereas, in case of BPH the maximum negative -24.03% was observed for IC090828 × Pusa Bhairav followed by IC090146 × Pant Samrat with -20.72% and IC090146 × Pant Samrat with -20.02%. However, the HSC results exhibited negative heterosis among brinjal crosses. Among crosses, IC090146 × Pant Samrat was noticed with the highest negative heterosis of -81.94%, closely followed by IC090781 × Pant Samrat with -81.45% and IC090810 × Pant Samrat was reported as of -80.03% over Pant Rituraj, highlighting their superior disease resistance. These findings underscore the superior disease resistance potential of these crosses under stress conditions.

4.8.7 Percent disease index (PDI)-for leaf at 21st DAI (%)

The results of heterosis for PDI for leaf at 21st DAI (shown in Table 4.8.3) demonstrated the highest improvement with -66.72% heterosis over mid parent was reported for

IC090810 × Pusa Bhairav followed by IC090781 × Pusa Bhairav with of -58.93% and IC090146 × Pant Samrat at -47.14%. The BPH results showed the negative heterosis among brinjal crosses. The cross IC090828 × Pusa Bhairav showed the maximum negative improvement with of -17.88% followed by IC090146 × Pant Samrat at -15.02% and IC090781 × Pant Samrat with of -14.1% over their better parents. Whereas, the HSC results exhibited negative heterosis across brinjal crosses, however, crosses like IC090781 × Pant Samrat noticed with the highest negative heterosis of -82.35% followed by IC090828 × Pant Samrat at -82.16% and IC090828 × Pusa Bhairav as of -80.69% over Pant Rituraj, indicating excellent disease resistance. These results underline the exceptional disease resistance potential of these crosses under prolonged stress conditions.

4.8.8 Percent disease index (PDI)-for fruit at 7th DAI (%)

The results (Table 4.8.3) for PDI for fruit at 7th DAI showed variation in disease resistance among the cross combinations. The highest negative MPH of -73.09% was observed in IC090887 × Pant Samrat followed by IC090887 × Pusa Bhairav at -63.86% and IC090146 × Pant Samrat with -61.49% over the mid parent. The results regarding BPH exhibited that cross combination of IC090828 × Pusa Bhairav demonstrated the highest negative BPH with the value of -46.8% followed by IC090146 × Pant Samrat at -35.38% and IC090781 × Pant Samrat with -24.79%. On the other hand, highly negative HSC was reported among brinjal crosses. The maximum negative HSC was found in the cross IC090146 × Pant Samrat with -90.24% followed by IC090781 × Pant Samrat at -88.64% and IC090810 × Pant Samrat with -87.25% over Pant Rituraj, reflecting the most pronounced disease resistance. These findings highlight the crosses' exceptional potential for disease resistance in fruits under stress conditions.

4.8.9 Percent disease index (PDI)-for fruit at 14th DAI (%)

The magnitude of heterosis for the trait PDI for fruit at 14th DAI as presented in Table 4.8.3 showed the varying levels of disease resistance in the cross combinations. The maximum MPH was noticed in IC090887 × Pant Samrat with -66.51% followed by IC090887 × Pusa Bhairav at -57.44% and IC090781 × Pant Samrat at -56.95%. The results of BPH observed with negative heterosis for most of cross combinations of brinjal. The cross combination of IC090146 × Pant Samrat demonstrated the highest BPH with -34.61% followed by IC090781 × Pant Samrat at -30.35% and IC090828 × Pusa Bhairav with -27.48% over their better parents. While, highly negative results were seen for HSC among brinjal crosses. The maximum negative HSC was found in IC090146 × Pant Samrat with -83.86%, closely followed by IC090781 × Pant Samrat at -82.81% and IC090810 × Pant Samrat at -81.91% over Pant Rituraj. These results highlight the potential of these crosses for strong disease resistance in fruit under prolonged stress conditions.

4.8.10 Percent disease index (PDI)-for fruit 21st DAI (%)

The heterosis results for PDI for fruit at 21st DAI presented in Table 4.8.4 revealed that the highest negative MPH was reported in IC090887 × Pant Samrat at the value of -69.71% followed by IC090887 × Pusa Bhairav at -63.81% and IC090781 × Pant Samrat at -48.31%. Whereas, negative BPH was found for various brinjal crosses in which the cross IC090146 × Pant Samrat exhibited the maximum BPH with the value of -15.74% closely followed by IC090887 × Pusa Bhairav at -15.49% and IC090828 × Pusa Bhairav with -14% over their better parents. While, highly negative HSC was observed among brinjal crosses. The highest negative HSC was found in the cross IC090146 × Pant Samrat with -84.95%, closely followed by IC090781 × Pant Samrat at -84.49% and IC090810 × Pant Samrat at -83.77% over Pant Rituraj, indicating superior disease resistance. These findings highlight the crosses' strong potential for exceptional disease resistance under extended stress conditions.

4.8.11 Lesion size on fruits (cm^2)

The heterosis results for lesion size on fruits showed a notable reduction in lesion size for several cross combinations, indicating improved disease resistance (Table 4.8.4). The maximum negative MPH was found in IC090887 × Pant Samrat with -81.22% followed by IC090887 × Pusa Bhairav at -69.46% and IC090146 × Pant Samrat at -62.94%. In case of BPH results the highest negative heterosis was observed in IC090781 × Pusa Bhairav with -38.28% closely followed by IC090146 × Pant Samrat at -36.79% and IC090146 × Pusa Bhairav with -36.35% over their better parents. However, the results for HSC revealed highly negative heterosis in various brinjal crosses. The highest negative HSC was reported in IC090146 × Pant Samrat with -93.86%, closely followed by IC090781 × Pant Samrat with -92.76% and IC090810 × Pant Samrat with the value -92.11% over Pant Rituraj, indicating superior disease resistance. These findings highlight the exceptional potential of these crosses for minimizing lesion size and enhancing resistance to fruit diseases.

4.8.12 Days to first seed emergence (DAS)

The heterosis results for days to first seed emergence (DAS) revealed variability in seedling emergence across the cross combinations as shown in Table 4.8.4. The highest negative MPH was reported in IC090146 × Pant Samrat with -10.23% followed by IC090146 × Pusa Bhairav at -7.73% and IC090810 × Pusa Bhairav at -6.93%. Whereas, the BPH results revealed the maximum reduction in the cross of IC090146 × Pant Samrat at -7.57% followed by IC090146 × Pusa Bhairav at -6.16% and IC090810 × Pusa Bhairav with -5.52% over their better parents. While the HSC results exhibited variability across the crosses. The maximum reduction was observed in IC090146 × Pant Samrat with -19.20% followed by IC090146 × Pusa Bhairav at -17.96% and IC090810 × Pusa Bhairav as -14.59% over Pant Rituraj. These results highlight the crosses' potential for enhancing early seed emergence traits.

4.8.13 Days to 50% seed emergence (DAS)

The heterosis results for days to 50% seed emergence (DAS) demonstrated varying emergence patterns across the cross combinations (Table 4.8.5). The maximum negative MPH of -15.38% was noticed in IC090810 × Pusa Bhairav followed by IC090781 × Pusa Bhairav with -13.03% and IC090146 × Pant Samrat at -11.57%. However, the maximum reduction over better parent was noticed in IC090810 × Pusa Bhairav at -11.93%, closely followed by IC090781 × Pusa Bhairav with -10.49% and IC090146 × Pusa Bhairav at -9.28%. Whereas the highest reduction in HSC over Pant Rituraj was reported in IC090146 × Pant Samrat with -27.69% followed by IC090810

× Pusa Bhairav at -25.91% and IC090781 × Pusa Bhairav with -24.7%. These findings underscore the potential of these crosses for achieving earlier seed emergence.

4.8.14 Plant height at 30 DAT (cm)

The heterosis results for plant height at 30 DAT (cm) demonstrated variable responses across cross combinations (Table 4.8.5). For the MPH, the maximum positive heterosis was observed for the cross IC090146 × Pant Samrat with 34.91%, closely followed by IC090810 × Pant Samrat with 34.22% and IC090781 × Pant Samrat with 33.2%. Whereas, in BPH highly significant and positive heterosis was recorded among brinjal crosses. However, IC090810 × Pant Samrat exhibited the highest BPH with having 28.04% followed by IC090146 × Pant Samrat with 26.99% and IC090781 × Pant Samrat with 26.54% over their better parents. Similarly, substantial significant variation was noticed for HSC across eggplant crosses. The maximum positive change was found for IC090810 × Pant Samrat with the value 47.25%, closely followed by IC090146 × Pant Samrat with 46.04% and IC090781 × Pant Samrat as of 45.53% over Pant Rituraj.

4.8.15 Plant height at 60 DAT (cm)

The heterosis results for plant height at 90 DAT (cm) showed a range of responses across the cross combinations (Table 4.8.5). The results of MPH revealed that the IC090810 × Pant Samrat cross was found with maximum positive heterosis of value 35.47%, closely followed by IC090781 × Pant Samrat with 34.99% and IC090146 × Pant Samrat with 34.02%. Further the results of BPH showed a considerable positive heterosis among crosses. However, the highest positive improvement was noticed in IC090781 × Pant Samrat with 23.45%, closely followed by IC090810 × Pant Samrat with 22.07% and IC090146 × Pant Samrat with 21.61% over its better parent. Whereas, highly significant and positive HSC was recorded across brinjal crosses. In this order, the maximum heterosis was observed for IC090781 × Pant Samrat with 39.76%, closely followed by IC090810 × Pant Samrat with 38.20% and IC090146 × Pant Samrat with 37.69% over susceptible check *i.e.*, Pant Rituraj.

4.8.16 Plant height at 90 DAT (cm)

The heterosis results for plant height at 90 DAT revealed variability across the cross combinations (Table 4.8.6). IC090810 × Pant Samrat showed the highest positive heterosis (MPH) of 33.34% followed by IC090781 × Pant Samrat with 31.34% and IC090828 × Pusa Bhairav with 30.85% over their mid parents. In case of BPH, highly significant and positive heterosis was recorded across brinjal crosses. Among crosses, IC090810 × Pant Samrat noticed with the maximum heterosis value as 24.98%, closely followed by IC090781 × Pant Samrat with 24.23% and IC090146 × Pusa Bhairav as 24% over its better parents. Similarly, highly considerable variation for HSC was found across the crosses. However, the highest HSC was recorded in IC090810 × Pant Samrat with 40.38%, closely followed by IC090781 × Pant Samrat with 39.53% and IC090146 × Pant Samrat with 38.41% over Pant Rituraj. These results reflect a wide range of plant height heterosis across crosses, with notable increases relative to the parent varieties, particularly the better parent and susceptible check.

4.8.17 Plant height at final harvest (cm)

The magnitude of heterosis for this trait exhibited positive heterosis for MPH, BPH and HSC (Table 4.8.6). Among brinjal crosses, IC090146 × Pant Samrat showed the highest value as 37.17%, closely followed by IC090810 × Pant Samrat with 36.01% and IC090781 × Pant Samrat with 35.85% over its mid parents. Further the results of BPH demonstrated highly positive and significant variability across cross combinations. However, the maximum BPH showed by IC090146 × Pant Samrat with 29.70%, closely followed by IC090781 × Pant Samrat with 28.30% and IC090810 × Pant Samrat with 26.38%. Similarly, considerable positive heterosis was observed in all crosses for HSC. The highest magnitude of heterosis over Pant Rituraj was found in IC090146 × Pant Samrat as 47.06%, followed by IC090781 × Pant Samrat with 45.47% and IC090810 × Pant Samrat with 43.30%.

4.8.18 Total number of primary branches plant^{-1} at final harvest

The results shown in Table 4.8.6 revealed that the maximum MPH was noticed in the cross IC090781 × Pant Samrat with 67% followed by IC090146 × Pant Samrat with

61.21% and IC090810 × Pant Samrat with having value of 49.74% over its mid parent. In case of BPH, a positive and highly significant change was recorded across the eggplant crosses. However, IC090146 × Pant Samrat exhibited the highest positive improvement of 37.63% followed by IC090781 × Pant Samrat with 34.57% and IC090810 × Pant Samrat with 25.72% over their better parents. Further, the results related to HSC the cross IC090146 × Pant Samrat demonstrated maximum positive and highly significant heterosis with 57.47% followed by IC090781 × Pant Samrat as 53.97% and IC090810 × Pant Samrat with value of 43.85% over Pant Rituraj for this trait.

4.8.19 Total number of nodes at final harvest

The results for different categories of heterosis is presented under the Table 4.8.7 which revealed that cross IC090146 × Pant Samrat showed the highest MPH with 32.94%, closely followed by IC090781 × Pant Samrat with 31.6% and IC090887 × Pant Samrat with 28% compared to their middle parents. Whereas, the results of BPH demonstrated highly significant and positive heterosis among brinjal crosses. However, the maximum magnitude of BPH was reported in IC090146 × Pant Samrat with 25.89% followed by IC090781 × Pant Samrat with 23.21% and IC090810 × Pant Samrat with 19.69% over its better parent. On the other side, the HSC results were higher in magnitude and highly significant across the cross combinations. In this order, the cross IC090146 × Pant Samrat was noticed with the highest HSC value as 53.34% followed by IC090781 × Pant Samrat with 50.07% and IC090810 × Pant Samrat with 45.78% over Pant Rituraj.

4.8.20 Internodal length of plant at final harvest (cm)

The heterosis results for this trait revealed that the cross IC090146 × Pant Samrat had the highest negative heterosis (MPH) of -40.63% followed by IC090781 × Pant Samrat with -29.69% and closely followed by IC090810 × Pant Samrat with -29.6% over their mid parents (Table 4.8.7). Whereas, the results of BPH demonstrated that among crosses, IC090146 × Pant Samrat exhibited maximum negative heterosis of -30.81% followed by IC090810 × Pant Samrat with -23.51% and IC090781 × Pant Samrat as -19.61% over its better parents. The results for HSC showed negative heterosis in most of the brinjal crosses. However, the highest HSC was recorded in IC090146 × Pant Samrat with -42.44% followed by IC090781 × Pant Samrat with -30.83% and IC090810 × Pant Samrat with -27.81% over Pant Rituraj.

Table 4.8.1 Magnitude of heterosis for percent leaf incidence (%), percent fruit incidence (%) and percent leaf area diseased-eye estimation (%) in brinjal crosses in the year 2023

Crosses	Percent leaf incidence (%)				Percent fruit incidence (%)				Percent leaf area diseased-eye estimation (%)			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	10.37	-13.32	1.07	-70.65	8.03	-29.48	-8.65	-75.19	11.50	-41.52	-34.28	-81.87
IC090146 × Pant Samrat	6.18	-43.11	-23.37	-82.50	4.52	-54.42	-22.87	-86.02	16.99	-4.57	23.35**	-73.21
IC090781 × Pusa Bhairav	11.55	-16.76	12.63**	-67.30	5.90	-55.99	-32.90	-81.77	11.80	-47.13	-32.53	-81.39
IC090781 × Pant Samrat	6.62	-48.20	-17.92	-81.26	4.70	-60.61	-19.80	-85.47	17.72	-13.42	28.65**	-72.05
IC090810 × Pusa Bhairav	11.02	-13.86	7.41**	-68.81	5.85	-49.68	-33.41	-81.91	12.10	-44.27	-30.85	-80.92
IC090810 × Pant Samrat	7.01	-40.09	-13.14	-80.17	4.91	-51.69	-16.21	-84.82	16.15	-18.61	17.28**	-74.52
IC090828 × Pusa Bhairav	11.06	-23.11	7.85**	-68.69	5.48	-55.25	-37.62	-83.06	13.68	-40.96	-21.78	-78.42
IC090828 × Pant Samrat	7.80	-41.35	-3.35	-77.93	6.36	-41.02	8.53**	-80.33	16.24	-23.82	17.90**	-74.39
IC090887 × Pusa Bhairav	9.47	-58.91	-7.65	-73.19	7.94	-60.44	-9.68	-75.46	13.44	-66.11	-23.16	-78.80
IC090887 × Pant Samrat	9.47	-56.88	17.36**	-73.20	7.74	-58.40	32.00**	-76.08	13.05	-65.49	-5.27	-79.42

Table 4.8.2 Magnitude of heterosis for percent fruit area diseased-eye estimation (%), percent disease index-for leaf at 7th and 14th DAI (%) in brinjal crosses in the year 2023

Cross	Percent fruit area diseased (PFAD)-eye estimation (%)				Percent disease index-for leaf at 7th DAI (%)				Percent disease index-for leaf 14th DAI (%)			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	13.12	-26.38	1.16	-78.51	4.24	-17.24	-9.89	-68.91	7.97	-35.45	-20.02	-74.41
IC090146 × Pant Samrat	10.16	-42.08	-18.16	-83.36	2.40	-44.41	-22.58	-82.38	5.63	-48.45	-20.72	-81.94
IC090781 × Pusa Bhairav	12.15	-38.65	-6.29	-80.10	4.02	-26.26	-14.57	-70.52	8.64	-34.55	-13.35	-72.27
IC090781 × Pant Samrat	10.45	-46.49	-15.83	-82.88	2.70	-41.87	-12.90	-80.18	5.78	-50.88	-18.60	-81.45
IC090810 × Pusa Bhairav	14.59	-23.04	12.50**	-76.11	4.70	-13.32	0.00	-65.49	8.78	-29.33	-11.94	-71.82
IC090810 × Pant Samrat	10.78	-42.28	-13.17	-82.34	2.89	-37.48	-6.77	-78.78	6.22	-43.36	-12.33	-80.03
IC090828 × Pusa Bhairav	12.54	-38.14	-3.32	-79.46	5.69	-4.93	20.96**	-58.26	7.57	-43.05	-24.03	-75.69
IC090828 × Pant Samrat	13.12	-34.36	5.68*	-78.51	5.48	5.79	76.77**	-59.77	7.24	-38.94	2.04	-76.75
IC090887 × Pusa Bhairav	12.52	-65.71	-3.47	-79.50	4.20	-16.06	-10.74	-69.20	9.09	-58.75	-8.83	-70.83
IC090887 × Pant Samrat	11.55	-68.11	-6.97	-81.08	5.28	25.67	70.16**	-61.27	7.40	-64.06	4.30	-76.24

