3. MATERIALS AND METHODS

3.1. Major pests studied and the methods employed for pest sampling

In this investigation 4 major pests studied were-

(i) shoot and fruit borer (*Leucinodes orbonalis* Guen.)

(ii) cotton leaf hopper or jassid (*Amrasca biguttula biguttula* Ishida)

(iii) cotton aphid or aphid (*Aphis gossypii* Glover) and

(iv) spotted leaf beetle (*Epilachna vigintioctopunctata* Fab.)

Data were recorded from the time of first occurrence of pests. The populations of jassid, aphid and spotted leaf beetle were counted from 5 leaves (2 top, 2 middle and 1 bottom) from each of the 5 central plants in every subplot at 20 day intervals till the completion of harvesting. The total number of shoots damaged due to the attack of *L. orbonalis* in the central 5 plants was also recorded. The fruits were harvested at an interval of 10 days, sorted out into marketable fruits, counted and weighed for computation of final yield.

Any decision of pest management must be based on economic ratio of benefit to cost, and this largely depends on the quantitative pest density.

The sampling procedure consisted of a constant number of sample for each sampling occasion for each sampling programme, it was necessary to decide upon:

(i) the size of the sampling unit used

(ii) the number of sampling units taken and

(iii) the location (i.e.distibution) of that sampling unit

3.2. Agroclimatic features of the experimental site

Field studies were carried out during 1991 to 1996, in the vicinity of North Bengal University, Siliguri, West Bengal at Block seed farm, Salbari; CADC farm, Satbhaia, Naxalbari and farmers field of Siliguri subdivision of Darjeeling. Place is located 26°4´N, 88°26´E and 126m amsl. The area belongs to foothills of Darjeeling, plain topography and an average annual rainfall of 350cm with minimum temperature of 12°C and maximum of 30°C in general.

Soil of Siliguri sub-division of Darjeeling district is deep, light texture, high permeable porus soil with water regime fluctuating within 1 metre depth relative to river-flow level; moderate level of organic matter content without appreciable mineralisation, highly acidic, low in bases, phosphate, potash and micronutrient. Area is mostly flat with 0-1% having low height field bund. Soil P^H ranged from 5.5-6.0, acidic in nature.

The climate of the experimental site is of subtropical humid. The climatic parameters mainly monthwise average rainfall(mm) and 10 years average data (1983-1992) is presented in Table 3. Monthwise minimum and maximum relative humidity (%) and temperature (°C) have been presented in Table 4.

Fig.9 depicts monthly assured rainfall showing, mean, 50%, 60% and 70% assured rainfall (mm) in Darjeeling district. Fig.10 represents the rainfall scenario of Siliguri subdivision in particular period of experimentation along with 10 years average data.

Table 3. **Mean monthly rainfall (mm) of Siliguri subdivision during 1991-96**

Years/Month	1991	1992	1993	1994	1995	1996	10 Yrs. Av. ('83-'92)
JAN.	24.00	16.00	17.60	48.20	1.10	43.00	15.45
FEB.	2.50	12.00	8.60	58.60	14.70	4.40	22.20
MAR.	42.50	0.00	8.80	28.60	20.50	5.00	39.00
APR.	32.00	61.00	114.70	42.20	7.20	14.40	80.77
MAY	128.00	161.00	186.30	152.20	137.70	305.60	280.65
JUNE	1358.00	369.00	495.20	314.80	1092.90	273.30	725.43
JULY	650.50	755.40	847.70	380.80	862.00	1159.20	1033.32
AUG.	749.50	366.90	500.80	446.70	582.60	623.30	624.64
SEP.	1459.50	385.10	283.90	374.47	416.90	-	678.44
OCT.	149.50	244.20	271.40	43.80	268.60	-	232.23
NOV.	0.00	0.00	44.10	3.00	83.40	-	7.10
DEC.	39.00	21.80	14.60	0.00	12.00	-	17.93
TOTAL	**4635.00**	**2392.40**	**2793.70**	**1893.47**	**3499.60**		**3807.01**

Table 4. Meteorological data for the experimental period (1991-96)

