2. REVIEW OF LITERATURE

2.1 List of the brinjal pests occurring in India

Nair (1975) compiled from different sources a general list of pests under different orders and families that are known to attack brinjal in India. The list is tabulated below.

Scientific Name	Common Name	Family	Order
1. *Atractomorpha crenulata* Fab.	Hopper	Acridiidae	Orthoptera
2. *Orthacris sp.*	"	"	"
3. *Poecilocerus pictus* Fab.	"	"	"
4. *Empoasca binotata* Pruthi	Jassid	Jassidae	Hemiptera
5. *E. punjabensis* Pruthi	"	"	"
6. *E. parathea* Pruthi	"	"	"
7. *E. devastans* Dist.	"	"	"
8. *Aphis gossypii* Glover	Aphid	Aphididae	"
9. *Centrococcus insolitus* Gr.	Mealy bug	Coccidae	"
10. *Aspidiotus desturctor* Sign.	"	"	"
11. *A. orientalis* Newst.	"		"
12. *Chionaspis manni* Gr.	"	"	"
13. *Cerococcus hibisci* Gr.	"	"	"
14. *Creontiades pallidifer* Wlk.	-	Miridae	"
15. *Halticus minutus* Reut.	-	"	"
16. *Anoplocnemis phasiana* Fab.	-	Coreidae	"
17. *Spilostethus panduras* Scopoli	Seed-bug	Lygaeidae	"
18. *Spilostethus hospes* Fab.	Seed-bug	"	"
19. *Urentius echinus* Dist.	Lace-wing bug	Tingidae	"
20. *Aspongopus janus* Fab.	-	Pentatomidae	"
21. *Selenothrips indicus* Bagn.	Thrips	Thripidae	Thysanoptera

Scientific Name	Common Name	Family	Order
22. *Scirtothrips dorsalis* Hood.	Thrips	Thripidae	Thysanoptera
23. *Phthorimoea blapsigona* M.	Bud borer	Gelechiidae	Lepidoptera
24. *P. ergasima* Meyr.	"	"	"
25. *P. helipa* Lower	"	"	"
26. *P. operculella* Zell.	Bud borer	Gelechiidae	Lepidoptera
27. *Leucinodes orbonalis* Guen.	Shoot and fruit borer	Pyralidae	"
28. *Euzophera perticella* Raj.	Stem borer	"	"
29. *Nephopteryx minutella* Rag.	Leaf feeder	"	"
30. *Phycita clientella* Z.	Leaf roller	"	"
31. *Psara bipunctalis* Fab.	Leaf webber	"	"
32. *Pterophorus lienigianus* Z.	-	Pterophoridae	Lepidoptera
33. *Acherontia styx* West.	-	Sphingidae,	"
34. *Antoba(Eublemma) olivacea* Wlk.	Leaf folder	Noctuidae	"
35. *Selepa docilis* Btlr.	-	"	"
36. *Laphygma exigua* Hb.	-	"	"
37. *Prodenia litura* Fab.	-	"	"
38. *Solenopus germinata* Fab.	Household ant	Formicidae	Hymenoptera
39. *Camponotus maculatus infuscus*	-	"	"
40. *Holotrichia insularis* Bren.	Root grub	Melolonthinae	"
41. *Epilachna vigintioctopunctata* Fab.	Epilachna beetle	Coleoptera	Coccinellidae
42. *Lema praeusta* Fab.	-	Chrysomelidae	Coleoptera
43. *L. semiregularis* Jac.	-	Chrysomelidae	Coleoptera
44. *L. signatipennis* Jac.	-	Chrysomelidae	Coleoptera
45. *Myllocerus blandus* Fst.	-	Curculionidae	Coleoptera
46. *M. pretiosus* Fst.	-	Curculionidae	Coleoptera
47. *M.subfasciatus* Quen.	-	Curculionidae	Coleoptera
48. *Tetranychus telarius* Linn.	Spidermite	Tetranychidae	Acarina
49. *T. cucurbitae* Rah and Sap.	Spidermite	"	"
50. *T. cinnabarinus* Boisduval	-	-	-
51. *Aceria lycopersici* Wlff.	-	Eriophyidae	"

Mites of the super-family Tetranychoidea and Eriophyoidea comprise most of the economically important phytophagous species. The most important and abundant group is the Tetranychidae (Spider mites) which cause extensive damage to the field crops in India and abroad.

Twenty-three species of mites have so far been reported to be associated with brinjal plant from different parts of the world. The species are enlisted below :

Scientific Name	*Family*	*Part affected*	*Reference*
1. *Tetranychus tumidus*	Tetranychidae	Leaf	Weber, 1951
2. *Aceria lycopersici* K.	Eriophydae	Leaf	Lamb, 1953
3. *Tetranychus maefarlanci* Baker and Pritchard	Tetranychidae	Leaf	Moutia, 1958
4. *Tetranychus evansi* Baker and Pritchard	"	"	Moutia, 1958
5. *Tetranychus cinnabarinus* Boisd.	"	"	Prasad,1974
6. *Tetrranychus desertarum*	"	"	Nickel, 1958. Banks
7. *T. ludene* Zacher.	"	"	Meyer Rodrigos. 1566
8. *T. nescaledonicus* Andre	"	"	Pande and Jadava.1976
9. *Brevipalpus phoenicis* Geiti	Tenuipalpidae	"	Nagesh Chandra and Channna Basavanna, 1976
10. *Polyphagotarsonemus latus* Banks.	Tersonemidae	-	Dhooria and Bindra, 1977
11. *Eutetranychus bredini*	Tetranychidae	-	Gupta, 1985.
12. *Platyeteitranychus multidigituli*	"	"	Gupta, 1985.
13. *Tetranychus savedi*	"	"	Gupta, 1985.
14. *Panonychus* (T) *harti*	"	"	Gupta, 1985.
15. *Brevipalpus* californicus (Banks)	Tennuipalpidae	"	"
16. *B. karachiensis*	"	"	Sadana, 1985 b.
17. *B. obovatus*	Donnadieu	-	Sadana, 1985 b.
Predatory Mites :			
18. *Amblyseius* (T) *kalimpongensis*	Phytoseiidae	Berlese	Gupta, 1985.
19. *A.* (E) *alstoniae* Gupta	"	Berlese	Gupta, 1985.
20. *A.* (T) *tetranychivorus* Gupta	-	"	"
21. *A. (P) multidentatus* Swirski and Shechter		-	"
22. *A.* (N) *ranngatensis*	"	"	"
23. *Phytoseius kapuri* Gupta	-	-	Gupta, 1985.