Table 4.8.3 Magnitude of heterosis for percent disease index-for leaf at 21st DAI, percent disease index-for fruit at 7th and 14th DAI (%) in brinjal crosses in the year 2023

Cross	Percent disease index-for leaf 21st DAI (%)				Percent disease index-for fruit 7th DAI (%)				Percent disease index-for fruit 14th DAI (%)			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	15.02	-33.11	-17.88	-76.22	2.34	-35.81	-23.32	-80.35	6.72	-13.35	-0.52	-64.70
IC090146 × Pant Samrat	11.15	-43.89	-15.02	-82.35	1.16	-61.49	-35.38	-90.24	3.07	-54.33	-34.61	-83.86
IC090781 × Pusa Bhairav	16.49	-31.04	-9.87	-73.90	2.56	-32.68	-15.93	-78.45	6.22	-27.92	-7.93	-67.32
IC090781 × Pant Samrat	11.27	-47.14	-14.10	-82.16	1.35	-57.51	-24.79	-88.64	3.27	-56.95	-30.35	-82.81
IC090810 × Pusa Bhairav	16.63	-27.69	-9.08	-73.67	2.59	-23.71	-14.94	-78.20	6.03	-29.82	-10.67	-68.30
IC090810 × Pant Samrat	12.20	-40.23	-7.01	-80.69	1.52	-45.31	-15.60	-87.25	3.44	-54.53	-26.73	-81.91
IC090828 × Pusa Bhairav	17.05	-30.17	-6.78	-73.01	1.62	-59.60	-46.80	-86.36	4.90	-46.18	-27.48	-74.26
IC090828 × Pant Samrat	12.61	-42.26	-3.93	-80.05	2.17	-36.04	20.61**	-81.78	6.16	-23.64	31.20**	-67.61
IC090887 × Pusa Bhairav	16.56	-58.93	-9.49	-73.79	2.55	-63.86	-16.26	-78.54	6.23	-57.44	-7.78	-67.27
IC090887 × Pant Samrat	12.56	-66.72	-4.31	-80.13	1.73	-73.09	-3.62	-85.44	4.56	-66.51	-2.98	-76.05

Table 4.8.4 Magnitude of heterosis for percent disease index-for fruit at 21st DAI (%), lesion size on fruits (cm^2) and days to first seed emergence (DAS) in brinjal crosses in the year 2023

Cross	Percent disease index (PDI)-for fruit at 21st DAI (%)				Lesion size on fruits (cm^2)				Days to first seed emergence (DAS)			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	14.55	-27.72	-13.13	-76.97	0.33	-37.29	-36.35	-85.53	6.33	-7.73	-6.16	-17.96
IC090146 × Pant Samrat	9.51	-45.36	-15.74	-84.95	0.14	-62.94	-36.79	-93.86	6.23	-10.23	-7.57	-19.20
IC090781 × Pusa Bhairav	14.45	-33.39	-13.73	-77.13	0.32	-44.59	-38.28	-85.96	6.62	-4.44	-3.78	-14.20
IC090781 × Pant Samrat	9.80	-48.31	-13.12	-84.49	0.17	-61.54	-25.51	-92.76	7.24	3.25	5.24**	-6.16
IC090810 × Pusa Bhairav	14.46	-29.72	-13.67	-77.11	0.47	-13.31	-10.32	-79.61	6.59	-6.93	-5.52	-14.59
IC090810 × Pant Samrat	10.25	-42.54	-9.13	-83.77	0.18	-53.60	-18.74	-92.11	6.85	-4.33	-4.06	-11.15
IC090828 × Pusa Bhairav	14.41	-38.00	-14.00	-77.20	0.33	-43.41	-36.35	-85.53	6.75	-3.85	-3.23	-12.52
IC090828 × Pant Samrat	11.10	-45.85	-1.60	-82.43	0.24	-45.94	6.09	-89.69	6.80	-4.23	-3.68	-11.80
IC090887 × Pusa Bhairav	14.16	-63.81	-15.49	-77.59	0.40	-69.46	-23.82	-82.68	6.83	-0.76	0.59	-11.48
IC090887 × Pant Samrat	11.02	-69.71	-2.30	-82.56	0.22	-81.22	-2.93	-90.57	6.77	-2.76	-0.22	-12.19

Table 4.8.5 Magnitude of heterosis for days to 50% seed emergence (DAS), plant height at 30 DAT and 60 DAT (cm) in brinjal crosses in the year 2023

Cross	Days to 50% seed emergence (DAS)				Plant height at 30 DAT (cm)				Plant height at 60 DAT (cm)			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	7.53	-9.45	-9.28	-23.68	51.02	21.53	15.35**	30.32**	74.85	23.90	13.44**	25.93**
IC090146 × Pant Samrat	7.13	-11.57	-8.59	-27.69	57.18	34.91	26.99**	46.04**	81.84	34.02	21.61**	37.69**
IC090781 × Pusa Bhairav	7.43	-13.03	-10.49	-24.70	54.97	29.72	24.28**	40.41**	79.27	30.20	20.14**	33.36**
IC090781 × Pant Samrat	8.06	-2.83	3.27*	-18.31	56.98	33.20	26.54**	45.53**	83.08	34.99	23.45**	39.76**
IC090810 × Pusa Bhairav	7.31	-15.38	-11.93	-25.91	53.50	25.72	20.96**	36.65**	79.38	32.34	20.30**	33.54**
IC090810 × Pant Samrat	8.15	-2.80	4.49**	-17.34	57.65	34.22	28.04**	47.25**	82.15	35.47	22.07**	38.20**
IC090828 × Pusa Bhairav	7.86	-0.44	4.94**	-20.33	53.62	27.30	21.23**	36.96**	78.68	31.17	19.25**	32.37**
IC090828 × Pant Samrat	8.05	5.27	7.48**	-18.41	54.43	28.00	20.88**	39.02**	78.34	29.18	16.41**	31.79**
IC090887 × Pusa Bhairav	8.17	4.15	10.56**	-17.19	52.93	25.85	19.66**	35.19**	77.69	29.57	17.74**	30.69**
IC090887 × Pant Samrat	7.60	0.10	2.91*	-22.92	55.24	30.11	22.68**	41.09**	79.86	31.74	18.66**	34.35**

Table 4.8.6 Magnitude of heterosis for plant height at 90 DAT (cm), plant height at final harvest (cm) and total no. of primary branches plant^{-1} in brinjal crosses in the year 2023

Cross	Plant height at 90 DAT (cm)				Plant height at final harvest (cm)				Total no. of primary branches plant^{-1} at final harvest			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	89.13	29.15	24.00**	34.74**	98.99	26.46	22.32**	32.23**	9.41	31.54	14.98**	24.40**
IC090146 × Pant Samrat	91.56	30.38	23.22**	38.41**	110.09	37.17	29.70**	47.06**	11.91	61.21	37.63**	57.47**
IC090781 × Pusa Bhairav	89.12	29.03	23.98**	34.72**	98.68	26.22	21.94**	31.82**	9.89	46.84	20.90**	30.82**
IC090781 × Pant Samrat	92.30	31.34	24.23**	39.53**	108.90	35.85	28.30**	45.47**	11.64	67.00	34.57**	53.97**
IC090810 × Pusa Bhairav	88.63	29.51	23.30**	33.98**	99.62	29.55	23.10**	33.07**	9.32	32.55	13.88**	23.21**
IC090810 × Pant Samrat	92.86	33.34	24.98**	40.38**	107.28	36.01	26.38**	43.30**	10.88	49.74	25.72**	43.85**
IC090828 × Pusa Bhairav	88.19	30.85	22.69**	33.32**	96.19	24.29	18.86**	28.49**	8.95	31.64	9.35**	18.32**
IC090828 × Pant Samrat	88.13	28.45	18.61**	33.22**	102.21	28.77	20.41**	36.53**	10.08	43.31	16.47**	33.27**
IC090887 × Pusa Bhairav	87.45	29.18	21.66**	32.20**	99.64	29.45	23.13**	33.10**	9.34	34.49	14.18**	23.54**
IC090887 × Pant Samrat	89.93	30.51	21.04**	35.95**	100.67	27.51	18.60**	34.48**	10.54	46.80	21.85**	39.42**

Table 4.8.7 Magnitude of heterosis for total no. of nodes at final harvest, internodal length of plant at final harvest (cm) and stem diameter (cm) in brinjal crosses in the year 2023

Cross	Total no. of nodes at final harvest				Internodal length of plant at final harvest (cm)				Stem diameter (cm)			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	19.40	16.28	11.63**	32.12**	7.36	-6.42	6.90**	-11.06	2.35	-3.29	-19.10	-13.60
IC090146 × Pant Samrat	22.51	32.94	25.89**	53.34**	4.76	-40.63	-30.81	-42.44	4.68	88.32	55.32**	71.88**
IC090781 × Pusa Bhairav	19.33	17.24	11.25**	31.68**	7.52	-5.73	5.69**	-9.07	2.78	8.40	-4.48	2.02
IC090781 × Pant Samrat	22.03	31.60	23.21**	50.07**	5.72	-29.69	-19.61	-30.83	4.48	71.29	48.67**	64.52**
IC090810 × Pusa Bhairav	20.29	22.18	16.75**	38.18**	8.45	1.53	8.26**	2.18	2.27	8.24	-22.03	-16.73
IC090810 × Pant Samrat	21.40	26.97	19.69**	45.78**	5.97	-29.60	-23.51	-27.81	3.89	81.12	29.07**	42.83**
IC090828 × Pusa Bhairav	18.71	15.04	7.65**	27.42**	7.90	1.48	17.38**	-4.47	2.21	7.67	-23.92	-18.75
IC090828 × Pant Samrat	20.35	23.24	13.81**	38.62**	7.17	-9.79	6.46**	-13.36	2.59	22.80	-14.12	-4.96
IC090887 × Pusa Bhairav	18.59	16.26	6.99**	26.63**	7.02	-11.05	1.08	-15.11	2.78	0.18	-4.48	2.02
IC090887 × Pant Samrat	20.79	28.00	16.28**	41.62**	6.60	-18.01	-4.97	-20.19	3.13	10.89	3.99**	15.07**

Table 4.8.8 Magnitude of heterosis for peduncle length (cm), petiole length (cm) and leaf area (cm^2) in brinjal crosses in the year 2023

Cross	Peduncle length (cm)				Petiole length (cm)				Leaf area (cm^2)			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	6.03	-7.05	2.55	-11.32	3.39	9.64	14.36**	46.54**	266.96	28.27	-7.23	23.32**
IC090146 × Pant Samrat	8.00	21.64	35.97**	17.57**	3.56	54.73	117.43**	53.90**	304.62	58.09	18.58**	40.71**
IC090781 × Pusa Bhairav	5.34	-5.49	27.18**	-21.54	3.02	3.61	15.74**	30.52**	257.61	20.55	-10.48	19.00**
IC090781 × Pant Samrat	8.14	41.97	93.92**	19.63**	3.87	82.55	136.70**	67.53**	299.09	50.85	16.43**	38.16**
IC090810 × Pusa Bhairav	5.49	-18.61	-14.15	-19.26	3.04	0.50	7.43**	31.39**	300.05	38.74	4.27**	38.60**
IC090810 × Pant Samrat	7.87	15.23	23.06**	15.74**	3.98	78.48	143.43**	72.29**	307.98	53.35	19.89**	42.27**
IC090828 × Pusa Bhairav	6.91	15.71	42.67**	1.54	2.82	-3.18	8.27**	21.86**	235.48	10.92	-18.17	8.78**
IC090828 × Pant Samrat	6.31	4.17	30.27**	-7.28	3.14	48.05	91.74**	35.71**	267.84	36.04	4.26*	23.72**
IC090887 × Pusa Bhairav	6.20	-1.55	12.73**	-8.82	3.45	28.01	58.62**	49.35**	287.25	35.41	-0.18	32.69**
IC090887 × Pant Samrat	5.65	-11.56	2.64	-16.99	3.14	64.83	92.05**	35.93**	253.27	28.76	-1.41	16.99**

4.8.21 Stem diameter (cm)

The results shown in Table 4.8.7 revealed that the maximum MPH was noticed in the cross IC090146 × Pant Samrat with 88.32% followed by IC090810 × Pant Samrat with 81.12% and IC090781 × Pant Samrat with having value of 71.29% over its mid parent. In case of BPH, the maximum, positive and highly significant magnitude change was recorded for the cross IC090146 × Pant Samrat of 55.32% followed by IC090781 × Pant Samrat with 48.67% and IC090887 × Pant Samrat with 3.99% over their better parents. Further, the results related to HSC declared that cross IC090146 × Pant Samrat was found with maximum positive and highly significant heterosis with 71.88% followed by IC090781 × Pant Samrat as 64.52% and IC090810 × Pant Samrat with value of 42.83% over Pant Rituraj for this trait.

4.8.22 Peduncle length (cm)

The heterosis results for peduncle length revealed a variety of positive and negative heterotic effects across the cross combinations (Table 4.8.8). The cross IC090810 × Pusa Bhairav showed the most negative heterosis of -18.61% over the mid-parent (MPH) followed by IC090887 × Pant Samrat as -11.56% and IC090146 × Pusa Bhairav with -7.05%. Further, the results of BPH stated that IC090810 × Pusa Bhairav was the only reported cross with the most negative heterosis of -14.15% compared to its better parent. In contrast, the lowest positive and highly considerable value of BPH was observed in IC090146 × Pusa Bhairav with 2.55% followed by IC090887 × Pant Samrat with 2.64% and IC090887 × Pusa Bhairav with considerable value of 12.73% over its better parent. Whereas, the maximum negative HSC was recorded in IC090781 × Pusa Bhairav with -21.54% followed by IC090810 × Pusa Bhairav with -19.26% and IC090887 × Pant Samrat with -16.99% over the susceptible check *i.e.*, Pant Rituraj.

4.8.23 Petiole length (cm)

The heterosis results for petiole length indicated variable performance across the crosses. The cross IC090828 × Pusa Bhairav showed the only and highest negative value as -3.18% for MPH followed by the minimum positive value for IC090810 × Pusa Bhairav with 0.5% and IC090781 × Pusa Bhairav with 3.61% over their middle parents. Whereas, the results of BPH exhibited that the minimum and highly significant magnitude of heterosis was recorded in IC090810 × Pusa Bhairav with a value of 7.43% followed by IC090828 × Pusa Bhairav as 8.27% and IC090146 × Pusa Bhairav with 14.36% compared to its better parent. While, the minimum positive and substantial HSC was demonstrated by IC090828 × Pusa Bhairav with 21.86% followed by IC090781 × Pusa Bhairav with 30.52% and IC090810 × Pusa Bhairav with 31.39% over Pant Rituraj.

4.8.24 Leaf area (cm^2)

The results for different categories of heterosis for this trait is presented under the Table 4.8.8. From the obtained results of MPH it was noticed that cross IC090146 × Pant Samrat showed the highest positive heterosis with 58.09% followed by IC090810 × Pant Samrat with 53.35% and IC090781 × Pant Samrat with 50.85% compared to their middle parents. Whereas, the results of BPH demonstrated highly significant and maximum positive heterosis for IC090810 × Pant Samrat with 19.89%, closely followed by IC090146 × Pant Samrat with 18.58% and IC090781 × Pant Samrat with 16.43% over its better parent. On the other side, the HSC results stated that maximum positive and highly significant improvement was recorded in IC090810 × Pant Samrat with a value of 42.27% followed by IC090146 × Pant Samrat with 40.71% and IC090810 × Pusa Bhairav with 38.60% showing significant variation in heterosis compared to Pant Rituraj.

4.8.25 Days to first flowering (DAT)

The heterosis results for days to first flowering (DAT) demonstrated varying effects across the cross combinations (Table 4.8.9). The highest negative MPH of -20.32% was noticed in IC090146 × Pant Samrat, closely followed by IC090781 × Pant Samrat with -19.41% and IC090810 × Pant Samrat at -17.92%. However, the maximum reduction over better parent was noticed in IC090146 × Pant Samrat at -18.28% followed by IC090781 × Pant Samrat with -16.89% and IC090810 × Pant Samrat at -14.96%. Whereas the highest reduction in HSC over Pant Rituraj was reported in IC090146 × Pant Samrat with -26.73%, closely followed by IC090781× Pant Samrat at -25.48% and

IC090810 × Pant Samrat with -23.75%.These results highlight the crosses' potential for achieving early flowering under favourable conditions.