	RELATIVE HUMIDITY (%)												TEMPERATURE (°C)											
	Minimum						Maximum						Minimum						Maximum					
Year / Month	1991	1992	1993	1994	1995	1996	1991	1992	1993	1994	1995	1996	1991	1992	1993	1994	1995	1996	1991	1992	1993	1994	1995	1996
JAN.	-	64.39	65.13	55.00	51.00	55.00	-	72.84	94.19	92.00	88.00	92.00	-	10.32	9.63	9.60	6.70	7.9	-	24.40	20.59	24.30	23.40	22.9
FEB.	-	60.55	54.75	59.00	52.00	49.00	-	78.00	90.71	90.00	88.00	91.00	-	9.38	12.58	10.60	10.10	10.7	-	22.83	23.78	24.30	25.00	26.6
MAR.	-	47.44	43.10	55.29	49.00	49.00	-	75.30	83.03	81.26	85.00	86.00	-	16.35	14.16	16.43	13.80	15.3	-	30.12	26.33	28.32	29.80	30.2
APR.	-	61.47	45.90	54.00	34.00	39.00	-	76.53	78.57	75.00	65.00	68.00	-	19.69	18.96	18.70	17.90	17.4	-	33.33	31.17	31.60	33.80	33.9
MAY.	-	88.90	66.65	64.00	61.00	68.00	-	93.61	87.48	83.00	82.00	87.00	-	21.97	21.98	22.00	23.20	20.7	-	30.68	30.79	32.90	33.50	32.5
JUNE.	-	72.92	71.17	76.00	80.00	72.00	-	88.73	91.17	91.00	95.00	93.00	-	24.43	22.35	23.60	23.00	21.6	-	32.42	31.68	31.50	30.60	31.4
JULY.	-	75.77	74.23	74.00	78.00	79.00	-	91.29	93.45	91.00	96.00	96.00	-	30.56	23.88	24.00	23.10	22.5	-	31.58	31.39	33.20	30.80	30.9
AUG.	-	75.65	81.06	75.00	76.00	77.00	-	91.84	93.97	92.00	92.00	95.00	-	24.65	24.41	23.80	22.80	22.1	-	32.22	31.06	32.50	31.9	32.6
SEP.	86.73	72.73	73.87	72.00	77.00	-	92.33	92.27	91.43	90.00	92.00	-	26.62	24.15	23.33	22.70	21.9	-	80.55	31.89	31.50	32.10	30.7	-
OCT.	76.13	60.55	74.87	66.00	65.00	-	82.58	92.84	92.26	89.00	88.00	-	20.48	20.27	20.27	18.80	18.4	-	31.71	30.61	30.27	30.00	31.2	-
NOV.	62.57	43.50	55.57	54.00	52.00	-	67.00	91.73	91.47	87.00	86.00	-	12.94	13.59	15.85	12.40	14.00	-	30.78	29.31	28.28	29.10	29.5	-
DEC.	52.26	48.16	47.00	47.00	54.00	-	79.42	92.48	90.00	88.00	91.00	-	9.99	9.75	10.50	8.70	10.4	-	26.89	48.16	26.60	25.60	24.8	-

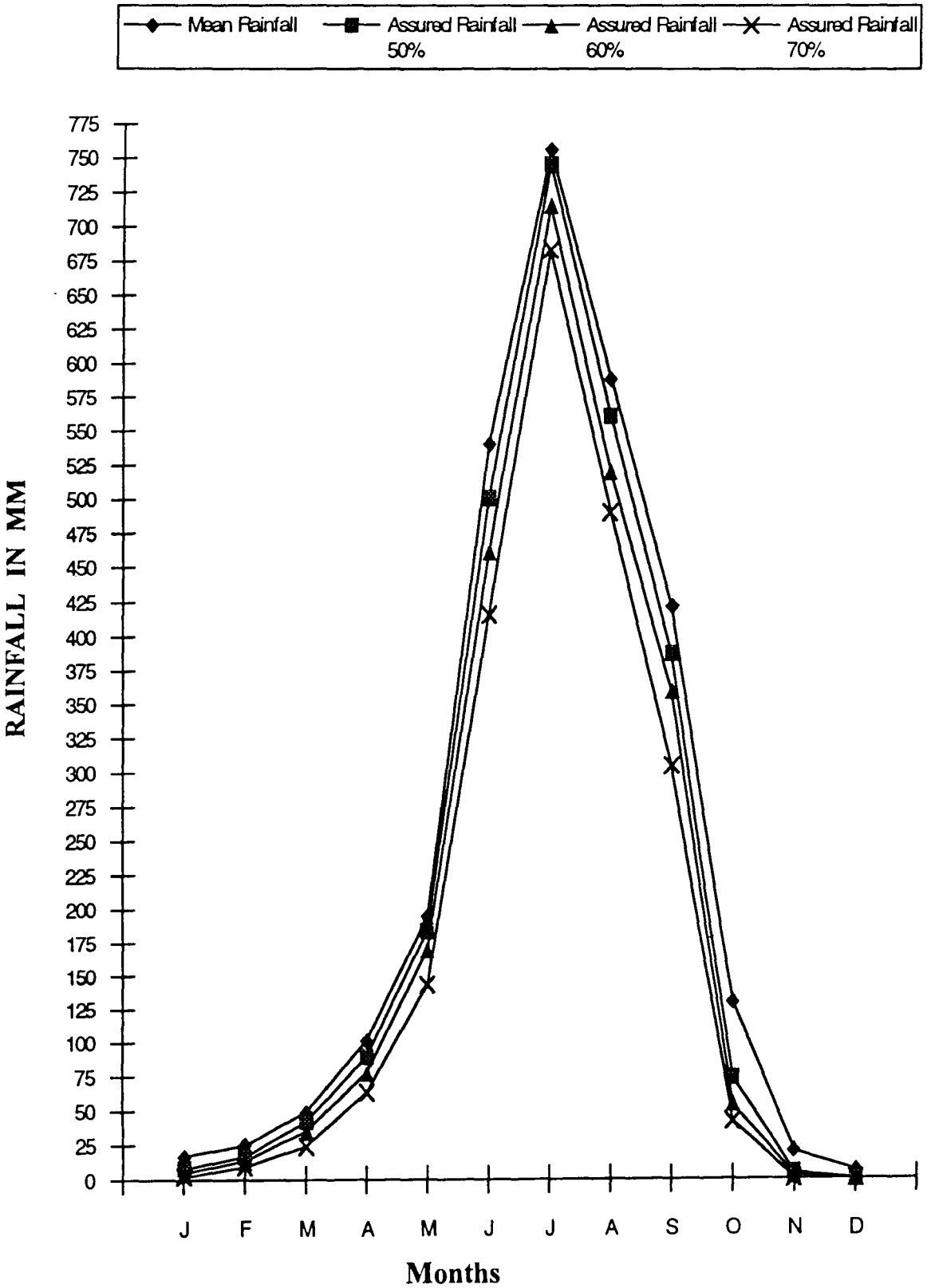

Fig. 9 : Monthly assured rainfall graph showing mean, 50%, 60%, 70% rainfall (mm) in Darjeeling district (based on 80 years data)