4.8.26 Days to 50% flowering (DAT)

The heterosis for days to 50% flowering (DAT) revealed variation across crosses (Table 4.8.9). The highest negative MPH was noticed in IC090828× Pant Samrat at -22.03%, closely followed by IC090781 × Pant Samrat at -21.58% and IC090810 × Pant Samrat at -18.44. The results regarding BPH demonstrated that maximum negative heterosis value at -20.85% was observed in the cross IC090828 × Pant Samrat, closely followed by IC090781 × Pant Samrat at -20.28% and IC090810 × Pant Samrat at -17.63 over their better parents. The best-performing crosses over Pant Rituraj (HSC) were IC090828 × Pant Samrat with -28.64%, closely followed by IC090781 × Pant Samrat with -28.12% and IC090810 × Pant Samrat with -25.74% suggesting varied flowering times within the crosses. These findings highlight the crosses' diverse flowering patterns, allowing selection based on specific breeding goals.

4.8.27 Total no. of long styled flower

The heterosis results for the total number of long-styled flowers show varied outcomes across the cross combinations (4.8.9). The results showed that the maximum positive MPH was noticed in the cross IC090810 × Pant Samrat with 48.05% followed by IC090781 × Pant Samrat with 37.32% and IC090828 × Pant Samrat with having value of 34.78% over its mid parent. In case of BPH, the highest favourable positive and highly significant change was recorded across the eggplant crosses. However, cross IC090146 × Pant Samrat exhibited the highest positive improvement of 29.17%, closely followed by IC090781 × Pant Samrat with 28.09% and IC090810 × Pant Samrat with 23.98% over their better parents. Further, the results related to HSC the cross IC090146 × Pant Samrat demonstrated maximum positive and highly significant heterosis with 47.99%, closely followed by IC090781 × Pant Samrat as 46.75% and IC090810 × Pant Samrat with value of 42.04% over Pant Rituraj for this trait.

4.8.28 Total no. of medium styled flower

The heterosis for the total number of medium-styled flowers shows the following trends across the crosses (Table 4.8.10). The cross IC090887 × Pant Samrat demonstrated the highest positive heterosis of 41.07% followed by IC090146 × Pant Samrat with 39.29% and IC090146 × Pusa Bhairav with 37.13% as compared to its mid parent. On the other hand, the results of BPH revealed that cross IC090887 × Pant Samrat exhibited the most positive and considerable level of heterosis with 30.18% followed by IC090146 × Pant Samrat with 22.86% and IC090887 × Pusa Bhairav with 20.76% over their better parent. Whereas, the results regrading HSC demonstrated that the top performer crosses over Pant Rituraj are IC090781 × Pant Samrat with 25.21%, followed by IC090146 × Pant Samrat with 22.25% and IC090810 × Pant Samrat with 21.62%. This suggests that the genetic combinations in these crosses could be optimal for the desired flower type.

4.8.29 Number of node to first fruiting

The heterosis data for the number of node to first fruiting is presented in Table 4.8.10 which revealed highly significant variations across the cross combinations, especially for BPH and HSC. The IC090810 × Pusa Bhairav exhibited the lowest positive MPH of 10.45% followed by IC090887 × Pusa Bhairav at 13.83% and IC090887 × Pant Samrat with 16.29% over their mid parents. Whereas, the minimum positive and substantial variations for BPH was reported in cross IC090810 × Pusa Bhairav with 20.42% followed by IC090887 × Pusa Bhairav with 25.40% and IC090828 × Pusa Bhairav with 26.99% over its better parent. However, the lowest positive and highly significant HSC was found in IC090810 × Pusa Bhairav with 4.54% followed by IC090781 × Pusa Bhairav with 6.38% and IC090887 × Pusa Bhairav at 6.81% over Pant Rituraj. These results suggest potential of these crosses for early fruiting at the lower number of nodes under varying growth conditions.

4.8.30 Days to first fruit set (DAT)

The heterosis results for days to first fruit set (DAT) presented in Table 4.8.10, indicated that the maximum reduction in MPH was found in cross IC090146 × Pant Samrat with -26.14% followed by IC090781 × Pant Samrat at -22.87% and IC090810 × Pant Samrat at -19.67% over their mid parents. Whereas, the highest favourable change for BPH was reported for cross IC090146 × Pant Samrat with -23.95% followed by IC090781 × Pant Samrat at -20.21% and IC090810 × Pant Samrat with -17.7% compared to the better parents. While for HSC the maximum negative HSC was found in IC090146 × Pant Samrat with -31.54% followed by IC090781 × Pant Samrat as with -28.18% and IC090810 × Pant Samrat with -25.62% over the susceptible check (Pant Rituraj). These findings highlight the crosses' potential for achieving earlier fruit set, a desirable trait for improving crop productivity.

4.8.31 Days to first picking of fruits (DAT)

The heterosis results for days to first picking of fruits (DAT) demonstrated that the highest negative MPH was reported for cross IC090781 × Pant Samrat with -20.68% followed by IC090146 × Pant Samrat at -19.93% and IC090810 × Pant Samrat with -17.95% compared to its mid parent (Table 4.8.11). Whereas, the maximum reduction for BPH was noticed in IC090146 × Pant Samrat with -19.07%, closely followed by IC090781 × Pant Samrat with -18.98% and IC090810 × Pant Samrat with -14.63% over its better parent. On the other side, the highest negative heterosis for HSC was reported in IC090146 × Pant Samrat with -25.48%, closely followed by IC090781 × Pant Samrat with -25.39% and IC090810 × Pant Samrat at -21.39% over the susceptible check *i.e.*, Pant Rituraj. These findings suggest a diverse range of fruit picking times, allowing breeders to tailor crosses for specific harvesting schedules.

4.8.32 Total no. of fruits plant^{-1}

The results regarding the magnitude of heterosis for total number of fruits plant^{-1} is presented in Table 4.8.11. The top performer for the MPH were the crosses such as IC090146 × Pant Samrat with 36.13%, closely followed by IC090781 × Pant Samrat with 35.34% and IC090887 × Pusa Bhairav with 23.53%. While, the results of BPH and HSC demonstrated the highly significant variations for most of the brinjal crosses. In this order, the highest positive and substantial BPH was noticed for IC090146 × Pant Samrat with 15.30%, closely followed by IC090781 × Pant Samrat with 14.46% and IC090828 × Pusa Bhairav with 13.98% over the better parent. Similarly, the maximum favourable and considerable HSC results was recorded for cross IC090146 × Pant Samrat with a value of 46.42%, closely followed by IC090781 × Pant Samrat with 45.35% and IC090810 × Pant Samrat with 43.44% over the susceptible check (Pant Rituraj), showing more promising results in terms of fruit set.

4.8.33 Average fruit weight (g)

The heterosis results of MPH, BPH and HSC for average fruit weight (g) revealed that the BPH and HSC results were highly significant compared to MPH across eggplant crosses (Table 4.8.11). However, the cross IC090781 × Pant Samrat noticed with 61.09% was recorded with the maximum positive MPH of 61.09%, closely followed by IC090887 × Pant Samrat with 60.68% and IC090828 × Pant Samrat with the value of 57.67% as compared to its mid parent. The results for BPH exhibited that cross IC090810 × Pant Samrat was recorded with the highest positive BPH with substantial variability at 31.97% followed by IC090781 × Pant Samrat with 28.49% and IC090146 × Pant Samrat as 27.29% over its better parent. Whereas, IC090810 × Pant Samrat showed the maximum improvement in fruit weight with 56.17% HSC followed by IC090781 × Pant Samrat as 52.05% and IC090146 × Pant Samrat with 50.63%, suggesting that these crosses produced heavier fruits over Pant Rituraj. Overall, these results highlight that fruit weight is a critical area for improvement in several cross combinations, with many showing significant reductions in fruit size, which could impact the overall marketability and yield.

4.8.34 Fruit length (cm)

The heterosis results for fruit length (cm) showed variability across the crosses (Table 4.8.12). First of all, the MPH was noticed maximum and positive for IC090810 × Pant Samrat with the value 47.77% followed by IC090781 × Pant Samrat with 43.35% and IC090146 × Pant Samrat with 34.87% over its mid parent. Whereas, the cross IC090810 × Pant Samrat observed with highest positive and significant BPH value as 17.08% followed by IC090781 × Pant Samrat with 15.87% and IC090146 × Pant Samrat with 13.55% compared to its better parent. On the other side, cross IC090810 × Pant Samrat was reported with the maximum and considerable increase for HSC with a value of

72.52% followed by IC090781 × Pant Samrat with 70.74% and IC090146 × Pant Samrat at 67.32% over the susceptible check, suggesting that these crosses can potentially outperform their parent varieties in terms of fruit length.

4.8.35 Fruit diameter (cm)

The results regarding magnitude of heterosis for fruit diameter (cm) is presented under Table 4.8.12, demonstrated that the highest MPH noticed in cross IC090146 × Pant Samrat with 79.56% followed by IC090810 × Pant Samrat as 72.95% and IC090781 × Pant Samrat with 68.81% compared to its mid parent. Whereas, the maximum positive and significant increase for BPH was found for the cross IC090146 × Pant Samrat with 71.97% followed by IC090810 × Pant Samrat with 69.29% and IC090781 × Pant Samrat with 64.02% over their better parent. On the other hand, the results of HSC stated a positive and substantial variations among crosses. However, IC090810 × Pant Samrat showed the most significant improvement with a positive heterosis value of 70.73% followed by IC090146 × Pant Samrat with 66.10% and IC090781 × Pant Samrat with 58.41%, suggesting that these crosses produced wider fruits compared to Pant Rituraj.

4.8.36 Fruit yield plant^{-1} (kg)

The results related to the magnitude of heterosis for fruit yield plant^{-1} (kg) is presented in Table 4.8.12. The following crosses were reported as the top performer for MPH including, IC090146 × Pant Samrat with 77.02%, followed by IC090781 × Pant Samrat with 59.1% and IC090887 × Pant Samrat with 53.62%. Whereas, the results of BPH and HSC demonstrated positive and highly considerable variations for most of the eggplant crosses. For instance, the maximum favourable improvement for BPH and HSC was recorded in cross IC090146 × Pant Samrat with sharing the values of 30.31% and 50.47% followed by IC090810 × Pant Samrat with 22.73% and 41.72% and IC090781 × Pant Samrat with 19.49% and 37.97%, suggesting more promising improvement in these crosses for the trait per plant fruit yield over their better parents and susceptible check (Pant Rituraj).

4.8.37 Fruit yield plot^{-1} (kg) and fruit yield hectare^{-1} (q)

The Table 4.8.13 represents the heterosis results for the traits like fruit yield plot^{-1} (kg) and fruit yield hectare^{-1} (q), showcasing improved cross performance for most of the eggplant crosses. However, the cross IC090146 × Pant Samrat exhibited the maximum positive heterosis (MPH) with 72.84% followed by IC090781 × Pant Samrat at 68.97% and IC090810 × Pant Samrat with 44% as compared to their mid parents. On the other side, the top performing crosses for BPH and HSC, which are reported with most favourable improvement and highly significant variability include IC090146 × Pant Samrat with the values 32.66% and 45.37% followed by IC090781 × Pant Samrat with 26.09% and 38.17% and IC090810 × Pant Samrat with having 21.81% and 33.49%, respectively. These crosses demonstrate promising performance in fruit yield improvement. These crosses exhibit significant positive heterosis for both of the traits related to fruit yield per plot and per hectare basis, highlighting their improved performance relative to their better parentages and susceptible checks.

4.8.38 Total chlorophyll content (mg g^{-1})

The heterosis results for total chlorophyll content (mg g^{-1}) presented under Table 4.8.13, revealed that among crosses IC090146 × Pant Samrat had the maximum positive value of MPH at 40.11% followed by IC090781 × Pant Samrat with 35.65% and IC090828 × Pant Samrat with 31.25% over their mid parents. While, for BPH IC090781 × Pant Samrat exhibited the most favourable and highly significant change with 9.94%, closely followed by IC090146 × Pant Samrat with 8.74% and IC090810 × Pant Samrat with 3.16%, suggesting improved total chlorophyll content compared to their better parents. However, the results related to HSC demonstrated substantial variability and positive magnitude across eggplant crosses. The cross IC090781 × Pant Samrat was noticed with the highest positive and significant HSC value of 91.25% followed by IC090146 × Pant Samrat at 89.17% and IC090810 × Pant Samrat with 79.45%, showing notable positive heterosis over Pant Rituraj. Thus, indicating potential for improved chlorophyll content under stress conditions.

4.8.39 Total soluble solids (°Brix)

The heterosis results for total soluble solids (°Brix) revealed both positive and negative variations among crosses (Table 4.8.14). However, IC090781 × Pant Samrat noticed with the most positive MPH at 15.56% followed by IC090146 × Pant Samrat with 12.56% and IC090887 × Pant Samrat with 11.49% as compared to their mid parents. While, the BPH results stated that cross IC090781 × Pant Samrat recorded with the maximum positive and highly significant heterosis of value 7.27% followed by IC090887 × Pant Samrat as 5.31% and IC090146 × Pant Samrat with 5.22% over its better parent, suggesting enhanced level of total soluble solids in these crosses. On the other side, the cross IC090781 × Pant Samrat showed the highest positive and substantial HSC with 18.42% followed by IC090887 × Pant Samrat with 16.26% and IC090146 × Pant Samrat at 16.15%, indicating potential for improved sugar content in the fruits over Pant Rituraj.

4.8.40 Ascorbic acid (mg 100 g^{-1})

The heterosis results of BPH and HSC demonstrated highly significant variations for most of the crosses for ascorbic acid content (mg 100 g^{-1}) in brinjal fruits (Table 4.8.14). However, the results regarding MPH declared that cross, IC090146 × Pant Samrat found with the maximum positive heterosis of 35.19% followed by IC090810 × Pant Samrat with 32.25% and IC090781 × Pant Samrat with 32.02% over its mid parent. Whereas, the cross IC090810 × Pant Samrat noticed with highest positive BPH and a remarkable increase of 18.01% followed by IC090146 × Pant Samrat as 15.73% and IC090828 × Pusa Bhairav with 12.50% as compared to their better parents. On the other hand, the HSC results revealed that among brinjal crosses, IC090810 × Pant Samrat recorded with the largest positive and considerable increase of 145.69% followed by IC090146 × Pant Samrat with 140.95% and IC090828 × Pant Samrat at 133.19% over the susceptible check. These results highlight substantial variability in ascorbic acid content, with several crosses showing significant improvements over Pant Rituraj, indicating potential for enhanced vitamin C content.

4.8.41 Vitamin A (IU g^{-1})

The heterosis results regarding Vitamin A (IU g^{-1}) is presented under Table 4.8.14. In this order, the results of MPH revealed that among crosses, IC090887 × Pusa Bhairav had the maximum positive value of MPH with 34.61% followed by IC090146 × Pant Samrat with 25.35% and IC090781 × Pant Samrat with 25.07% over their mid parents. While, for BPH the cross IC090781 × Pant Samrat exhibited the most notable and favourable increase with 10.71% followed by IC090146 × Pant Samrat with 8.46% and IC090887 × Pusa Bhairav with 6.22%, compared to their better parents. However, the results related to HSC demonstrated the maximum positive and substantial variation for the cross IC090781 × Pant Samrat with a value of 85.26% followed by IC090146 × Pant Samrat at 81.50% and IC090810 × Pant Samrat with 76.59%, showing notable positive heterosis over Pant Rituraj, suggesting potential for enhanced vitamin A production.

4.8.42 Total anthocyanin (mg 100 g^{-1})

The heterosis result regarding MPH for the trait total anthocyanin (mg 100 g^{-1}) revealed that the cross IC090887 × Pusa Bhairav was found with the maximum positive MPH of 288.15% followed by IC090146 × Pusa Bhairav with 271.63% and IC090828 × Pusa Bhairav at 239.63% as compared to its mid parent (Table 4.8.15). In case of BPH among crosses, IC090887 × Pusa Bhairav recorded with the most favourable change with considerable variation of 105.23% followed by IC090146 × Pusa Bhairav at 100.98% and IC090828 × Pusa Bhairav with 82.78% over its better parent. Whereas, crosses like IC090810 × Pant Samrat, IC090146 × Pant Samrat and IC090781 × Pant Samrat are reported as the top performer for HSC with having positive and significant improvement of 49.12%, 47.95% and 46.78%, respectively over Pant Rituraj for this trait.

4.8.43 Total protein (%)

The heterosis results for total protein (%), revealed varying degrees of heterosis across crosses (Table 4.8.15). The cross, IC090146 × Pant Samrat exhibited the maximum positive increase of MPH as 49.8% followed by IC090781 × Pant Samrat with 47.72%

and IC090828 × Pusa Bhairav with 46.33% as compared to its mid parent. While, the results regarding BPH demonstrated that brinjal cross IC090828 × Pusa Bhairav was noticed with the highest positive and significant change at 7.37%, closely followed byIC090146 × Pant Samrat with 6.27% and IC090781 × Pant Samrat with 1.42% over their better parents. Whereas, highly significant and positive improvement was recorded for HSC results across the brinjal crosses. However, the cross IC090828 × Pusa Bhairav noticed with highest positive increase of 279% followed by IC090146 × Pant Samrat with 273% and IC090781 × Pant Samrat at 256% over Pant Rituraj, indicating enhanced level of total proteins in these crosses in the different seasons under the stress conditions.