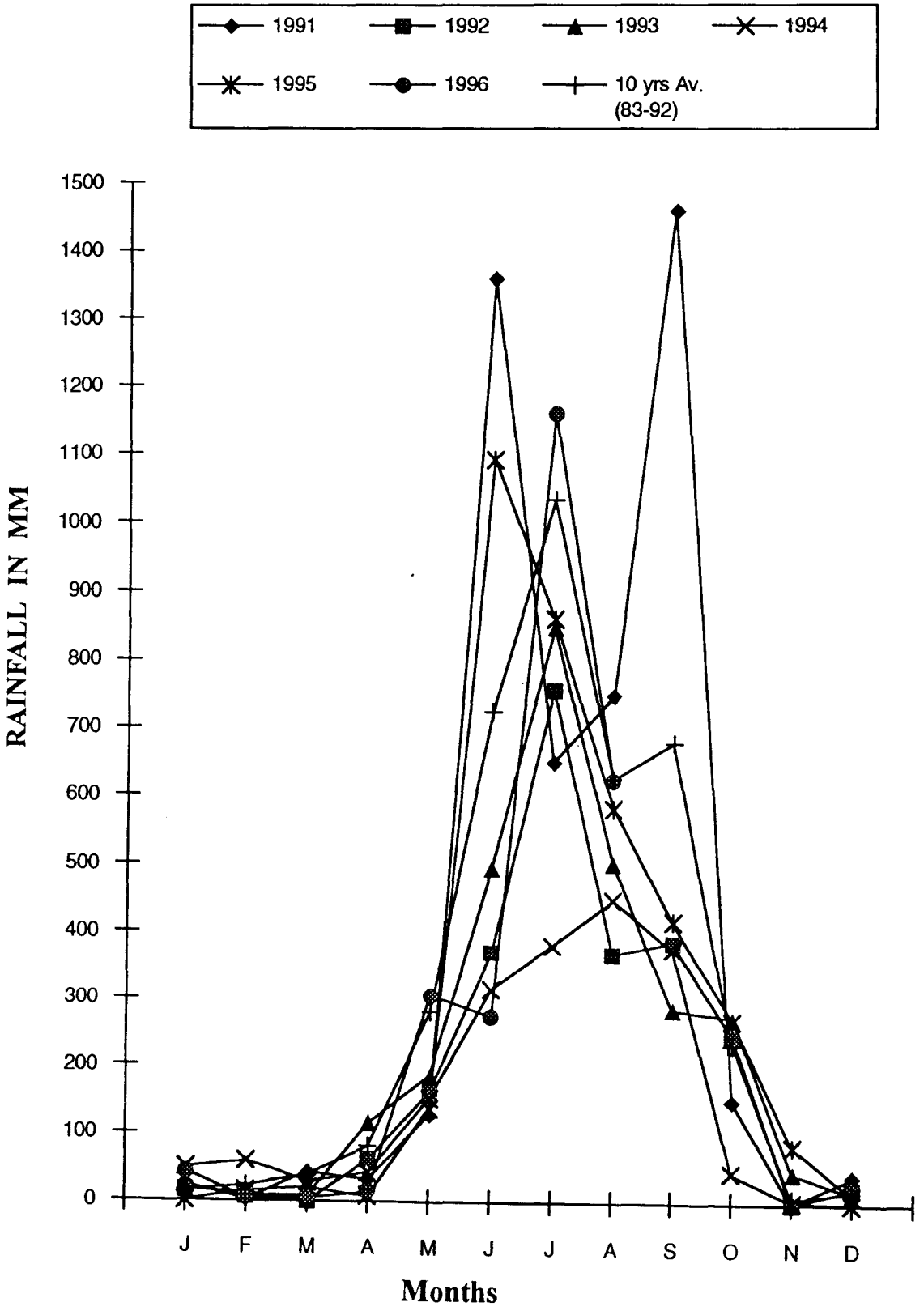

Fig.10. **Monthly rainfall graph of Siliguri Subdivision during 1991-96 in mm**

3.3 Source of germplasm

Investigation was carried out including 53 germplasm of brinjal collected from different corners of India. But due to failure in germination, 12 varieties were discarded and ultimately experiment was conducted with the following 41 varieties or lines of egg plant.

1. R-14, 2. Nishchindipur Local, 3. Sufal, 4. KB-9, 5. White Long Cluster, 6. Nurki, 7. Muktajhuri, 8. Shyamla Dhepa, 9. Neelam Long, 10. Pusa Purple Round, 11. Kalo Dhepa, 12. Pusa Purple Long, 13. Banaras Giant White, 14. KB-20, 15. L-13, 16. Boral, 17. Pusa Purple Cluster, 18. Banarasi, 19. KB-5, 20. Muktakeshi., 21. Krishnanagar Purple Round, 22. Navkiran, 23. Rajkrishna, 24. Pyratuni, 25. IR-8 Baramasi, 26. Banaras Long Purple, 27. Baramasi, 28. Shyamla Bhangar, 29. BB_1, 30. Murshidabad Local 31. ARM-3, 32. Krishna, 33. Krishnanagar Hybrid Variety-90, 34. KB-52, 35. KB-10, 36. Brinjal Long Green, 37. Pusa Kranti, 38. KB-2, 39. Black Prince, 40. Agora, 41. Suttons Long.