4.8.44 Total phenol content (mg GAE g^{-1} DW)

The heterosis results for total phenol content (mg GAE g^{-1} DW) presented in Table 4.8.15, showed substantial variation, specifically in HSC. For instance, among eggplant crosses, IC090781 × Pant Samrat followed by IC090146 × Pant Samrat and IC090810 × Pant Samrat were the top performing crosses reported for the MPH with 47.41%, 46.49% and 42.72%. Whereas, the BPH results demonstrated that cross IC090146 × Pant Samrat showed the most positive and considerable change with 9.79% followed by IC090781 × Pant Samrat with 8.34% and IC090810 × Pant Samrat with 7.02% over its better parent. In contrast, highly significant and positive improvement was noticed across the eggplant crosses for HSC results. However, IC090146 × Pant Samrat observed with the maximum positive and remarkable increment with 376.72% followed by IC090781 × Pant Samrat with 370.40% and IC090810 × Pant Samrat at 364.66% over Pant Rituraj. These results illustrate the variability in total phenol content, with several crosses showing substantial increases over Pant Rituraj, indicating their potential for enhanced nutritional qualities.

4.8.45 Proline content (mg g^{-1} DW)

The heterosis results regarding proline content (mg g^{-1} DW), revealed varying degrees of heterosis across crosses (Table 4.8.16). The cross, IC090887 × Pant Samrat exhibited the maximum positive increase of MPH as 27.67% followed by IC090146 × Pant

Samrat with 24.85% and IC090781 × Pant Samrat with 22.27% as compared to its mid parent. While, the results of BPH demonstrated that brinjal cross, IC090146 × Pant Samrat was noticed with the highest positive and significant change at 9.91% followed by IC090781 × Pant Samrat with 7.46% and IC090810 × Pant Samrat with 4.39% over their better parents. Whereas, highly significant and positive improvement was reported for HSC results across the eggplant crosses. However, the cross IC090146 × Pant Samrat was noticed with the highest favourable change with 80.62% followed by IC090781 × Pant Samrat with 76.59% and IC090810 × Pant Samrat with 71.54% over Pant Rituraj, indicating improved level of prolines in these crosses in the different seasonal stress conditions.

Table 4.8.9 Magnitude of heterosis for days to first flowering (DAT), days to 50% flowering (DAT) and total no. of long styled flower in brinjal crosses in the year 2023

Cross	Days to first flowering (DAT)				Days to 50% flowering (DAT)				Total number of long styled flower			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	43.38	-13.63	-11.84	-20.21	46.73	-14.59	-14.19	-21.05	57.32	16.19	13.63**	34.57**
IC090146 × Pant Samrat	39.83	-20.32	-18.28	-26.73	44.03	-18.33	-17.49	-25.61	63.03	29.95	29.17**	47.99**
IC090781 × Pusa Bhairav	43.30	-14.26	-12.00	-20.36	46.99	-14.65	-14.52	-20.61	57.62	24.35	14.23**	35.29**
IC090781 × Pant Samrat	40.51	-19.41	-16.89	-25.48	42.55	-21.58	-20.28	-28.12	62.50	37.32	28.09**	46.75**
IC090810 × Pusa Bhairav	44.46	-12.37	-9.64	-18.22	47.82	-12.58	-12.15	-19.22	54.41	30.53	7.87**	27.75**
IC090810 × Pant Samrat	41.45	-17.92	-14.96	-23.75	43.96	-18.44	-17.63	-25.74	60.50	48.05	23.98**	42.04**
IC090828 × Pusa Bhairav	42.89	-13.30	-12.84	-21.11	46.13	-16.09	-16.08	-22.06	58.26	32.72	15.50**	36.79**
IC090828 × Pant Samrat	41.63	-15.45	-14.59	-23.42	42.24	-22.03	-20.85	-28.64	58.06	34.78	18.98**	36.31**
IC090887 × Pusa Bhairav	43.48	-12.49	-11.64	-20.02	47.09	-13.61	-12.87	-20.44	57.48	15.38	13.95**	34.95**
IC090887 × Pant Samrat	42.08	-14.92	-13.67	-22.60	44.91	-16.38	-15.84	-24.13	59.57	21.59	21.10**	39.86**

Table 4.8.10 Magnitude of heterosis for total no. of medium styled flower, no. of node to first fruiting and days to first fruit set (DAT) in brinjal crosses in the year 2023

Cross	Total number of medium styled flower				Number of node to first fruiting				Days to first fruit set (DAT)			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	28.47	37.13	17.33**	16.76**	7.78	27.93	57.71**	10.28**	54.41	-2.19	2.70	-10.99
IC090146 × Pant Samrat	29.81	39.29	22.86**	22.25**	9.11	41.93	84.69**	29.15**	41.84	-26.14	-23.95	-31.54
IC090781 × Pusa Bhairav	28.17	29.76	7.68**	15.53**	7.50	23.30	51.82**	6.38**	50.78	-9.14	-4.14	-16.92
IC090781 × Pant Samrat	30.53	36.61	16.71**	25.21**	8.88	38.24	79.66**	25.89**	43.90	-22.87	-20.21	-28.18
IC090810 × Pusa Bhairav	29.24	34.23	11.14**	19.91**	7.37	10.45	20.42**	4.54**	49.94	-10.15	-5.74	-18.30
IC090810 × Pant Samrat	29.65	32.25	12.72**	21.62**	8.72	24.39	42.48**	23.69**	45.46	-19.67	-17.37	-25.62
IC090828 × Pusa Bhairav	28.88	31.79	8.70**	18.44**	8.14	19.40	26.99**	15.46**	47.53	-14.13	-10.29	-22.24
IC090828 × Pant Samrat	28.61	26.87	7.70**	17.35**	8.46	18.17	31.90**	19.93**	50.97	-9.57	-7.35	-16.61
IC090887 × Pusa Bhairav	26.47	35.14	20.76**	8.57**	7.53	13.83	25.40**	6.81**	49.17	-10.31	-7.19	-19.56
IC090887 × Pant Samrat	28.54	41.07	30.18**	17.04**	8.09	16.29	34.64**	14.68**	49.90	-10.63	-9.30	-18.36

Table 4.8.11 Magnitude of heterosis for days to first picking of fruits (DAT), total no. of fruits plant^{-1} and average fruit weight (g) in brinjal crosses in the year 2023

Cross	Days to first picking of fruits (DAT)				Total no. of fruits plant^{-1}				Average fruit weight (g)			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	60.75	-1.46	1.17	-9.66	40.11	19.66	7.68**	18.66**	139.91	38.50	10.70**	46.22**
IC090146 × Pant Samrat	50.11	-19.93	-19.07	-25.48	49.49	36.13	15.30**	46.42**	144.13	52.61	27.29**	50.63**
IC090781 × Pusa Bhairav	57.40	-7.89	-4.41	-14.64	40.63	21.41	9.08**	20.20**	134.96	39.29	6.79**	41.05**
IC090781 × Pant Samrat	50.17	-20.68	-18.98	-25.39	49.13	35.34	14.46**	45.35**	145.49	61.09	28.49**	52.05**
IC090810 × Pusa Bhairav	56.93	-10.32	-5.19	-15.33	41.93	10.65	8.78**	24.06**	131.81	26.71	4.30**	37.76**
IC090810 × Pant Samrat	52.86	-17.95	-14.63	-21.39	48.48	19.02	12.95**	43.44**	149.43	53.33	31.97**	56.17**
IC090828 × Pusa Bhairav	53.15	-13.77	-11.48	-20.95	42.45	17.42	13.98**	25.60**	139.63	48.87	10.48**	45.93**
IC090828 × Pant Samrat	57.56	-8.02	-7.04	-14.40	45.57	16.88	6.17**	34.83**	137.51	57.67	21.44**	43.72**
IC090887 × Pusa Bhairav	54.89	-9.71	-8.59	-18.37	41.67	23.53	11.87**	23.28**	141.47	49.65	11.94**	47.86**
IC090887 × Pant Samrat	55.84	-9.54	-9.26	-16.96	43.34	18.51	0.97	28.22**	141.33	60.68	24.82**	47.71**

Table 4.8.12 Magnitude of heterosis for fruit length (cm), fruit diameter (cm) and fruit yield plant^{-1} (kg) in brinjal crosses in the year 2023

Cross	Fruit length (cm)				Fruit diameter (cm)				Fruit yield plant^{-1} (kg)			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	15.04	16.01	-2.69	44.71**	5.64	11.08	-13.63	37.56**	3.16	22.36	-7.60	-1.25
IC090146 × Pant Samrat	17.39	34.87	13.55**	67.32**	6.81	79.56	71.97**	66.10**	4.82	77.02	30.31**	50.47**
IC090781 × Pusa Bhairav	12.84	3.13	-16.93	23.53**	5.09	-0.93	-22.13	24.02**	3.97	50.33	15.94**	23.91**
IC090781 × Pant Samrat	17.74	43.35	15.87**	70.74**	6.50	68.81	64.02**	58.41**	4.42	59.10	19.49**	37.97**
IC090810 × Pusa Bhairav	13.02	6.72	-15.73	25.31**	5.55	3.98	-15.08	35.24**	3.23	7.32	-5.70	0.78
IC090810 × Pant Samrat	17.93	47.77	17.08**	72.52**	7.00	72.95	69.29**	70.73**	4.54	44.31	22.73**	41.72**
IC090828 × Pusa Bhairav	15.59	25.53	0.87	50.00**	5.47	1.44	-16.23	33.41**	3.91	47.50	14.18**	22.03**
IC090828 × Pant Samrat	16.22	31.39	5.94**	56.11**	4.60	11.99	8.11**	12.20**	3.53	26.57	-4.60	10.16**
IC090887 × Pusa Bhairav	15.05	20.36	-2.62	44.80**	6.08	12.34	-6.97	48.17**	3.25	27.08	-4.97	1.56
IC090887 × Pant Samrat	15.19	22.16	-0.82	46.15**	5.36	29.90	24.97**	30.61**	4.14	53.62	12.04**	29.38**

Table 4.8.13 Magnitude of heterosis for fruit yield plot^{-1} (kg), fruit yield hectare^{-1} (q) and total chlorophyll content (mg g^{-1}) in brinjal crosses in the year 2023

Cross	Fruit yield plot^{-1} (kg)				Fruit yield hectare^{-1} (q)				Total chlorophyll content (mg g^{-1})			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	21.19	9.74	-13.47	-12.07	523.18	9.74	-13.47	-12.07	1.19	28.76	-1.00	76.85**
IC090146 × Pant Samrat	35.04	72.84	32.66**	45.37**	865.01	72.84	32.66**	45.37**	1.28	40.11	8.74**	89.17**
IC090781 × Pusa Bhairav	19.95	6.39	-18.56	-17.24	492.44	6.39	-18.56	-17.24	1.17	21.58	-2.45	74.26**
IC090781 × Pant Samrat	33.30	68.97	26.09**	38.17**	822.18	68.97	26.09**	38.17**	1.29	35.65	9.94**	91.25**
IC090810 × Pusa Bhairav	23.80	11.30	-2.84	-1.27**	587.50	11.30	-2.84	-1.27**	1.21	22.56	0.12	78.86**
IC090810 × Pant Samrat	32.17	44.00	21.81**	33.49**	794.28	44.00	21.81**	33.49**	1.21	24.97	3.16*	79.45**
IC090828 × Pusa Bhairav	26.79	41.95	9.39**	11.16**	661.45	41.95	9.39**	11.16**	1.13	21.16	-6.56	66.91**
IC090828 × Pant Samrat	24.98	25.93	-5.43	3.63**	616.63	25.93	-5.43	3.63**	1.20	31.25	2.17	77.74**
IC090887 × Pusa Bhairav	25.06	31.15	2.33	3.98**	618.73	31.15	2.33	3.98**	1.18	23.97	-2.28	74.55**
IC090887 × Pant Samrat	26.55	32.30	0.53	10.17**	655.52	32.30	0.53	10.17**	1.19	27.35	1.36	76.34**

Table 4.8.14 Magnitude of heterosis for total soluble solids (°Brix), ascorbic acid (mg 100 g^{-1}) and vitamin A (IU g^{-1}) content in brinjal crosses in the year 2023

Cross	Total soluble solids (°Brix)				Ascorbic acid (mg 100 g^{-1})				Vitamin A (IU g^{-1})			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	4.83	-3.54	-9.72	-0.62	1.66	-15.56	-24.77	42.67**	0.25	8.58	0.40	44.51**
IC090146 × Pant Samrat	5.65	12.56	5.22**	16.15**	2.80	35.19	15.73**	140.95**	0.31	25.35	8.46**	81.50**
IC090781 × Pusa Bhairav	5.09	2.36	-4.86	4.73	2.13	10.36	-3.18	83.62**	0.21	-10.38	-15.06	22.25**
IC090781 × Pant Samrat	5.76	15.56	7.27**	18.42**	2.69	32.02	11.39**	131.90**	0.32	25.07	10.71**	85.26**
IC090810 × Pusa Bhairav	4.17	-16.20	-22.15	-14.30	1.90	-7.20	-13.64	63.79**	0.12	-47.92	-52.21	-31.21
IC090810 × Pant Samrat	5.43	9.09	1.21	11.73**	2.85	32.25	18.01**	145.69**	0.31	22.81	5.53**	76.59**
IC090828 × Pusa Bhairav	5.20	-4.24	-5.55	6.89**	2.48	22.98	12.50**	113.36**	0.15	-28.21	-38.15	-10.98
IC090828 × Pant Samrat	5.15	-5.20	-6.36	5.97*	2.71	27.59	12.01**	133.19**	0.25	4.58	-15.20	41.91**
IC090887 × Pusa Bhairav	4.83	-4.55	-9.72	-0.62	1.71	0.74	-22.50	46.98**	0.26	34.61	6.22**	52.89**
IC090887 × Pant Samrat	5.65	11.49	5.31**	16.26**	2.29	27.22	-5.18	97.41**	0.25	17.19	-12.26	46.82**

Table 4.8.15 Magnitude of heterosis for total anthocyanin (mg 100 g^{-1}), total protein (%) and total phenol content (mg GAE g^{-1} DW) in brinjal crosses in the year 2023

Cross	Total anthocyanin (mg 100 g^{-1})				Total protein (%)				Total phenol content (mg GAE g^{-1} DW)			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	648.03	271.63	100.98**	36.18**	1.70	36.00	-3.68	240.00**	0.48	-8.60	-28.33	173.28**
IC090146 × Pant Samrat	704.09	95.74	1.59*	47.95**	1.87	49.80	6.27**	273.00**	0.83	46.49	9.79**	376.72**
IC090781 × Pusa Bhairav	351.47	101.15	9.00**	-26.14	1.57	29.75	-11.05	214.00**	0.53	3.29	-20.72	202.30**
IC090781 × Pant Samrat	698.49	94.00	0.78	46.78**	1.78	47.72	1.42	256.00**	0.82	47.41	8.34**	370.40**
IC090810 × Pusa Bhairav	462.66	166.61	43.49**	-2.78	1.66	28.29	-6.23	231.00**	0.44	-15.95	-34.06	151.44**
IC090810 × Pant Samrat	709.64	97.75	2.39**	49.12**	1.77	37.74	0.85	254.00**	0.81	42.72	7.02**	364.66**
IC090828 × Pusa Bhairav	589.37	239.63	82.78**	23.85**	1.90	46.33	7.37**	279.00**	0.56	8.64	-16.13	219.83**
IC090828 × Pant Samrat	655.97	82.79	-5.36	37.84**	1.45	12.02	-17.66	189.00**	0.58	4.61	-22.70	235.63**
IC090887 × Pusa Bhairav	661.74	288.15	105.23**	39.06**	1.27	9.01	-28.05	154.00**	0.53	23.20	-20.57	202.87**
IC090887 × Pant Samrat	555.29	56.06	-19.88	16.69**	1.34	15.09	-23.93	167.00**	0.66	39.21	-12.71	279.02**

Table 4.8.16 Magnitude of heterosis for proline content (mg g^{-1} DW) and ash content (%) in brinjal crosses in the year 2023

Cross	Proline content (mg g^{-1} DW)				Ash content (%)			
	Mean	MPH	BPH	HSC	Mean	MPH	BPH	HSC
IC090146 × Pusa Bhairav	7.62	0.72	-9.91	42.73**	7.66	4.89	-7.64	41.80**
IC090146 × Pant Samrat	9.65	24.85	9.91**	80.62**	8.92	25.02	12.06**	65.19**
IC090781 × Pusa Bhairav	6.17	-18.34	-27.07	15.53**	7.54	0.10	-9.05	39.63**
IC090781 × Pant Samrat	9.43	22.27	7.46**	76.59**	8.87	20.35	11.39**	64.19**
IC090810 × Pusa Bhairav	6.44	-14.45	-23.83	20.67**	6.87	-7.79	-17.13	27.22**
IC090810 × Pant Samrat	9.16	19.12	4.39**	71.54**	8.50	16.68	6.79**	57.42**
IC090828 × Pusa Bhairav	7.19	-4.77	-14.98	34.69**	6.90	-5.64	-16.83	27.69**
IC090828 × Pant Samrat	6.74	-12.64	-23.24	26.13**	7.78	8.86	-2.32	43.98**
IC090887 × Pusa Bhairav	8.46	22.26	0.01	58.44**	5.73	-15.67	-30.85	6.16
IC090887 × Pant Samrat	9.04	27.67	2.97*	69.20**	7.74	16.70	-2.76	43.33**

4.8.46 Ash content (%)

The heterosis results for ash content revealed some interesting trends as depicted in Table 4.8.16. Among crosses, IC090146 × Pant Samrat, IC090781 × Pant Samrat and IC090887 × Pant Samrat were reported as the top performers regarding MPH with having the positive values of 25.02%, 20.35% and 16.70%, respectively. While, the BPH results demonstrated that IC090146 × Pant Samrat had the most positive and highly significant variation of 12.06% followed by IC090781 × Pant Samrat with 11.39% and IC090810 × Pant Samrat with 6.79% over its better parent. Whereas, considerable variability and favourable results were noticed across the brinjal crosses for HSC. However, the cross IC090146 × Pant Samrat exhibited the maximum positive and considerable change with 65.19%, closely followed by IC090781 × Pant Samrat with 64.19% and IC090810 × Pant Samrat with 57.42% over the susceptible check *i.e.*, Pant Rituraj. These results suggest that while several crosses showed positive heterosis for ash content, there is considerable variation in the magnitude of increase over Pant Rituraj.