These planting material have clear variability with respect to plant growth, type, pigmentation, color-shape-size of fruit as summarised in Table 5. These are collected from different parts of the country as enumerated on the next page :

Another 12 varieties such as P-18 line from BCKV, Kalyani, W.B. Arka Shirish, Arka Sourav, collected from IIHR, Bangalore, Pusa Anmol, S-5, SM 17-4 from New Delhi (IARI) and Banamala, Krishnanagar (27 × 30), T_3, Muktakeshi, Amdanga (3), Amdanga (8), collected from Horticultural Research Station, Krishnanagar, W.B., unfortunately did not germinate in the very exclusive climate of Darjeeling foot hills and were as such could not be included in the experiments.

Name of germplasm	*Source*
Pusa Purple Long, Pusa Purple Cluster, Pusa Purple Round.	IARI, New Delhi
Navkiran	Kashmir Seed Co., Kashmir
BB_1	OUAT (Orissa University of Agriculture and Technology) Bhubaneswar.
R-14, L-13, Sufal	IAHS (Indo American Hybrid Seed Co.) Bangalore, Karnataka.
Black Beauty, Muktakeshi, Banarasi, Neelam Long	Bharat Nursery, Calcutta, W.B.
Suttons Long, Nurki	Suttons & Sons, Calcutta, W.B.
Shyamla Dhepa, Kalo Dhepa	From Farmer's field
Baramasi, IR-8 Baramasi	Siliguri, North Bengal.
KB-2, KB-5, KB-10, KB-20, KB-52.	All India Co-ordinated Vegetable Improvement Project, BCKV, Kalyani, Nadia, WB.
Banaras Giant White	Varanasi, U.P.
Banaras Long Purple	
Murshidabad Local	Murshidabad, W.B.
Nishchindipur Local, ARM-3	Midnapur (Mecheda), W.B.
Shyamla Bhangar	Bhangar, 24 Parganas (South), W.B.
Boral	Calcutta, W.B. (Sealdah)
Brinjal Long Green	IAHS. Co., Siliguri, Hill Cart Road, W.B.
Krishnanagar Purple Round	Assitant Horticulturist,
Krishnanagar Hybrid Variety '90	Krishnanagar Horticultural
Krishna, Raj Krishna.	Research Station, Dept. of Agriculture, W.B.
Pyratuni, Muktajhuri,	Krishnanagar, Nadia
White Long Cluster	West Bengal.
Agora	Sandose Co. Seed, Collected from Siliguri, Bidhan Market.

3.4. Source of Agrochemicals

Agrochemicals used in the experiment are presented in tabular form as briefed below.

Trade Name	Chemical Name	Company source
1. Metacid 50 EC	Methyl Parathion 50 EC	Bayer (India) Ltd., Bombay.
2. Thiodan 35 EC	Endosulfan	Hoechest.
3. Basathrin 25 EC	Cypermethrin 25 EC	BASF India Ltd., Bombay.
4. Rogor 30 EC	Dimethoate	Ralis India.
5. Monocil	Monocrotophos 36%	NOCIL, Bombay.
6. Decis 2.5 EC	Decamethrin	Hoechest.
7. Demecron 85 EC	Phosphomidan 85 EC	Hindusthan Cibaca.
8. Ripcord 10%	Cypermethrin 10% EC	NOCIL, Bombay.
9. Suquin	Quinalphos 25 EC	Sudarshan Chemical Industries Ltd., Pune.
10. Malathion 50 EC	Malathion 50% EC	East Coast Pesticides, Ganjam, Orissa.
11. Neem Gold	Azadirachtin-0.3%	SPIC, Madras.
12. Vage Guard	Vage Guard	Exel Agro Industries.

3.5. Screening of *Solannum melangena* for its relative susceptibility to four major insect pests

3.5.1. Relative susceptibility to *Leucinodes orbonalis* as a fruit borer and as a shoot borer

The experiment was conducted during autumn-winter seasons of 1991-92 and 1992-93 to study the response of 41 cultivars and lines of brinjal against the damage caused by major insect pests at Siliguri. The experiment was laid out in simple randomized block design with 3 replications during both the years. The size of subplot was 3.0 m × 2.8 m, having 20 plants

spaced 70 cm × 60 cm apart. The crop was left for natural infestation of pests. Data were recorded from the time of first occurrence of the pests. The total number of shoots damaged due to the attack of *L. orbonalis* in the central 5 plants was also recorded. The fruits were harvested at an interval of 10 days, sorted out into marketable and unmarketable fruits, counted and weighed for computation of final yield. The data were statistically analysed.

The resistance grade index was calculated for each variety according to the degree of infestation. According to Lal *et al.* (1976), percent fruit damage on number and weight basis were considered for gradation. These grades were deemed as immune (0%), highly resistant (1-10%), fairly resistant (11-20%), tolerant (21-30%), susceptible (31-40%) and highly susceptible (above 41% infestation).

Following the grade index of Subbaratnam and Butani(1981) the relative tolerance was estimated on the basis of incidence of number of pests/5 plants for shoot borer. But the index for fruit borer was considered on the basis of fruit damage (%).

On this basis following are the grading index :

Grade	Shoot borer	Fruit borer
Tolerant	< 2.0	< 15.0 %
Moderately Tolerant	2.1-3.0	16.0-25.0%
Susceptible	3.1-5.0	26.0-40.0%
Highly susceptible	> 5.0	> 40

3.5.2. Relative susceptibility to jassid, aphid and spotted leaf beetle

Likewise the populations of cotton leaf hopper (jassid), cotton aphid (aphid) and spotted leaf beetle were counted from 5 leaves (2 top, 2 middle and 1 bottom) from each of the 5 central plants in every subplot at 20 day intervals-starting from the first incidence till completion of harvesting and data were statistically analysed.

Following the grade index of Subbaratnam and Butani(1981) the relative tolerance was estimated on the basis of incidence of number of insect pests/5 leaves/pl for cotton leaf hopper and aphid. On this basis the grading index are :

Grade	Cotton leaf hopper	Cotton aphid
Tolerant	< 10.0	< 20.0
Moderately tolerant	11.0 - 19.0	21.0 - 30.0
Susceptible	23.0 - 30.0	31.0 - 50.0
Highly Susceptible	> 30.0	> 50.0

however, no grade index is available for spotted leaf beetle.

3.6. Variability studies

Genetic varibility or the differences among the 41 cultivars were tested for significancee by using analysis of variance technique on the basis of model proposed by Panse and Sukhatme (1989). The genotypic and phenotypic co-efficient of variation were calculated by the formula given by Burton (1952). The genotypic and phenotypic variance were calculated as per the formulae given by Burton and Devane (1953). Heritability in broad sense was estimated by using formula given by Hanson (1963). The procedure suggested by Allard (1960) was used for computation of genetic advances.

3.6.1. Genotypic and phenotypic variability for vegetative characters.

Following vegetative character were considered during investigation.

(i) **Plant height at first flowering :**

The mean of the height of 5 randomly selected plants was measured in cm at the time when plants flowered.

(ii) **Plant height at first harvesting :**

The average height of 5 randomly selected plants were measured in cm at the time when tender fruits having edible maturity were first harvested for consumption.

(iii) **Number of primary branches :**

For each randomly selected 5 numbers of individual plant, the number of primary branches were counted arising from the main stem and their average value was taken into consideration.

(iv) **Number of secondary branches :**

Mean of the randomly selected 5 plants with regards to number of secondary branches arising out from the primary branches were taken under observation.

(v) **Days to flower :**

The average days taken to flower after transplanting were calculated for each parent and hybrids of 5 randomly selected representative plants. Data of each replication mean during each time was averaged to calculate mean days.

(vi) **Days taken from transplanting to first picking :**

Number of days were recorded from date of transplanting to the first edible stage of picking.

(vii) **Marketable yield :**

The weights of the total number of fruits for each selected plant were considered to calculate the average yield/pl in kg.

3.6.2. Variability for some reproductive characters

Under this group following 5 parameters were considered.

(i) **Length of fruit :**

The mean length of the randomly selected fruits from each harvest for each selected plant were recorded in cm.

(ii) **Maximum circumference of the fruit :**

The maximum circumference in cm. was recorded for those fruits whose lengths were measured and the average value for each randomly selected plant was calculated.

(iii) **Number of fruits/plant :**

Number of fruits produced per plant were recorded and the average of each treatment was calculated from randomly selected plants.

(iv) **Weight of fruit :**

Mean weight of marketable or unmarketable fruits for this character was recorded from each picking of each variety in each replication for treatment average in kg/fruit.

(v) **Total yield/plant :**

For this character total number of marketable and unmarketable fruits and their respective yield were added together from each of the replications for treatment average.

At each picking time the number of markatable and unmarketable fruits and their respective weights were calculated. The Picking of fruits were

made at an interval of 7-10 days. Then by adding all the numbers of all harvest total number of marketable and unmarketable fruits, their respective yield were calculated for each replications and averaged out and converted to total yield/pl in kg. by addition of marketable and unmarketable yield.

3.6.3. Variablility for some important susceptibility components for *L. orbonalis* attack

Susceptibility components considered are as briefed below -

(i) **Number of larvae/plant :**

Randomly selected 10 plants from each replication were taken for calculation of the number of larvae/pl. Infested fruits of the plants were also added to the shoot infestation. This is based on the number of larvae found during the investigationn and averaged out for treatment total.

(ii) **Number of larvae/fruit :**

From among the infested fruits from each lot of a replication was taken to find out the number of larvae present with in the fruits. And average value for randomly selected 10 infested fruits gives the required data.

(iii) **Number of holes/plant :**

Ten plants were randomly selected to estimate the number of holes/ pl including the holes on fruit and average out.

(iv) **Number of holes/fruit :**

Out of 10 randomly selected infested fruits number of holes were averaged out to find out the total number of holes/ft.

(v) **Number of days taken by the borer to attack on branches :**

After transplanting, number of days taken to observe first incidence of attack on the shoots by the borer pest was counted for this purpose and average out for each replication.

(vi) **Number of days taken by the borer to attack on fruits :**

Similarly, number of days taken from transplanting to observe the first incidence of the attack by the fruit borer was counted for this purpose.

(vii) **Percent infested branches/plant :**

Number of shoots affected in each plant by the shoot and fruit borer was recorded while picking was done at an interval of 10 days. Based on total number of secondary branches or shoots or twigs and number of infested shoots, percent infestation/pl was calculated from the 5 central plants from each replication.