Heterosis, or cross vigour, has been widely documented as a significant contributor to the improvement of yield and agronomic traits in brinjal breeding. Studies have consistently shown that cross crosses often outperform their parents, with particularly strong heterotic effects observed in traits like fruit yield, size, and number of fruits per plant. This trend highlights the potential for heterosis to be harnessed for developing high-yielding cross brinjal varieties. These results are consistent with previous studies (Chadha *et al*., 1990; Bulgundi, 2000; Kaur *et al*., 2001), which also reported significant heterosis in brinjal crosses. The high heterosis observed in these crosses can be attributed to the genetic diversity between the parental lines, which is a key factor for the expression of heterosis, as suggested by Singh and Murty (1971) and others. Susmitha *et al*. (2022) observed significant heterosis in brinjal crosses. The cross ICO-345590 × Arka Kusumkar demonstrated high BPH for trait like fruit yield per plant, while high susceptible heterosis was recorded for traits like plant height (ICO-344674 × ICO-383119), days to first harvest (ICO-344674 × Arka Kusumkar), fruit length (Arka Kusumkar × ICO-345590), and fruit girth (ICO-345590 × ICO-545862), emphasizing the potential of heterosis in improving key traits.

In the component-wise analysis, the cross JBL-08-08 × NSR-1 showed high heterosis for the trait 'number of fruits per plant', a major yield determinant. However, other crosses that exhibited considerable heterosis for fruit number did not show corresponding high heterosis for fruit yield (Prabhu *et al*., 2005; Roy *et al*., 2009). Additionally, the study highlighted the complexity of yield as a trait, where multiple components interact to determine the final heterotic expression. Reddy *et al*. (2020) reported significant heterosis in brinjal for traits like yield and flowering. Negative heterosis was preferred for early flowering and picking, with DBR-8 × JKGEH-6012 performing best. The cross JB-9 × JKGEH-6012 showed the highest positive heterosis for fruit yield across all comparisons, indicating its potential for high-yielding cross development.

Mishra *et al*. (2023) reported significant positive heterosis for vegetative growth and fruit yield in crosses like BBSR-08-2 × Selection from BBSR-145-1, BBSR-08-2 × BBSR-10-25, and BBSR-08-2 × BBSR-10-26. These crosses performed better than the mid-parent, better parent, and susceptible check. Dudhatra *et al*. (2024) identified crosses AB 15-08 × AB 20-13, AB 15-08 × AB 20-03, and AB 20-07 × GP BRJ 224 as top performers, showing potential for exploiting heterosis in traits like fruit yield and related characteristics. Rahul *et al*. (2022) observed the highest heterosis for fruit yield per plant in the cross HE-100 × H-8 (42.27%), showcasing its potential for improved yield. Crosses like HE-100 × BR-112 exhibited earliness, offering advantages for faster production cycles.

Significant positive heterosis for the number of branches per plant was observed in most of the top-yielding crosses, except for GBL-1 × NBB-1, these findings were documented by Patil and Shinde (1989) and Reddy and Patel (2014). Furthermore, early growth vigour, indicated by seedling height and plant height, was positively associated with higher fruit yield in several crosses, aligning with studies by Patil and Shinde (1989) and Shafeeq *et al*. (2005). Anjana *et al*. (2023) reported significant BPH and susceptible heterosis across 22 traits in brinjal. Cross P2 × P4 exhibited 42.42% BPH and 25.12% susceptible heterosis, while P1 × P4 showed 41.73% BPH and 14.15% susceptible heterosis, both indicating strong potential for improved fruit yield and quality. Mondal *et al*. (2021) suggested that heterosis breeding, utilizing both additive and non-additive genetic variance, is the best strategy for developing high-yielding crosses with improved fruit size, quality, and resistance to pests. The cross Garia × Punjab Sadabahar showed strong positive SCA effects for traits like plant height, fruit weight, and borer resistance, indicating significant cross vigour.

Interestingly, the top yielding crosses showed negative heterosis for traits such as fruit weight and fruit length, which are considered desirable in the South Gujarat region where smaller fruits are preferred. This finding supports the idea that negative heterosis for certain quality traits, such as fruit weight, can be advantageous for specific market preferences, as suggested by Kumar *et al*. (1999) and Bulgundi (2000). Additionally, all top yielding crosses exhibited negative heterosis for total soluble sugars, indicating the preference for lower sugar content in brinjal (Suneetha *et al*., 2006). Rameshkumar and Vethamonai (2020) observed significant heterosis in all traits evaluated in 6 brinjal genotypes and their crosses. Notably, the cross Seetipulam Local × Sevathampatti Local exhibited 22.49% heterosis for plant height and 34.57% for fruit yield per plant, while Spiny Local × Sevathampatti Local showed 46.97% heterosis for the number of branches. Kasera *et al*. (2020) observed significant heterosis across all traits, with the strongest cross vigor for plant height, fruit yield, and the number of fruits per plant, indicating the potential to exploit heterosis for yield improvement.

The researches done by Sidhu *et al*. (2022) and Gangadhara *et al*. (2021) suggested that both additive and non-additive genetic effects play a key role in the manifestation of heterosis. This indicates that selection for cross vigor may benefit from considering both genetic interactions and the specific parent combinations that give rise to superior crosses. Moreover, the identification of crosses such as IC-433678 × IC-89986 and JB-9 × JKGEH-6012 as promising candidates for enhanced yield further underscores the role of specific cross combinations in achieving significant improvements.

Additionally, the findings from Samatha *et al*. (2021a) and Siva *et al*. (2020) reinforce the idea that the expression of heterosis is not limited to yield alone but extends to other desirable traits like fruit weight and size. The consistent identification of crosses showing positive heterosis for multiple traits highlights the possibility of developing multi-trait superior crosses, which could offer a broader range of benefits for commercial cultivation. Similar results were reported by Kumar *et al*. (2012), Biswas *et al*. (2013), Reddy and Patel (2014), Makani *et al*. (2013), Reddy and Patel (2014), Deshmukh *et al*. (2015), Ramani *et al*. (2015), and Sao and Mehta (2010).

Overall, the study's results underscore that high heterosis for fruit yield in brinjal is not solely dependent on a single component but rather a combination of traits, including the number of fruits per plant, number of branches, and early growth characteristics. These findings reinforce the importance of selecting cross combinations based on both yield and quality traits, rather than focusing exclusively on heterosis for any single trait. The evidence strongly supports the potential of heterosis in enhancing brinjal productivity and quality. By leveraging both additive and non-additive genetic factors, breeders can develop cross varieties that not only outperform their parent lines in terms of yield but also exhibit desirable traits for improved market appeal and adaptability.

4.9 Proportional contribution of lines, testers and their interaction

The analysis of line, tester, and interaction contributions to various traits revealed distinct patterns of genetic influence, with testers generally having the most substantial effect, followed by lines, and the interaction between line and tester playing a relatively minor role (Table 4.9). Line contribution was most pronounced in several traits like days to first seed emergence (67.53), total protein (65.93%), PDI-for leaf at 7^{th} DAI (61.59%), leaf area (52.47%), PFI (52.31%) and total no. of medium styled flowers (45.75%). On the other hand, the line's contribution was minimal for certain traits, such as, petiole length (29.18%), total soluble solids (20.04%), total anthocyanin (19.49%), total no. of long styled flower (19.03%), plant height at 30 DAT (18.02%), no. of node to first fruiting (13.79%), peduncle length (12.66%), fruit yield $plant^{-1}$ (10.74%), total no. of fruits $plant^{-1}$ (8.04%), PLAD (7.50%), total phenol content (7.05%), PDI-for fruit at 7^{th} DAI (6.80%), PDI-for fruit at 14^{th} (6.37%), average fruit weight (5.87%), days to first fruit set (DAT) (5.86%), fruit length (5.67%), PLI (5.12%), fruit yield $plot^{-1}$ and $hectare^{-1}$ (4.25%), days to first picking of fruits (DAT) (3.68%), and PDI-for fruit at 21^{st} DAI (1.71%) where other factors, including the tester or environmental conditions, played a more substantial role.

Tester contribution was most pronounced in several traits such as PDI-for leaf at 21st DAI (91.71%), days to 50 flowering DAT (81.86%), lesion size on fruits (79.47%), days to first flowering DAT (75.51%), PLI (74.40%), total no. of fruits plant-1 (72.81%), no. of node to first fruiting (71.02%), total no. of primary branches plant-1 at final harvest (70.54%), total phenol content (70.26%), PDI-for leaf at 14th DAI (69.19%), days to first seed emergence (67.53%), and PLAD-eye estimation (65.08%). In these traits, tester effects representing the influence of male parents played a dominant role, indicating the importance of additive genetic variance from the tester parent. However, the tester's contribution was found to be minimal for certain traits, such as total protein (0.26%), days to 50% seed emergence DAS (3.89%), days to first picking of fruits DAT (26.20%), average fruit weight (38.49%), ascorbic acid (64.92%), vitamin A (48.66%), and some traits related to fruit area diseased and leaf area, where other factors, especially the parental lines or the specific cross combinations, exerted a greater influence.

Interaction of line × tester was most pronounced in several traits like days to first picking of fruits DAT (70.13%), days to first fruit set DAT (63.26%), average fruit weight (55.64%), petiole length (40.83%), fruit yield plot^{-1} and hectare^{-1} (42.36%), fruit yield plant-1 (40.10%), fruit diameter (51.74%), peduncle length (52.59%), total anthocyanin (50.58%), fruit length (35.94%), PFAD (34.26%), proline content (30.43%), PLAD (27.42%), and total no. of medium styled flowers (22.27%). In these cases, the line × tester interaction demonstrates a predominant role of non-additive genetic effects, heterosis, and the unique performance of specific crosses. On the other hand, the line × tester interaction's contribution was minimal for a few traits such as PDI-for leaf at 21st DAI (1.05%), days to 50 seed emergence DAS (59.56%), days to first seed emergence (23.84%), lesion size on fruits (9.20%), total no. of fruits plant^{-1} (19.14%), and stem diameter (20.35%), where the effects of either the line or tester parent played a more critical role in trait expression.

4.10 Morphological observations

The morphological observations related to fruit shape, fruit colour, calyx spininess and leaf spininess of parents and their crosses is presented in the Table 4.10.

Table 4.9 Proportional contribution of lines, testers and their interaction

Traits	Line	Tester	Line × Tester
Percent leaf incidence (PLI) (%)	5.12	74.40	20.48
Percent fruit incidence (PFI) (%)	52.31	15.23	32.46
Percent leaf area diseased (PLAD)-eye estimation (%)	7.50	65.08	27.42
Percent fruit area diseased (PFAD)-eye estimation (%)	20.15	45.59	34.26
Percent disease index (PDI)-for leaf at 7th DAI (%)	61.59	13.38	25.03
Percent disease index (PDI)-for leaf at 14th DAI (%)	16.16	69.19	14.64
Percent disease index (PDI)-for leaf at 21st DAI (%)	7.23	91.71	1.05
Percent disease index (PDI)-for fruit 7th DAI (%)	6.80	52.32	40.88
Percent disease index (PDI)-for fruit 14th DAI (%)	6.37	52.05	41.59
Percent disease index (PDI)-for fruit 21st DAI (%)	1.71	95.12	3.18
Lesion size on fruits (cm^2)	11.33	79.47	9.20
Days to first seed emergence (DAS)	67.53	8.63	23.84
Days to 50% seed emergence (DAS)	36.55	3.89	59.56
Plant height at 30 DAT (cm)	18.02	59.91	22.06
Plant height at 60 DAT (cm)	27.62	45.21	27.17
Plant height at 90 DAT (cm)	37.16	47.10	15.74
Plant height at final harvest (cm)	21.95	62.61	15.44
Total no. of primary branches plant^{-1} at final harvest	23.01	70.54	6.45
Total no. of nodes at final harvest	22.07	70.18	7.74
Internodal length of plant at final harvest (cm)	23.28	58.75	17.97
Stem diameter (cm)	25.57	54.08	20.35
Peduncle length (cm)	12.66	34.76	52.59
Petiole length (cm)	29.18	29.99	40.83
Leaf area (cm^2)	52.47	12.85	34.68
Days to first flowering (DAT)	13.63	75.51	10.86
Days to 50% flowering (DAT)	13.19	81.86	4.94
Total no. of long styled flower	19.03	57.01	23.97

Total no. of medium styled flower	45.75	31.97	22.27
No. of node to first fruiting	13.79	71.02	15.20
Days to first fruit set (DAT)	5.86	30.88	63.26
Days to first picking of fruits (DAT)	3.68	26.20	70.13
Total no. of fruits plant^{-1}	8.04	72.81	19.14
Average fruit weight (g)	5.87	38.49	55.64
Fruit length (cm)	5.67	58.38	35.94
Fruit diameter (cm)	37.12	11.14	51.74
Fruit yield plant^{-1} (kg)	10.74	49.17	40.10
Fruit yield plot^{-1} (kg)	4.25	53.39	42.36
Fruit yield hectare^{-1} (q)	4.25	53.39	42.36
Total chlorophyll content (mg g^{-1})	38.08	39.88	22.04
Total soluble solids (°Brix)	20.04	58.60	21.35
Ascorbic acid (mg 100 g^{-1})	21.31	64.92	13.78
Vitamin A (IU g^{-1})	25.71	48.66	25.62
Total anthocyanin (mg 100 g^{-1})	19.49	29.93	50.58
Total protein (%)	65.93	0.26	33.81
Total phenol content (mg GAE g^{-1} DW)	7.05	70.26	22.68
Proline content (mg g^{-1} DW)	27.18	42.39	30.43
Ash content (%)	37.88	58.02	4.10

Table 4.10 Top performing lines, tester and crosses of brinjal for various disease, growth, yield and biochemical traits

Traits	Lines	Tester	Crosses
Percent leaf incidence (%)	IC090146, IC090810	Pant Samrat	IC090887 × Pusa Bhairav, IC090781 × Pant Samrat, IC090146 × Pant Samrat
Percent fruit incidence (%)	IC090781, IC090810	Pant Samrat	IC090146 × Pant Samrat, IC090828 × Pusa Bhairav
Percent leaf area diseased-eye estimation (%)	IC090887, IC090810	Pusa Bhairav	IC090887 × Pant Samrat, IC090781 × Pusa Bhairav, IC090146 × Pusa Bhairav
Percent fruit area diseased-eye estimation (%)	IC090146, IC090828	Pant Samrat	IC090828 × Pusa Bhairav, IC090810 × Pant Samrat, IC090146 × Pant Samrat
Percent disease index-for leaf at 7th DAI (%)	IC090146, IC090781	Pant Samrat	IC090887 × Pusa Bhairav, IC090146 × Pant Samrat, IC090810 × Pant Samrat
Percent disease index-for leaf at 14th DAI (%)	IC090146, IC090781	Pant Samrat	IC090828 × Pusa Bhairav, IC090781 × Pant Samrat, IC090810 × Pant Samrat
Percent disease index-for leaf at 21st DAI (%)	IC090146, IC090781	Pant Samrat	IC090781 × Pant Samrat, IC090146 × Pusa Bhairav, IC090887 × Pusa Bhairav
Percent disease index-for fruit 7th DAI (%)	IC090146, IC090828	Pant Samrat	IC090828 × Pusa Bhairav, IC090781 × Pant Samrat, IC090146 × Pant Samrat
Percent disease index-for fruit 14th DAI (%)	IC090781, IC090810	Pant Samrat	IC090828 × Pusa Bhairav, IC090146 × Pant Samrat, IC090781 × Pant Samrat
Percent disease index-for fruit 21st DAI (%)	IC090146, IC090781	Pant Samrat	IC090146 × Pant Samrat, IC090887 × Pusa Bhairav, IC090828 × Pusa Bhairav
Lesion size on fruits (cm^2)	IC090146, IC090781	Pant Samrat	IC090810 × Pant Samrat, IC090828 × Pusa Bhairav, IC090781 × Pusa Bhairav
Days to first seed emergence (DAS)	IC090146, IC090810	Pant Samrat	IC090781 × Pusa Bhairav, IC090146 × Pant Samrat, IC090887 × Pant Samrat
Days to 50% seed emergence (DAS)	IC090146, IC090810	Pusa Bhairav	IC090887 × Pant Samrat, IC090810 × Pusa Bhairav, IC090146 × Pant Samrat