(viii) **Percent infested fruit/plant :**

It was estimated from the total number of fruits/pl and infested fruit for same plant and their percent conversion. Average for each replication gives treatment data in percentage. This is based on number of fruits mainly.

(ix) **Percent loss in yield/plant.**

The quantity of unmarketable fruits divided by total yield (both marketable and unmarketable) when multiplied by 100 gives the estimate of percent yield loss. This is based on the weight of fruits/pl.

3.7. Correlation and path analysis

Correlation and path analysis were done for all the vegetative, reproductive and susceptibility components enumerated as in 3.6.1, 3.6.2. and 3.6.3. Correlation and path analysis was performed with 41 genotypes of brinjal but during 1995-96 only 38 brinjal lines were tested. Lay out and replications were same for all the 3 cases.

For genotypic correlations the method of Robinson *et al.* (1949) and for path analysis, the method of Dewey and Lu (1959) were followed.

3.8. Genetic divergence

The multivariate analysis based on Mahalanobis D^2 statistic is desired to be employed as a powerful tool for measuring genetic divergence in plant breeding experiments (Mital *et al.*, 1975) and the populations were grouped into cluster treating D^2 as the square of generalised distance (Rao, 1952).

3.9. Screening of 12 agrochemicals using *L. orbonalis* as shoot borer and fruit borer

3.9.1. Efficacy of 12 agrochemicals on the suppression of *L. orbonalis* infesting a local cultivar (Dhepa)

Altogether 12 agrochemicals of different nature were put into trial in this investigation as water soluble sprays. Treatments were, - methyl parathion 0.05% (metacid 50 EC), - endosulfan 0.07% (thiodan 35 EC), - cypermethrin 0.006% (basathrin 25 EC), T_4-dimethoate 0.03% (rogor 30 EC), T_5 - monocrotophos 0.03 % (monocil 36 %), T_6 - decamethrin 0.002% (decis 2.5 EC), T_7 - Phosphomidan 0.04% (dimecron 85 EC), T_8 - cypermethrin 0.005 (ripcord 10%), T_9 - quinalphos 0.05EC), T_{11} - azadirachtin 0.001% (neem gold 0.30%), T_{12} - vage guard 0.001% (vage guard) and T_{13} - Control (waterspray).

The investigation was carried out in some experimental plots in the Darjeeling Terai having a distinct agroclimatic character. The locally preferred high yielding 'Dhepa' cultivar of brinjal was the experimental plant. The plants were sprayed thrice, first on 45 days after transplantation, thereafter on 15 days interval. Seedlings of brinjal were transplanted in a plot of 3m × 5m during October to February (rabi season) of 1993-

94, consisting of 12 chemical treatments and one control as water spray. For each treatments and control 10 plants were considered randomly. The number of infested shoots or fruits, due to attack of *L. orbonalis* Guen. recorded during the course of investigation were converted into percentage infestation over the control. The data were subjected to analysis of variance following Randomised Block Design after making angular transformation.

3.9.2. Impact of 12 agrochemicals on growth and yield of local cultivar of brinjal and cost:benefit ratio

Similarly, this experiment was conducted as reported in 3.9.1. while studying efficacy of 12 agrochemicals. The observation on plant vagetative growth parameters was restricted to the number of secondary branches, plant height and the number of leaves/pl at the time of each harvesting. The yield was computed while weighing the fruits after sorting out into healthy and borer affected fruits at each harvest. The economics of the pesticides was calculated from the yield data obtained during screening efficacy of the agrochemicals.

3.9.3. Efficacy of pesticide combinations using six promising brinjal cultivars under modern concept of IPM

In order to find out the resistance response of the cultivars, at first screening work was carried out during autumn winter season of 1991-92 and 1992-93. Following Lal *et al.* (1976), out of 41 cultivars screened, 3 cultivars namely, Kalo Dhepa (KD), Banaras Long Purple (BLP) and Navkiran were identified as resistant; Banaras Giant White (BGW) and Krishna as moderately susceptible and R-14 as highly susceptible cultivar to *L. orbonalis*. The promising 6 cultivars thus obtained were further tested

for two more years during 1993-94 and 1994-95 for confirmation of their resistance response to the 4 major insect pests with special emphasis to *L. orbonalis*.

In all the screening experiments varieties were transplanted in a randomized block design with 3 replications. The size of subplot (replication) was 3.0m × 2.8m having 20 plants spaced 70 cm. × 60 cm. apart.

Split plot technique was followed during 1993-94 and 1994-95 for pesticidal screening. During this period, varietal performace of brinjal towards the borer, jassid, aphid and spotted leaf beetle was tested in an unprotected crop as control. The pesticidal screening design was as under -

P_0 = Control having no treatments of water or insecticides.

P_1 = Root zone treatment with carbofuran @ 750g a.i./ha at 3 weeks stage after transplanting followed by single foliar spray of cypermethrin @ 50g a.i/ha at 70 days after transplanting.

P_2 = Carbofuran was applied as in the first one followed by single spray of endosulfan @ 525g a.i/ha at 70 days after transplanting.

P_3 = Water Spray only.

From all the experiments on varietal testing and chemical centrol, observations on the number of healthy and the cumulative mean percent fruits damage by the borer was worked out for different treatments. the population of jassid, spotted leaf beetle and aphid were recorded from 5 leaves of each of the 5 central plants in every subplot and averaged out. The observations were recorded through out the crop growth phase

at 20 day interval. The yield of marketable fruits were recorded at each picking on whole plot basis and converted into total yield/pl for different treatments.

3.10. Performance of six selected parents and their 30 F_1 hybrids

Hybridization experiment was conducted at CADC Farm, Siliguri during 1994 september to 1995, April including six selected parents in a diallele fashion. Seeds are collected and another experiment was conducted during September 1995 to April, 1996 under the following sub heads.

Materials : Materials include 6 promising and widely divergent varieties as parents and their 30 F_1 hybrids produced during 1994-95. along with other two popular varieties of Malda district of North Bengal as check variety. These are as briefed below —

Parents

1. Kalo Dhepa (KD)
2. Banaras Giant White (BGW)
3. Krishna
4. R-14
5. Bararas Long Purple (BLP)
6. Navkiran.

Check variety

1. Nababganj
2. Tal

Hybridization :

The varietal seeds were sown separately in the field on 15.10.94 and raised seedings were transplanted on 25.11.94 to 30.11.94 in 2 rows with

40 plants each for each of the parents with 1m isolation distance between the varieties as parents.

Bud selection for emasculation :

Flower bud selection for hybridization is very important. According to Krisnamurti and Subramanian (1954a) there are 4 types of flower in brinjal viz. —

(i) long-styled with big size ovary

(ii) medium styled with medium size ovary

(iii) pseudoshort styled with rudimentary ovary

(iv) true short-styled with very rudimentary ovary.

Long and medium styled flower buds which were just to bloom were selected for emasculation.

Emasculation : Before emasculation was done, morphology of flower was studied. Emasculation was done by forcep method in the afternoon to avoid drying of stigmatic secretion.

Anthesis in brinjal flowers, starts from 7,30 a.m. and continues upto 11 a.m. Peak time for anthesis is 8.30 to 10.30 a.m. The pollen dehiscence starts from 9.30 to 10 a.m.

Protection of stigma : Artificial cross pollination was done in the earlier part of the next morning (between 7.30 a.m. to 8.30 a.m.). Crossing were done between parents as stated on the next page :

In each combination more than 50 flower buds has been emasculated and cross pollinated for raising. F_1 hybrid seeds during 1995, October to 1996, at Siliguri.

	Female Parent	Male or Pollen Parent
1)	Kalo Dhepa (KD)	Banaras Giant White (BGW)
		Krishna
		R-14
		Banaras Long Purple (BLP)
		Navkiran.
2)	BGW	KD
		Krishna
		R-14
		BLP
		Navkiran
3)	Krishna	KD
		BGW
		R-14
		BLP
		Navkiran
4)	R - 14	KD
		BGW
		Krishna
		BLP
		Navkiran
5)	BLP	KD
		BGW
		Krishna
		R-14
		Navkiran
6)	Navkiran	KD
		BGW
		Krishna
		R-14
		BLP

Harvesting of F_1 hybrid seeds :

Well ripened, mature selfed and crossed fruits were harvested separately variety wise to extract seeds by farmentation methods, dried properly, packed in seed packets and kept in desiccator. Selfed seeds of parent varieties were also kept in desiccator. On an average there were 200 seeds for each cross combination.

Raising of F_1 generation along with their parents :

Thirty F_1 hybrids along with 8 parent varieties were sown on 15.10.95 to raise seedlings and these were transplanted on 25th Nov; 95.

Layout : The experiment was laid out in a randomised block design replicted thrice in a sandy loam soil with individual plot size 3.0 m × 2.8 m having 20 plants spaced 70 cm × 60 cm. apart. The crop was left for natural infestation of pests. Data were recorded from the time of first occurrence of the pests. Six weeks old seedlings were transplanted in the experimental plots. All cultural, and agrotechniques were adopted uniformly in all treatments as required.

Observation recorded : All the vegetative, reproductive and susceptibility parameters considered during the investigation was as in case of normal 41 varieties studied during 1991-92 and 1992-93.

Qualitative characters : Qualitative Characters viz flower colour, fruit colour, fruit shape and leaf characters were recorded for each selected plants.

Agrotechniques adopted :

Land Preparation : The experimental field was prepared thoroughly by repeated ploughing and laddering to get a fine tilth.

Raising of seedling in Nursery : The seeds were treated with bavistin @ 3 gm/kg of seeds and then sown in the raised seed beds on october 5 to 15 during 1991-96 for different experiments. The seeds of different varieties were sown in seperate seed beds. The 0.45 m × 0.45 m beds were first prepared with 0.4 kg organic manure @ 20 tons FYM/ha.

Transplanting : When the age of seedlings were 35-40 days these were transplanted in the main field during November-December for different experiments conducted during 1991-96.

Manures and Fertilizer : Compost @ 10 tons/ha were applied to the field at the time of final land preparation. A fertilizer dose of 75 Kg N, 50 Kg P_20_5 and 50 Kg K_2o/ha were applied as basal dose and another 75 Kg N were applied 30 days after transplanting, considering the medium to low level of nutrient status of the experimental field.

Irrigation and interculture : Spot application of irrigation by bucket was done during establishment phase of the seedling. Irrigation and interculture was provided as and when necessary other normal recommended cultural practice was adopted for raising brinjal crop.