Plant height at 30 DAT (cm)	IC090781, IC090810	Pant Samrat	IC090146 × Pusa Bhairav, IC090828 × Pusa Bhairav, IC090781 × Pusa Bhairav
Plant height at 60 DAT (cm)	IC090781, IC090810	Pant Samrat	IC090146 × Pant Samrat, IC090828 × Pusa Bhairav, IC090887 × Pusa Bhairav
Plant height at 90 DAT (cm)	IC090810, IC090781	Pant Samrat	IC090828 × Pusa Bhairav, IC090810 × Pant Samrat, IC090781 × Pant Samrat
Plant height at final harvest (cm)	IC090146, IC090781	Pant Samrat	IC090887 × Pusa Bhairav, IC090146 × Pant Samrat, IC090781 × Pant Samrat
Total no. of primary branches plant^{-1} at final harvest	IC090781, IC090146	Pant Samrat	IC090146 × Pant Samrat, IC090828 × Pusa Bhairav, IC090887 × Pusa Bhairav
Total no. of nodes at final harvest	IC090146, IC090810	Pant Samrat	IC090810 × Pusa Bhairav, IC090146 × Pant Samrat, IC090781 × Pant Samrat
Internodal length of plant at final harvest (cm)	IC090146, IC090781	Pant Samrat	IC090887 × Pusa Bhairav, IC090146 × Pant Samrat, IC090810 × Pant Samrat
Stem diameter (cm)	IC090781, IC090146	Pant Samrat	IC090146 × Pant Samrat, IC090887 × Pusa Bhairav, IC090828 × Pusa Bhairav
Peduncle length (cm)	IC090887, IC090828	Pusa Bhairav	IC090828× Pant Samrat, IC090887 × Pant Samrat, IC090781 × Pusa Bhairav
Petiole length (cm)	IC090828, IC090887	Pusa Bhairav	IC090887 × Pant Samrat, IC090810 × Pusa Bhairav, IC090781 × Pusa Bhairav
Leaf area (cm^2)	IC090810, IC090146	Pant Samrat	IC090887 × Pusa Bhairav, IC090781 × Pant Samrat, IC090146 × Pant Samrat
Days to first flowering (DAT)	IC090146, IC090781	Pant Samrat	IC090146 × Pant Samrat, IC090828 × Pusa Bhairav, IC090887 × Pusa Bhairav
Days to 50% flowering (DAT)	IC090828, IC090781	Pant Samrat	IC090887 × Pusa Bhairav, IC090781 × Pant Samrat, IC090146 × Pusa Bhairav
Total no. of long styled flower	IC090146, IC090781	Pant Samrat	IC090828 × Pusa Bhairav, IC090810 × Pant Samrat, IC090146 × Pant Samrat

Total no. of medium styled flower	IC090810, IC090781	Pant Samrat	IC090828 × Pusa Bhairav, IC090781 × Pant Samrat, IC090887 × Pant Samrat
No. of node to first fruiting	IC090887, IC090810	Pusa Bhairav	IC090828 × Pant Samrat, IC090887 × Pant Samrat, IC090781 × Pusa Bhairav
Days to first fruit set (DAT)	IC090781, IC090810	Pant Samrat	IC090146 × Pant Samrat, IC090828 × Pusa Bhairav, IC090887 × Pusa Bhairav
Days to first picking of fruits (DAT)	IC090781, IC090810	Pant Samrat	IC090828 × Pusa Bhairav, IC090146 × Pant Samrat, IC090887 × Pusa Bhairav
Total no. of fruits plant^{-1}	IC090810, IC090781	Pant Samrat	IC090887 × Pusa Bhairav, IC090146 × Pant Samrat, IC090828 × Pusa Bhairav
Average fruit weight (g)	IC090146, IC090887	Pant Samrat	IC090810 × Pant Samrat, IC090828 × Pusa Bhairav, IC090887 × Pusa Bhairav
Fruit length (cm)	IC090146, IC090828	Pant Samrat	IC090887 × Pusa Bhairav, IC090810 × Pant Samrat, IC090781 × Pant Samrat
Fruit diameter (cm)	IC090810, IC090146	Pant Samrat	IC090828 × Pusa Bhairav, IC090887 × Pusa Bhairav, IC090810 × Pant Samrat
Fruit yield plant^{-1} (kg)	IC090781, IC090146	Pant Samrat	IC090828 × Pusa Bhairav, IC090146 × Pant Samrat, IC090810 × Pant Samrat
Fruit yield plot^{-1} (kg)	IC090146, IC090810	Pant Samrat	IC090828 × Pusa Bhairav, IC090146 × Pant Samrat, IC090781 × Pant Samrat
Fruit yield hectare^{-1} (q)	IC090146, IC090810	Pant Samrat	IC090828 × Pusa Bhairav, IC090146 × Pant Samrat, IC090781 × Pant Samrat
Total chlorophyll content (mg g^{-1})	IC090146, IC090781	Pant Samrat	IC090781 × Pant Samrat, IC090810 × Pusa Bhairav, IC090887 × Pusa Bhairav
Total soluble solids (°Brix)	IC090781, IC090887	Pant Samrat	IC090828 × Pusa Bhairav, IC090810 × Pant Samrat, IC090146 × Pant Samrat
Ascorbic acid (mg 100 g^{-1})	IC090828, IC090781	Pant Samrat	IC090828 × Pusa Bhairav, IC090146 × Pant Samrat, IC090810 × Pant Samrat

Vitamin A (IU g^{-1})	IC090146, IC090781	Pant Samrat	IC090887 × Pusa Bhairav, IC090810 × Pant Samrat, IC090146 × Pusa Bhairav
Total anthocyanin (mg 100 g^{-1})	IC090146, IC090828	Pant Samrat	IC090887 × Pusa Bhairav, IC090781 × Pant Samrat, IC090810 × Pant Samrat
Total protein (%)	IC090146, IC090810	Pant Samrat	IC090828 × Pusa Bhairav, IC090781 × Pant Samrat, IC090146 × Pant Samrat
Total phenol content (mg GAE g^{-1} DW)	IC090781, IC090146	Pant Samrat	IC090828 × Pusa Bhairav, IC090810 × Pant Samrat, IC090146 × Pant Samrat
Proline content (mg g^{-1} DW)	IC090887, IC090146	Pant Samrat	IC090781 × Pant Samrat, IC090810 × Pant Samrat, IC090887 × Pusa Bhairav
Ash content (%)	IC090146, IC090781	Pant Samrat	IC090887 × Pant Samrat, IC090828 × Pusa Bhairav, IC090810 × Pant Samrat

Table 4.11 Morphological observations of fruit shape, fruit colour, calyx spininess and leaf spininess of parents, their crosses and susceptible check in the year 2023

Genotype	Code	Fruit shape	Fruit colour	Calyx spininess	Leaf spininess
Parents					
IC090146	L1	Cylindrical	Purple	Weak	Present
IC090781	L2	Cylindrical	Purple	Weak	Present
IC090810	L3	Cylindrical	Purple	Weak	Present
IC090828	L4	Cylindrical	Purple	Weak	Absent
IC090887	L5	Cylindrical	Purple	Absent	Absent
Pusa Bhairav	T1	Ellipsoid	Purple	Absent	Absent
Pant Samrat	T2	Cylindrical	Purple	Absent	Absent
Crosses					
IC090146 × Pusa Bhairav	L1 × T1	Cylindrical	Purple	Absent	Absent
IC090146 × Pant Samrat	L1 × T2	Cylindrical	Purple	Absent	Absent
IC090781 × Pusa Bhairav	L2 × T1	Cylindrical	Purple	Weak	Absent
IC090781 × Pant Samrat	L2 × T2	Cylindrical	Purple	Absent	Absent
IC090810 × Pusa Bhairav	L3 × T1	Cylindrical	Purple	Weak	Absent
IC090810 × Pant Samrat	L3 × T2	Cylindrical	Purple	Weak	Absent
IC090828 × Pusa Bhairav	L4 × T1	Cylindrical	Purple	Weak	Absent
IC090828 × Pant Samrat	L4 × T2	Cylindrical	Purple	Absent	Absent
IC090887 × Pusa Bhairav	L5 × T1	Cylindrical	Purple	Absent	Absent
IC090887 × Pant Samrat	L5 × T2	Cylindrical	Purple	Absent	Absent
Susceptible check					
Pant Rituraj	SC	Globular	Purple	Absent	Absent

The current investigation entitled **"Heterosis and Combining Ability Studies in Phomopsis Blight Resistant Genotypes of Brinjal (*Solanum melongena* L.)"** was conducted at the Vegetable Research Farm of Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India. The presented work is divided into two inter related studies; study-1 is related to the screening of brinjal genotypes against the phomopsis blight and validation of resistant genotypes. Whereas, study-2 deals with estimation of combining ability and heterosis for yield and yield attributes in parents, their crosses and comparison with a susceptible check. Each study was sub-divided into two experiments, conducted in two successive cropping seasons *i.e.*, spring-summer and *kharif* of 2022 and 2023, respectively. The salient findings based on observations recorded under the current investigation are summarized as under:

Study-1: Screening of brinjal genotypes against phomopsis blight and validation of resistant genotypes (pooled over season 2022)

i. In the study-1, a total of 33 brinjal genotypes (30 IC lines, two resistant checks, Pusa Bhairav and Pant Samrat, and one susceptible check, Pant Rituraj) were evaluated for their performance against phomopsis blight during the spring-summer and *kharif* seasons of 2022. The mean sum of squares of genotypes revealed highly significant differences (at 1% level) for all the traits studied.

ii. The overall results across all disease parameters revealed significant genotypic variation among the brinjal genotypes. A clear distinction in disease resistance was observed between the genotypes Pant Samrat (G_{32}) and Pant Rituraj (G_{33}). Pant Samrat consistently exhibited the lowest values for disease incidence and severity for both leaf and fruit at various stages across all parameters. Conversely, Pant Rituraj showed the highest values for all these parameters, indicating greater susceptibility to disease.

iii. The evaluation of growth and yield parameters revealed significant genotypic variability among brinjal genotypes. Pant Samrat (G_{32}) emerged as the most promising, exhibiting superior vegetative growth and the highest fruit yield per plant, plot, and hectare, while IC090887 (G_{13}) was notable for early emergence, offering potential for early market preference.

iv. Overall, significant biochemical diversity among the genotypes was observed, with Pant Samrat (G32) emerging as the most superior genotype by combining high nutritional quality with enhanced resistance-related metabolites, while Pusa Bhairav (G_{31}) showed strength in chlorophyll and mineral traits. In contrast, genotypes such as IC090887 (G_{13}), IC090940 (G_{18}), and Pant Rituraj (G_{33}) were comparatively inferior across multiple parameters.

v. The pooled phenotypic correlation coefficient analysis between 37 quantitative and qualitative features revealed that fruit yield per plot exhibited a complex association with various disease, earliness, growth, yield, and quality traits. Yield showed highly significant negative correlations with most disease parameters (except lesion size on fruits), as well as with earliness traits such as days to 50% seed emergence, days to 50% flowering, and days to first picking of fruits, indicating that higher disease incidence and delayed maturity adversely affected productivity. In contrast, most growth traits displayed significant positive correlations with yield, except petiole length, which showed a significant negative relationship. Furthermore, yield-attributing traits like average fruit weight, fruit length, fruit yield per plant, and fruit yield per hectare, along with quality traits including ascorbic acid, vitamin A, anthocyanins, proteins, phenols, and proline, exhibited strong positive correlations with fruit yield per plot.

vi. Similarly, pooled phenotypic path coefficient analysis revealed that several traits exerted strong direct effects on fruit yield per plot. The important disease traits such as PDI-for fruit at 21st DAI and PFAD showed substantial positive direct effects. Growth and morphological traits such as number of primary branches per plant, plant height at final harvest, and long-styled flowers further contributed positively, while traits like petiole-related and earliness variables had relatively lower direct influences. While, among the biochemical traits, total phenols, total proteins, vitamin A and total anthocyanins and yield related traits like average fruit weight, fruit number, fruit yield hectare^{-1} had the most pronounced direct effects on fruit yield.

vii. In the pooled analysis, the phenotypic coefficient of variation (PCV) consistently exceeded the genotypic coefficient of variation (GCV) across all traits analyzed. Several key traits, including total anthocyanins, lesion size on fruits, fruit yield per plant, fruit yield per plot, total protein, percent leaf area diseased (PLAD), percent fruit area diseased (PFAD), multiple percent disease index (PDI) values for fruit and leaf at 7th, 14th, 21st days after inoculation (DAI), percent fruit incidence, percent leaf incidence, total phenols, fruit number per plant, stem diameter, long-styled flowers, fruit yield per hectare, average fruit weight, petiole length, fruit diameter, and fruit length exhibited both high PCV and GCV.

viii. The results of the pooled analysis revealed that all studied traits exhibited high heritability values (exceeding 60%), indicating that these characters are primarily under genetic control and less influenced by environmental factors. On the other side, the highest genetic advancement as a percentage of mean was observed in traits such as total anthocyanin, lesion size on fruits, fruit yield per plant, fruit yield per plot, total protein, PLAD, PFAD, various PDI parameters for fruit and leaf at 7th, 14th, 21st DAI, PFI, PLI, total phenols, total fruits per plant, stem diameter, fruit yield per hectare, average fruit weight, long- and medium-styled flowers, fruit diameter, fruit length, petiole length, leaf area, primary branches per plant, peduncle length, vitamin A, and ascorbic acid. The combination of high heritability with high genetic advance in these traits signifies the predominance of additive gene action and highlights their suitability for effective selection in breeding programs.

ix. Thus, from the overall pooled analysis results of 2022, five lines were identified out of which four moderately resistant lines such as, IC090146, IC090781, IC090810 and IC090828 selected based on their disease resistance and improved biochemical parameters, and one susceptible line *i.e.*, IC090887, which nevertheless performed well in overall horticultural traits.

Study-2: Estimation of heterosis, combining ability for yield and yield attributes in parents, their crosses and comparison with a susceptible check (pooled over season 2023)

i. In the study-2, those five identified lines, along with two testers (Pusa Bhairav and Pant Samrat), their ten derivative crosses obtained through line × tester analysis, and one susceptible check (Pant Rituraj), were evaluated for performance during the spring-summer and *kharif* seasons of 2023. The line × tester ANOVA revealed significant differences among 17 genotypes for 47 traits, with no replication effects. Significant variation was observed among parents for all traits at 1% level, while crosses also exhibited significant differences for most traits, except plant height at 30, 60, and 90 DAT, primary branches per plant, total nodes, internodal length, flowering and fruiting time-related traits, total fruits per plant, fruit length, fruit yield (plant^{-1}, plot^{-1}, and hectare^{-1}), total soluble solids, proline, and ash content. In line vs tester comparisons, all traits were significant at the 1% level, except days to first seed emergence and days to 50% seed emergence, which were significant at the 5% level. For parents vs crosses, substantial differences were observed across almost all traits, except internodal length, petiole length, number of medium-styled flowers, and node to first fruiting.

ii. The mean performance studies of parents and their crosses revealed substantial variability in disease-related traits. Among the parents, Pant Samrat consistently recorded the lowest disease incidence and severity across parameters such as PLI, PFI, PLAD, PFAD, PDI for leaf and fruit at different days after inoculation, and lesion size on fruits, highlighting its strong resistance. In contrast, Pant Rituraj exhibited the highest values for these traits, confirming its susceptibility. Among the crosses, IC090146 × Pant Samrat consistently showed the lowest levels of PLI, PFI, PLAD, PFAD, PDI for leaf and fruit at various intervals, and the smallest lesion size, establishing it as the most resistant cross. Conversely, crosses such as IC090781 × Pusa Bhairav or IC090810 × Pusa Bhairav tended to record comparatively higher susceptibility values, though still performing better than the susceptible parent.

iii. In terms of growth and yield parameters, Pant Samrat again performed outstandingly among the parents, with superior plant height at various stages, maximum primary branches, nodes, thicker stem, longer peduncle, larger fruit set, and higher yield plant^{-1}, plot^{-1}, and q ha^{-1}. Among crosses, IC090146 × Pant Samrat proved most superior, showing the highest values for plant height at final harvest, primary branches, total nodes, stem diameter, fruit number, fruit yield plant^{-1}, plot^{-1}, ha^{-1}, coupled with early flowering and fruiting traits. This highlights its excellence in combining resistance with high-yield potential. Overall, crosses derived from Pant Samrat, particularly IC090146 × Pant Samrat, demonstrated a strong balance of disease resistance, vigorous growth, and superior yield performance.

iv. The pooled mean performance of parents and their crosses for biochemical parameters demonstrated significant variability, reflecting the genetic diversity influencing nutritional quality and stress resilience in brinjal. Among parents, Pant Samrat and Pusa Bhairav consistently showed superior performance for several key traits in which Pant Samrat recorded the highest ascorbic acid, vitamin A, anthocyanin, phenols, and proline, highlighting its robustness in both nutrition and defense-related metabolites, while Pusa Bhairav excelled in chlorophyll, protein, and ash content. Conversely, Pant Rituraj and IC090887 exhibited the lowest biochemical values across multiple parameters, suggesting weak resilience and nutritional potential.

v. The combining ability studies revealed significant contributions of both general combining ability (GCA) and specific combining ability (SCA) effects toward disease resistance traits in eggplant. Overall, the combining ability analysis highlighted IC090146 and Pant Samrat as the strongest general combiners for disease resistance, with IC090781 and IC090810 being moderately effective. The crosses like IC090146 × Pant Samrat and IC090781 × Pant Samrat emerged as promising crosses due to their significant negative SCA values across multiple disease parameters, making them valuable candidates for developing resistant brinjal cultivars in future breeding programs.

vi. The combining ability analysis for growth and yield traits highlighted that among the lines, IC090146 consistently exhibited favourable negative GCA values for early emergence, early flowering, and early fruit set. IC090781 and IC090810 were superior for vegetative vigour traits, including plant height, branch number, and stem diameter, while IC090146 also recorded positive and significant GCA effects for fruit length, average fruit weight, and yield per plot and hectare. Among testers, Pant Samrat consistently showed the highest positive and significant GCA across a wide range of traits, particularly plant height, branching, fruit weight, and yield, while also contributing to earliness in flowering and fruiting. In contrast, Pusa Bhairav recorded lower or adverse GCA effects for many yield-contributing characters. Crosses such as IC090146 × Pant Samrat, IC090781 × Pant Samrat, and IC090828 × Pusa Bhairav stood out with significant positive SCA values for key yield parameters, such as fruit number, average fruit weight, yield per plant, plot, and hectare. Crosses like IC090828 × Pant Samrat and IC090887 × Pusa Bhairav also showed desirable SCA values for earliness traits, while IC090810 × Pant Samrat excelled in fruit size and weight.

vii. The combining ability analysis for biochemical parameters revealed substantial genetic contributions from both GCA and SCA. Among the lines, IC090146 consistently showed strong positive GCA effects for vitamin A, anthocyanins, proteins, phenols, proline, and ash content, highlighting its role as a nutritionally superior and stress-resilient parent. IC090781 and IC090828 also recorded favourable GCA for traits like ascorbic acid, soluble solids, and total phenols, while IC090887 performed well for proline content, signifying its stress-related defense potential. Among the testers, Pant Samrat emerged as the strongest general combiner, contributing significant positive GCA for chlorophyll content, TSS, ascorbic acid, vitamin A, anthocyanins, phenols, proline, and ash, thereby establishing its superiority over Pusa Bhairav, which generally showed lower or adverse effects. The SCA analysis highlighted several superior cross combinations. IC090781 × Pant Samrat, IC090810 × Pant Samrat, and IC090828 × Pusa Bhairav displayed strong SCA effects for chlorophyll, soluble solids, ascorbic acid, and phenols, whereas IC090887 ×

Pusa Bhairav and IC090781 × Pant Samrat were outstanding for anthocyanins and proline content, respectively. Moreover, IC090146 × Pant Samrat appeared consistent across multiple biochemical traits, showcasing enhanced content of proteins, phenols, vitamin A, and proline in its cross combinations. Collectively, these results highlight that strategic line × tester crosses involving Pant Samrat as a tester and lines like IC090146, IC090781, and IC090828 can generate crosses with substantially improved biochemical quality.

viii. The heterosis studies for disease-related parameters revealed significant negative heterotic effects across all cross combinations. Particularly IC090146 × Pant Samrat, IC090781 × Pant Samrat, and IC090810 × Pant Samrat, consistently exhibited superior resistance by showing highly significant negative heterotic effects across foliar and fruit disease traits. These crosses hold excellent potential for minimizing disease incidence, severity, and lesion development, making them promising candidates for developing resistant brinjal cultivars and reducing reliance on chemical control measures.

ix. The heterosis results for growth and yield parameters identified IC090146 × Pant Samrat as the most outstanding cross, combining earliness, vegetative vigour, and superior yield performance across all yield-attributing traits, followed closely by IC090781 × Pant Samrat and IC090810 × Pant Samrat. These crosses exhibited strong positive heterosis for fruit yield per plant, plot, and hectare, alongside desirable improvements in fruit size and number, making them highly promising candidates for commercial cultivation and breeding programs aimed at both high productivity and earliness in brinjal.

x. Overall, the heterosis results for biochemical traits highlighted IC090146 × Pant Samrat, IC090781 × Pant Samrat, and IC090810 × Pant Samrat as the most promising crosses, combining superior nutritional quality with enhanced biochemical defenses, while IC090887 × Pusa Bhairav excelled in anthocyanin accumulation. These crosses displayed outstanding heterotic gains for key traits like vitamin C, phenols, proteins, and proline, establishing their potential for developing nutritionally enriched, stress-resilient, and disease-tolerant brinjal cultivars.

xi. Overall, the proportional contribution analysis emphasized that tester parents contributed most dominantly to disease resistance, flowering, and fruiting traits, while lines were more influential for biochemical traits such as total protein and earliness of seed emergence. Meanwhile, line × tester interactions played a decisive role in yield-contributing and quality traits, particularly fruit yield, size, and biochemical constituents. These findings confirm that breeding success in brinjal depends not only on parental choice but also on exploiting specific cross combinations to harness heterosis and non-additive genetic variance for yield and quality improvement.

Conclusion

The present investigation on "Heterosis and Combining Ability Studies in Phomopsis Blight Resistant Genotypes of Brinjal (*Solanum melongena* L.)" brought forth comprehensive insights into the genetic variability, disease resistance, heterosis, and combining ability patterns operating in brinjal. The systematic screening of genotypes revealed that Pant Samrat consistently emerging as the most resistant and superior performing parent. High heritability coupled with substantial genetic advance recorded for several traits highlighted the predominance of additive gene action, providing ample scope for effective selection in resistance breeding. Further, combining ability studies revealed the importance of both additive and non-additive genetic effects, with testers, particularly Pant Samrat, contributing most dominantly to disease resistance, plant vigour, yield, and nutritional quality. Lines such as IC090146, IC090781, and IC090810 are proved to be effective general combiners for key traits including earliness, yield, and biochemical defenses. Specific cross combinations such as IC090146 × Pant Samrat, IC090781 × Pant Samrat, and IC090810 × Pant Samrat consistently showed superior performance across disease resistance, growth, yield, and biochemical parameters, attributed to their strong SCA effects. Additionally, IC090887 × Pusa Bhairav emerged as a valuable cross for enhancing anthocyanin content.

FUTURE SCOPE OF RESEARCH

The present investigation provides a strong foundation for breeding phomopsis blight resistant, high-yielding, and nutritionally enriched brinjal cultivars; however, following areas remain open for further exploration:

The identified resistant genotypes like Pant Samrat, IC090146, IC090781, IC090810 and superior crosses, particularly IC090146 × Pant Samrat should be evaluated across diverse agro-climatic zones and multi-year trials to confirm their stability and adaptability under varying environmental conditions and disease pressures. Further, the integration of molecular tools such as simple sequence repeats (SSRs), single nucleotide polymorphisms (SNPs), or quantitative trait loci (QTL) mapping linked to phomopsis blight resistance and yield-contributing traits can accelerate the development of improved genotypes through marker-assisted selection and genomic selection approaches. Functional genomics and transcriptome profiling of resistant (Pant Samrat, IC090146) and susceptible (Pant Rituraj) genotypes can provide insights into the molecular mechanisms underpinning disease resistance and allow identification of candidate genes involved in host–pathogen interactions.

The identified superior crosses with high SCA effects for yield and resistance parameters can be further tested in large-scale hybrid development programmes and initiatives for commercial hybrid seed production. Crosses such as IC090887 × Pusa Bhairav, with elevated anthocyanin and other metabolites, open new avenues for developing nutritionally enriched brinjal cultivars. Resistant genotypes like Pant Samrat and their promising crosses can be integrated into eco-friendly pest and disease management strategies to reduce dependency on fungicides, thereby promoting sustainable and cost-effective cultivation systems. The resistant parental lines identified in this study may serve as donor parents in advanced backcross breeding or introgression programmes for transferring resistance and nutritional traits into elite but susceptible genetic backgrounds. Since climate variability influences disease incidence and host performance, the interaction of phomopsis blight resistance with abiotic stresses (such as drought or heat) must be studied to develop truly resilient cultivars.

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APPENDICES

Appendix-I

Analysis of variance (mean sum of square) for the study of screening of brinjal genotypes against phomopsis blight and validation of resistant genotypes

Spring-Summer Season (2022)

S. No.	Source of variation	Mean Sum of Squares (MSS)		
		Replication	Genotype	Error
	Degree of freedom	2	32	64
1.	Percent leaf incidence (%)	1.16	120.60**	0.46
2.	Percent fruit incidence (%)	0.07	101.41**	0.37
3.	Percent leaf area diseased (%)	2.10	399.98**	1.42
4.	Percent fruit area diseased (%)	0.37	323.71**	1.40
5.	Percent disease index-for leaf at 7th DAI (%)	0.07	14.79**	0.06
6.	Percent disease index-for leaf at 14th DAI (%)	0.16	73.75**	0.31
7.	Percent disease index-for leaf at 21st DAI (%)	1.02	364.23**	0.96
8.	Percent disease index-for fruit at 7th DAI (%)	0.03	7.71**	0.03
9.	Percent disease index-for fruit at 14th DAI (%)	0.20	30.82**	0.11
10.	Percent disease index-for fruit at 21st DAI (%)	3.39	342.62**	1.22
11.	Lesion size on fruits (cm^2)	0.00	0.54**	0.00
12.	Days to first seed emergence (DAS)	0.14	2.83**	0.06
13.	Days to 50% seed emergence (DAS)	0.10	4.91**	0.06
14.	Plant height at 30 DAT (cm)	0.44	31.67**	0.75
15.	Plant height at 60 DAT (cm)	3.82	127.03**	1.11
16.	Plant height at 90 DAT (cm)	0.37	110.14**	1.79
17.	Plant height at final harvest (cm)	0.62	102.07**	2.65
18.	Number of primary branches plant^{-1} at final harvest	0.03	2.88**	0.02
19.	Total number of nodes at final harvest	0.17	4.21**	0.11
20.	Internodal length of plant at final harvest (cm)	0.04	2.46**	0.03
21.	Stem diameter (cm)	0.01	0.85**	0.00
22.	Peduncle length (cm)	0.05	2.73**	0.02
23.	Petiole length (cm)	0.00	1.60**	0.01
24.	Leaf area (cm^2)	12.20	3312.84**	21.20
25.	Days to first flowering (DAT)	0.94	13.31**	2.27
26.	Days to 50% flowering (DAT)	1.12	24.63**	2.59
27.	Total number of long styled flower	2.12	199.81**	0.52
28.	Total number. of medium styled flower	0.28	44.94**	0.29
29.	Number of node to first fruiting	0.01	1.22**	0.03
30.	Days to first fruit set (DAT)	1.78	25.32**	2.27
31.	Days to first picking of fruits (DAT)	1.53	44.97**	3.12
32.	Total number of fruits plant^{-1}	0.44	132.49**	0.38
33.	Average fruit weight (g)	1.41	769.54**	3.02
34.	Fruit length (cm)	0.00	9.57**	0.04
35.	Fruit diameter (cm)	0.01	2.59**	0.01
36.	Fruit yield plant^{-1} (kg)	0.00	1.19**	0.00
37.	Fruit yield plot^{-1} (kg)	0.01	78.59**	0.07
38.	Fruit yield hectare^{-1} (q)	45.20	9699.58**	46.09
39.	Total chlorophyll content (mg g^{-1})	0.00	0.04**	0.00
40.	Total soluble solids (°Brix)	0.00	0.47**	0.02
41.	Ascorbic acid (mg 100 g^{-1})	0.00	0.31**	0.00
42.	Vitamin A (IU g^{-1})	0.00	0.00**	0.00
43.	Total anthocyanin (mg 100 g^{-1})	35.40	63455.60**	15.20
44.	Total protein (%)	0.00	0.17**	0.00
45.	Total phenols (mg GAE g^{-1} DW)	0.00	0.03**	0.00
46.	Proline content in fruits (mg g^{-1} DW)	0.09	2.07**	0.03
47.	Ash content (%)	0.04	1.90**	0.03

Values with ** are significant at 1% level

Kharif-Season (2022)

S. No.	Source of variation	Mean Sum of Squares (MSS)		
		Replication	Genotype	Error
	Degree of freedom	2	32	64
1.	Percent leaf incidence (%)	0.38	134.15**	0.58
2.	Percent fruit incidence (%)	0.05	106.72**	0.42
3.	Percent leaf area diseased (%)	3.25	420.39**	1.57
4.	Percent fruit area diseased (%)	0.20	342.28**	0.95
5.	Percent disease index-for leaf at 7th DAI (%)	0.04	21.79**	0.08
6.	Percent disease index-for leaf at 14th DAI (%)	1.27	154.35**	0.50
7.	Percent disease index-for leaf at 21st DAI (%)	1.28	365.30**	1.34
8.	Percent disease index-for fruit 7th DAI (%)	0.00	13.73**	0.05
9.	Percent disease index-for fruit 14th DAI (%)	0.75	69.51**	0.19
10.	Percent disease index-for fruit 21st DAI (%)	0.87	343.37**	1.12
11.	Lesion size on fruits (cm^2)	0.00	0.54**	0.00
12.	Days to first seed emergence (DAS)	0.05	1.64**	0.04
13.	Days to 50% seed emergence (DAS)	0.01	2.06**	0.07
14.	Plant height at 30 DAT (cm)	0.32	29.00**	0.81
15.	Plant height at 60 DAT (cm)	0.81	135.01**	2.09
16.	Plant height at 90 DAT (cm)	1.80	105.92**	2.12
17.	Plant height at final harvest (cm)	21.39	92.94**	3.46
18.	Number of primary branches $plant^{-1}$ at final harvest	0.02	2.56**	0.02
19.	Total number of nodes at final harvest	0.08	6.84**	0.23
20.	Internodal length of plant at final harvest (cm)	0.01	3.08**	0.03
21.	Stem diameter (cm)	0.00	0.81**	0.00
22.	Peduncle length (cm)	0.01	2.74**	0.02
23.	Petiole length (cm)	0.01	1.62**	0.01
24.	Leaf area (cm^2)	2.99	3317.78**	21.48
25.	Days to first flowering (DAT)	0.60	18.54**	1.31
26.	Days to 50% flowering (DAT)	6.72	20.59**	2.43
27.	Total number of long styled flower	0.25	173.12**	1.02
28.	Total number. of medium styled flower	0.29	56.62**	0.33
29.	Number of node to first fruiting	0.01	2.01**	0.02
30.	Days to first fruit set (DAT)	1.91	30.18**	2.11
31.	Days to first picking of fruits (DAT)	0.20	39.76**	2.98
32.	Total number of fruits $plant^{-1}$	0.07	128.10**	0.48
33.	Average fruit weight (g)	6.51	754.41**	3.18
34.	Fruit length (cm)	0.07	9.25**	0.05
35.	Fruit diameter (cm)	0.03	2.48**	0.01
36.	Fruit yield $plant^{-1}$ (kg)	0.00	1.50**	0.00
37.	Fruit yield $plot^{-1}$ (kg)	0.08	15.24**	0.05
38.	Fruit yield $hectare^{-1}$ (q)	38.18	9711.46**	34.82
39.	Total chlorophyll content (mg g^{-1})	0.00	0.04**	0.00
40.	Total soluble solids (°Brix)	0.00	0.37**	0.02
41.	Ascorbic acid (mg 100 g^{-1})	0.00	0.22**	0.00
42.	Vitamin A (IU g^{-1})	0.00	0.00**	0.00
43.	Total anthocyanin (mg 100 g^{-1})	13.9	63427.3**	13.8
44.	Total protein (%)	0.00	0.26**	0.00
45.	Total phenols (mg GAE g^{-1} DW)	0.00	0.03**	0.00
46.	Proline content in fruits (mg g^{-1} DW)	0.00	2.02**	0.03
47.	Ash content (%)	0.00	2.09**	0.03

Values with ** are significant at 1% level

Pooled over season (2022)