Plant Protection : Experimental plots were left for natural infestation by the insect pests. Only during sowing of seeds. A systemic fungicide Bavistion @ 3 gm/kg of seeds was used for checking fungal diseases. Roughing of little leaf infected plants were made when noticed in the field. Phomopsis blight infected fruits were plucked when observed. These methods were adopted for screening the germplasm during 1991-92, 1992-93 and 1995-96. Agrochemical spray were done while screening for different agrochemicals under specific experiments.

3.11. Statistical calculations and biometrical methods

Statistical Analysis :

The experimental data of the 1991-92, 1992-93, and 1995-96 for the various characters studied were subjected to the variance analysis appropriate to a simple RBD and the significance of different sources of variation were tested following standard procedure of 'F' test at probability level 0.05. The critical difference between the entries were calculated at 5% level of significance. Split Plot Technique was followed as per Panse and Sukhatme, 1989. Other biometrical analysis were done using the following procedure.

(i) **Genotypic, Phenotypic and error variances**

The expected mean sum of squares for error, E. (MS) i.e. $\delta^2 e$ may be considered as purely a random environmental variance. The mean sum of squares consist of variances (i) attributable to varietal differences (i.e. genotypic differences) and (ii) due to environmental variation among individuals of each genotype. Thus the expected mean sum of squares would be

$$E\ (MSv) = \delta^2 e + r\delta^2 g$$

$$E\ (MSe) = \delta^2 e$$

and therefore, $\delta^2 g = \dfrac{MS_v - MS_e}{r}$

Thus the genotypic variance being $\delta^2 g$ and the environmental variance as $\delta^2 e$, the phenotypic variance $\delta^2 p$ will be equal to $\delta^2 g + \delta^2 e$ (Singh and Chowdhury, 1985). $\delta^2 g$ and $\delta^2 p$ with regard to the different growth and yield attributing characters were worked out.

The data on phenotypic variation in various plant characters were statistically analysed. Standard errors of means and critical differences for each character were worked out by the method of analysis of variance used for randomised block design. (Panse and Sukhatme, 1989).

a) Standard error of means (S.Em ±) was calculated by using formula —

$$S.Em = \pm\sqrt{\frac{EMS}{r}}$$, where EMS = Error Mean Square

r = Number of replication.

b) Critical difference (CD) was calculated by using following formula - SED × t at 5% or 1% level of significance.

where, standard error difference, $SED = \sqrt{\frac{2EMS}{r}}$

(ii) Genotypic and phenotypic co-efficient of variation.

$$GCV = \sqrt{\frac{\delta^2 g}{X}}$$ where X = Grand mean of treatment.

$$PCV = \sqrt{\frac{\delta^2 p}{X}}$$

(iii) Heritability (broad sense) : It is the ratio of genotypic variance to the phenotypic variance.

$$\text{Thus, } h^2 = \frac{\delta^2 g}{\delta^2 p}$$

(iv) Genetic advance : The estimation of genetic advance under selection is obtained by using the following formula.

$GA = (K)\ (\delta_p)\ (H)$. where K = 2.06 at 5% selection intensity,

$\delta^2 p$ = phenotypic variance H = Heritability.

(v) Correlation are calculated using the following formula :

$$r(x_1x_2) = \frac{Cov\ (x_1x_2)}{\sqrt{v(x_1)\ v(x_2)}}$$

where, $r(x_1x_2)$ is the correlation between x_1 and x_2 Cov. (x_1x_2) is the covariance between x_1 and x_2

$v(x_1)$ is the variance of x_1

$v(x_2)$ is the variance of x_2

(vi) **Path co-efficient analysis.**

Path co-efficient analysis was carried out at the genotypic level as suggested by Wright (1921) and discussed by Li (1954) and Dewey and Lu (1959). The simultaneous equation of path analysis was worked out by Elemination Procedure.

Statistical calculation for heterosis in brinjal :

Percentage heterosis with respect to mid parent, better parent and superior variety was calculated for different characters by using the methods of Turner (1953) and Hayes *et al.* (1955).

(i) Percentage heterosis with respect to Mid parent

$$= \frac{F_1 - MP}{MP} \times 100$$

where, F_1 = Mean of F_1 hybrid

MP = Average Mid Parental value which is

$\frac{P_1 + P_2}{2}$ (P_1 and P_2 are the mean of two parent)

Critical difference (CD) of Mid parent was calculated by using formula —

CD for MP = $\sqrt{\frac{3}{2}} \times SEM \times t$ at 5% or and at 1% level of significance

where, $SEM = \frac{EMS}{r}$

(ii) Percentage heterosis with respect to better parent, i.e. heterobeltiosis can be calculated as $\frac{F_1 - BP}{BP} \times 100$

where, F_1 = Mean of F_1 hybrid

BP = Mean of better parent.

(iii) Percentage heterosis with respect to superior variety $\frac{F_1 - SV}{SV} \times 100$

where, F_1 = Mean of F_1 hybrid.

SV = Mean of Superior variety.

Critical difference (CD) of better and superior variety was calculated as -

$\sqrt{2 \times SEM} \times t$ at 5% or 1% level of significance.

where, $SEM = \frac{EMS}{r}$

EMS = Error mean squares, and

r = Number of replication.

3.12 Computer Software used

RBD, Path Analysis, D^2 statistics, GPVCA, Anand-inv., Inverse Basic, HPG, Lotus, Cw, Page Maker, Sigma Plow, Cannroot and Scientific calculater Casio 82L.