S. No.	Source of variation	Mean Sum of Squares (MSS)				
		Replication	**Genotype**	**Environment**	**Interaction**	**Error**
	Degree of freedom	**2**	**32**	**1**	**32**	**128**
1.	Percent leaf incidence (%)	1.31	251.83**	293.31	2.92	0.51
2.	Percent fruit incidence (%)	0.04	207.07**	261.21	1.06	0.39
3.	Percent leaf area diseased (%)	1.32	819.32**	235.99	1.04	1.53
4.	Percent fruit area diseased (%)	0.40	663.64**	248.80	2.34	1.16
5.	Percent disease index-for leaf at 7th DAI (%)	0.02	35.87**	291.30	0.72	0.07
6.	Percent disease index-for leaf at 14th DAI (%)	1.16	220.73**	3584.03	7.36	0.40
7.	Percent disease index-for leaf at 21st DAI (%)	0.38	729.53**	0.14	0.00	1.16
8.	Percent disease index-for fruit at 7th DAI (%)	0.01	21.01**	196.94	0.43	0.04
9.	Percent disease index-for fruit 14th DAI (%)	0.67	96.45**	1767.15	3.88	0.15
10.	Percent disease index-for fruit at 21st DAI (%)	1.39	686.00**	0.14	0.00	1.20
11.	Lesion size on fruits (cm^2)	0.00	1.07**	0.00	0.05	0.00
12.	Days to first seed emergence (DAS)	0.09	4.20**	0.02	0.27	0.05
13.	Days to 50% seed emergence (DAS)	0.04	6.13**	0.00	0.85	0.06
14.	Plant height at 30 DAT (cm)	0.37	59.85**	483.10	0.82	0.77
15.	Plant height at 60 DAT (cm)	2.44	260.67**	1878.92	1.37	1.61
16.	Plant height at 90 DAT (cm)	1.83	207.90**	2345.94	8.16	1.93
17.	Plant height at final harvest (cm)	14.13	173.94**	2215.83	21.07	3.13
18.	Number of primary branches plant^{-1} at final harvest	0.05	5.32**	7.80	0.12	0.02
19.	Total number of nodes at final harvest	0.01	9.70**	838.46	1.35	0.17
20.	Internodal length of plant at final harvest (cm)	0.00	5.40**	3.99	0.15	0.03
21.	Stem diameter (cm)	0.01	1.63**	5.24	0.03	0.00
22.	Peduncle length (cm)	0.05	5.47**	2.56	0.00	0.02
23.	Petiole length (cm)	0.00	3.22**	0.49	0.00	0.01
24.	Leaf area (cm^2)	9.69	6622.85**	2958.08	7.77	21.10
25.	Days to first flowering (DAT)	1.36	25.29**	7.93	6.56	1.76
26.	Days to 50% flowering (DAT)	4.94	26.87**	121.26	18.35	2.52
27.	Total number of long styled flower	1.09	356.12**	103.18	16.81	0.78
28.	Total number. of medium styled flower	0.28	96.43**	45.02	5.13	0.31
29.	Number of node to first fruiting	0.01	2.72**	2.80	0.51	0.02
30.	Days to first fruit set (DAT)	0.29	41.40**	47.28	14.11	2.21
31.	Days to first picking of fruits (DAT)	0.34	72.29**	89.67	12.44	3.03
32.	Total number of fruits plant^{-1}	0.14	228.83**	507.65	31.76	0.43
33.	Average fruit weight (g)	6.54	1520.38**	0.01	3.56	3.07
34.	Fruit length (cm)	0.04	18.73**	0.51	0.09	0.05
35.	Fruit diameter (cm)	0.02	5.02**	0.21	0.05	0.01
36.	Fruit yield plant^{-1} (kg)	0.00	2.58**	0.70	0.11	0.00
37.	Fruit yield plot^{-1} (kg)	0.08	77.12**	102.28	16.71	0.06
38.	Fruit yield hectare^{-1} (q)	10.9	19410.40**	403.8	0.60	40.90
39.	Total chlorophyll content (mg g^{-1})	0.00	0.08**	0.00	0.00	0.00
40.	Total soluble solids (°Brix)	0.00	0.72**	1.04	0.12	0.02
41.	Ascorbic acid (mg 100 g^{-1})	0.00	0.45**	0.38	0.08	0.00
42.	Vitamin A (IU g^{-1})	0.00	0.01**	0.01	0.00	0.00
43.	Total anthocyanin (mg 100 g^{-1})	15.65	126883**	0.93	0.28	14.79
44.	Total protein (%)	0.00	0.42**	0.01	0.00	0.00
45.	Total phenols (mg GAE g^{-1} DW)	0.00	0.06**	0.00	0.00	0.00
46.	Proline content in fruits (mg g^{-1} DW)	0.05	3.97**	2.56	0.12	0.03
47.	Ash content (%)	0.02	3.78**	2.83	0.22	0.03

Values with ** are significant at 1% level

Appendix-II

Analysis of variance (mean sum of square) for the study estimation of combining ability and heterosis for yield and yield attributes in parents and their crosses (pooled over season 2023)

S. No.	Source of variation	Mean Sum of Squares (MSS)								
		Replication	**Genotype**	**Parent**	**Line**	**Tester**	**Line vs Tester**	**Crosses**	**Parent vs Crosses**	**Error**
	Degree of freedom	**2**	**17**	**6**	**4**	**1**	**1**	**9**	**1**	**34**
1.	Percent leaf incidence (%)	0.014	258.351 **	532.801 **	491.386 **	21.333 **	1209.927 **	68.545 **	319.909 **	0.943
2.	Percent fruit incidence (%)	0.384	200.870 **	405.625 **	346.633 **	34.850 **	1012.370 **	57.490 **	262.764 **	0.486
3.	Percent leaf area diseased (%)	0.84	794.492 **	1562.880 **	1666.344 **	29.391 **	2682.512 **	290.131 **	723.413 **	2.211
4.	Percent fruit area diseased (%)	0.026	832.688 **	1597.367 **	1472.348 **	1.725	3693.085 **	311.899 **	931.720 **	3.289
5.	Percent disease index-for leaf at 7^{th} DAI (%)	0.036	28.027 **	60.985 **	29.320 **	5.280 **	243.353 **	6.155 **	27.123 **	0.293
6.	Percent disease index-for leaf at 14^{th} DAI (%)	0.108	216.354 **	451.284 **	398.505 **	5.468	1108.218 **	53.179 **	275.346 **	1.671
7.	Percent disease index-for leaf at 21^{st} DAI (%)	2.581	871.554 **	1725.455 **	1380.547 **	87.696 **	4742.842 **	282.313 **	1051.323 **	4.483
8.	Percent disease index-for fruit at 7^{th} DAI (%)	0.085	22.011 **	46.355 **	19.459 **	1.287	199.011 **	1.346 **	61.920 **	0.352
9.	Percent disease index-for fruit at 14^{th} DAI (%)	0.256	77.042 **	165.617 **	78.052 **	3.922 *	677.570 **	14.157 **	111.568 **	0.771
10.	Percent disease index-for fruit at 21^{st} DAI (%)	3.045	788.700 **	1568.808 **	1614.235 **	58.168 **	2897.739 **	285.875 **	633.477 **	3.375
11.	Lesion size on fruits (cm^2)	0	1.244 **	2.356 **	2.988 **	0.002	2.182 **	0.594 **	0.424 **	0.004
12.	Days to first seed emergence (DAS)	0.043	0.203 **	0.236 **	0.256 **	0.139	0.255 *	0.172 **	0.274 **	0.037
13.	Days to 50% seed emergence (DAS)	0.21	1.175 **	1.554 **	0.184	7.426 **	1.163 *	0.936 **	1.049 *	0.23
14.	Plant height at 30 DAT (cm)	0.447	15.949 **	25.771 **	0.465	7.987	144.778 **	2.872	74.707 **	3.171
15.	Plant height at 60 DAT (cm)	0.092	105.184 **	250.081 **	11.85	17.448	1435.638 **	3.908	147.290 **	12.895
16.	Plant height at 90 DAT (cm)	0.343	35.213 **	80.231 **	11.859	9.901	424.050 **	4.501	41.510 *	6.775
17.	Plant height at final harvest (cm)	1.864	10.377 **	22.830 **	7.823 **	15.188 **	90.499 **	2.632 *	5.356 *	1.127
18.	Number of primary branches $plant^{-1}$ at final harvest	0.002	3.122 **	6.646 **	0.319	0.755	37.842 **	0.182	8.441 **	0.246
19.	Total number of nodes at final harvest	0.218	2.270 **	3.783 **	2.405 **	1.841 *	11.237 **	0.458	9.508 **	0.437
20.	Internodal length of plant at final harvest (cm)	0.038	1.596 **	3.777 **	0.876 **	0.063	19.093 **	0.28	0.35	0.191
21.	Stem diameter (cm)	0.004	1.511 **	3.068 **	1.556 **	0.004	12.175 **	0.330 **	2.805 **	0.024
22.	Peduncle length (cm)	0.052	3.562 **	6.854 **	4.408 **	0.007	23.482 **	1.501 **	2.363 **	0.216
23.	Petiole length (cm)	0.012	1.736 **	2.295 **	0.614 **	10.773 **	0.542 **	1.556 **	0.002	0.032
24.	Leaf area (cm^2)	37.39	15003.600 **	27984.070 **	417.727	4804.000 **	161429.500 **	1273.988 **	60687.330 **	275.242
25.	Days to first flowering (DAT)	0.556	20.678 **	36.923 **	7.014	39.422 **	154.057 **	6.959	46.679 **	4.162
26.	Days to 50% flowering (DAT)	0.809	19.634 **	34.380 **	2.195	14.919	182.583 **	4.048	71.428 **	3.768
27.	Total number of long styled flower	0.888	33.169 **	55.774 **	33.864 **	6.931	192.255 **	14.370 *	66.735 **	6.188
28.	Total number of medium styled flower	0.041	12.599 **	22.384 **	5.3	35.363 **	77.744 **	7.407 **	0.612	2.122
29.	Number of node to first fruiting	0.052	1.148 **	2.828 **	0.562	0.037	14.683 **	0.149	0.057	0.228
30.	Days to first fruit set (DAT)	1.919	11.883 **	18.718 **	3.1	20.646 **	79.266 **	4.034 *	41.506 **	1.906
31.	Days to first picking of fruits (DAT)	2.673	21.485 **	40.908 **	2.588	13.611	221.488 **	3.521	66.621 **	3.437
32.	Total number of fruits $plant^{-1}$	0.377	43.418 **	91.905 **	1.114	30.178 **	516.794 **	4.305	104.517 **	4.107
33.	Average fruit weight (g)	75.53	2593.708 **	5781.967 **	41.976	1466.115 **	33057.790 **	206.162 **	4952.068 **	28.776
34.	Fruit length (cm)	0.104	21.169 **	47.065 **	0.13	5.188 *	276.681 **	0.686	50.137 **	0.891
35.	Fruit diameter (cm)	0.021	3.031 **	4.287 **	0.172	14.520 **	10.517 **	2.106 **	3.819 **	0.126
36.	Fruit yield $plant^{-1}$ (kg)	0	3.668 **	8.754 **	0.031	0.371 **	52.033 **	0.065	5.568 **	0.039
37.	Fruit yield $plot^{-1}$ (kg)	0.983	528.079 **	1260.282 **	4.377	54.528 **	7489.659 **	9.552	801.601 **	6.098
38.	Fruit yield $hectare^{-1}$ (q)	817.963	502950.800 **	1200370.00**	4169.85	51849.160 **	7133694.000 **	9079.279	763276.900 **	5017.36
39.	Total chlorophyll content (mg g^{-1})	0.001	0.139 **	0.277 **	0.007	0.002	1.629 **	0.014 **	0.438 **	0.005
40.	Total soluble solids (°Brix)	0.184	0.347 **	0.694 **	0.542 **	0.015	1.982 **	0.097	0.513 **	0.055
41.	Ascorbic acid (mg 100 g^{-1})	0	0.549 **	1.084 **	0.687 **	0.062 *	3.696 **	0.180 **	0.661 **	0.013
42.	Vitamin A (IU g^{-1})	0	0.005 **	0.010 **	0.004 **	0.002 *	0.044 **	0.001 **	0.010 **	0
43.	Total anthocyanin (mg 100 g^{-1})	30.2	208322.400 **	397425.000 **	35.918	404551.600 **	1979855.000 **	34352.270 **	639438.000 **	478.016
44.	Total protein (%)	0.002	0.704 **	1.430 **	0.111 **	0.175 **	7.963 **	0.043 **	2.293 **	0.007
45.	Total phenols (mg GAE g^{-1} DW)	0.003	0.336 **	0.696 **	0.078 **	0.066 **	3.796 **	0.017 **	1.044 **	0.004
46.	Proline content in fruits (mg g^{-1} DW)	0.01	3.124 **	6.547 **	1.990 **	0.134	31.188 **	0.243	8.527 **	0.263
47.	Ash content (%)	0.029	3.695 **	6.729 **	1.920 **	0.001	32.693 **	0.395	15.192 **	0.328

Values with * are significant at 5 % level; ** are significant at 1 % level

CURRICULUM VITAE AT GLANCE

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ACADEMIC QUALIFICATIONS				
Particulars	**Discipline**	**Passing Year**	**Board/University/College/School**	**Percentage/CGPA**
ASRB-NET	**Vegetable Science**	**2023**	**Agricultural Scientists Recruitment Board (ASRB) Department of Agricultural Research and Education Krishi Anusandhan Bhavan-l, Pusa, New Delhi-110012, India**	**Qualified with 54%**
M.Sc.*	**Horticulture (Vegetable Science)**	**2020**	**Hemvati Nandan Bahuguna Garhwal University (A Central University) Srinagar, Garhwal Uttarakhand-249161, India**	**8.23 CGPA**
B.Sc. Honours (4-Years)	**Horticulture**	**2018**	**Doon (PG) College of Agriculture Science & Technology, Dehradun, Uttarakhand–248197, India**	**88.93%**
Class 12 (Science)	**Hindi, English, Physics, Chemistry, Biology**	**2011**	**Central public SR. Sec. School, Talwandi, Kota, Rajasthan – 324005, India**	**61.23%**
Metric (Class 10)	**Hindi, English, Maths, Science, Social Science, Sanskrit**	**2009**	**Adarsh Vidhya Mandir School, Jhalawar, Rajasthan – 326023, India**	**86.33%**

***M.Sc. Thesis Title:** Impact of Foliar Application of Plant Bio-Regulators on Vegetative, Floral and Yield Traits in Bottle Gourd [*Lagenaria siceraria* (Molina) Standl.] Cv. Gutka Long Under Valley Condition of Garhwal Hills

List of Publications:

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Goutam, E., Rana, D. K., Shah, K. N., Singh, V., Bharti, & Choudhary, R. (2025) Impact of Foliar Application of Plant Bio-Regulators on Vegetative, Floral and Yield Traits in Bottle Gourd (*Lagenaria siceraria*) Under Valley Condition of Garhwal Hills. *Vegetos*, 01–08. https://doi.org/10.1007/s42535-025-01297-9 [Q3; Scopus indexed; H-Index = 24; SJR = 0.25; NAAS = 5.68]

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Granted Copyrights:

- Granted copyright on the title "Pathogenesis, prevalence and overcoming measure of Phomopsis blight in brinjal" for Literary/ Dramatic work with having diary number 26933/2022-CO/L & Registration number L-124991/2023 on the date 12th June, 2023.
- Granted copyright on the title "Enhancing growth, yield and quality traits of onion (*Allium cepa* L.) through humic acid and sulphur nanoparticle applications" for Literary/ Dramatic work with having diary number 41209/2024-CO/L & Registration number L-162825/2025 on the date 26th March, 2025.

Patents:

- Patent published on the title "Induction of root nodules in French bean CV. Contender *(Phaseolus vulgaris* L.)*"* on 25/10/2024 with application number 202411077513.
- Patent registered for invented design on "Seed longevity predicting AI device" on 06/09/2025 with application number 472597-001.

Trainings attended:

- One month training on Nursery Management of Horticultural Crops w.e.f. 02/04/2018 to 02/05/2018 at Rajeshwari Nursery, Jogiwala, Haridwar Road, Dehradun, Uttarakhand-248005
- Six days training programme on Urban Agriculture conducted under Skill Training of Rural Youth (STRY) scheme, sponsored by Ministry of Agriculture and Farmers Welfare, Government of India, from 18 to 23 April, 2022 at Punjab Agricultural Management & Extension Training Institute, PAMETI, Ludhiana, Punjab.

Presentation (Paper and Poster) at International/National Conferences:

- Participated and Poster Presentation on the topic "A Step Towards Rooftop Vegetable Farming" at I Vegetable Science Congress on Emerging Challenges in Vegetable Research & Education (VEGCON-2019), from 01 February to 03 February, 2019 at Agriculture University, Jodhpur, Rajasthan
- Participated and presented a paper entitled "Impact of Global Climate Change on Agriculture for Food Security" at National Seminar on Agricultural Transformation and Rural Development In India: Issues, Challenges and Possibilities, held during 12-13 October, 2019, organized by Department of Economics, Hemvati Nandan Bahuguna Garhwal University (A Central University) Srinagar (Garhwal), Uttarakhand, India
- Participated and secured Third-position in poster presentation category on the topic "Heterosis and Combining Ability Studies in Phomopsis Blight Resistant Genotypes of Brinjal (*Solanum melongena* L.)" at 5th International Conference on Advances in Smart Agriculture and Biodiversity Conservation for Sustainable Development (SABCD-2022) during 04-06 March, 2022 held at Jaipur National University, Jaipur, Rajasthan, India

Career Achievements:

- **Best Oral Presentation Certificate (ICFA-2018)** on the topic "Agricultural Transformation and Sustainable Development Goals" in the International Conference on Food & Agriculture, held during March 29-31, 2018 in Dhanbad, India
- Awarded with **Young Scientist Associate Award 2022** for the outstanding contribution and recognition in the field of Vegetable Science by the Society of Agriculture Research and Social Development (SARSD), New Delhi on the occasion of 5^{th} International Conference on Advances in Agriculture Technology and Allied Sciences (ICAATAS 2022) at MS Swaminathan School of Agriculture, Centurion University of Technology and Management June- 4-5, 2022.

DECLARATION

I hereby declare that all the above information furnished by me is true to the best of my knowledge.

Etalesh Goutam

Place: Phagwara, Punjab, India