2.2. Effect of environmental factors on the bionomics of pest species On *Leucinodes orbonalis* Guen.

A temperature of 30°C and 30-90% r.h. were found to be more favourable for the multiplication of this pest (Atwal and Verma, 1972). The authors studied the biology and damaging potential of *L. orbonalis* on brinjal in the field and laboratory conditions of Punjab, Western India. In the field, larval population per 0.04 ha plot varied from, 1 larva in March (when the pyralid was in hibernation) to 116 larva in August and the percentage of fruit damaged by larval infestation was most abundant in the monsoon period when r.h. and temperature were high. The development of the pyralid was investigated on brinjal and potato in the laboratory at a temperature of 20-30°C and a r.h. of 30-90%. The development and the survival rate was higher at the highest temperature and humidity and it was concluded that the abundance of the pyralid in the field during monsoon was related to higher temperature and r.h..

Mall *et al.* (1992) recorded pest infestation in the 3rd week of August which attained a serious status during September when 76.66-93.33% plants were infested. Infestation of the pests on shoots did not seem to be directly influenced by either of the environmental factors. Though it was maximum at about 28°C temperature with 80% r.h.. On fruits, its infestation was positively affected by temperature and negatively by r.h.. Mehto *et al.* (1979) showed that temperature and r.h. had great bearing on the percentage of infestation on fruits. Pawer *et al.* (1986) also reported that the fruit was infested from the 3rd week of September and reached at its peak on the second week of November.

On *Amrasca biguttula biguttula* Ishida

Mall *et al.* (1992) reported that the incidence of the jassid was observed on newly transplanted crop from the 3rd week of August till the maturity of crop. The population of jassid gradually increased and remained higher from the mid-October to mid November with highest intensity 1.82 jassid/leaf. The average temperature ranged between 20-25°C and the average r.h. between 50-72% as well as dry season (no rainfall) showed a significant impact on the population build up of jassid. Sekhon and Singh (1985) also reported conduciveness of similar environmental conditions for population build up of jassid on the brinjal crop.

On *Aphis gossypii* Glover

Oliviera (1971) studied the relation between weather condition and fluctuation in population of aphids in potato fields. It was found that the size of the population was negatively correlated with the amount of rainfall and that both very high temperatures (above 30°C) and very low ones (under 12°C) were unfavourable for the aphid multiplication, the optimum range for their development being very narrow (26-27.5°C). However, no information is available on the influence of environmental factors on the incidence and abundance of aphids on brinjal in different seasons. According to Mall *et al.* (1992) incidence of aphid on brinjal crop was found from the 3rd week of August to 3rd week of December with a peak of 6.86 aphid/leaf during the first week of November. The average temperature range of 20-25°C and average r.h. range of 50-72% were more favourable for maximum activity of the pest. Singh and Kavadia (1979) observed disappearance of the pest from the brinjal crop with a fall of minimum temperature below 20°C.

On *Epilachna vigintioctopunctata* Fab.

According to Mall *et al.* (1992) spotted leaf beetle was recorded from 3rd week of August to middle of October with its maximum population of 0.22 beetle per leaf in the middle of September. When the average temperature and humidity were about 28°C and 80% respectively. The population gradually declined and disappeared probably due to fall in temperature and humidity and also due to aging of the crop.

Singh and Kavadia (1989) also found the maximum infestation of epilachna beetle in August to October on July planted crop. According to Iftakhar and Khan (1980) the pest remained active from July to November on brinjal and was more prevalent at temperature of 27-29°C and at r.h. of more than 80% during the month of August.

Grewal (1988) found that in Punjab, temperature and r.h. affected the number of coccinellid although the availability of food was also an important factor determining the number. High temperature and low r.h. had an adverse effect on egg hatchability, the viability of newly hatched larvae and fecundity, however, advanced stages of larvae and the adults were only moderately affected.

2.3 Screening of germplasm

Brinjal shoot and fruit borer is an important insect pest which acts as a hindering factor for the successful cultivation of this crop, particularly under a condition of high temperature and humidity even in case of wild species of the genus *Solanum*. While *S. incanum* showed an infestation of 8.6 percent, *S. sisymbriifolium* (Lall and Ahmad 1965; Dhankhar *et al.*; 1977), *S. integrifolium, S. xanthocarpum, S. nigram* and *S. khasianum* have earlier been found free from the damage of this insect (Lal *et al.*, 1976). In accordance with Chelliah and Srinivasan (1983) *S. integrifolium, S. sisymbrifolium* and *S. xanthocarpum* could be used effectively for exploitation of resistance characters. Kashyap and Kalloo (1983), in their review reported that fruits of *S. khasianum* were found to be infested with this insect at Vegetable Research Farm, Haryana Agricultural University, Hissar. (Dhankhar, personal communication).

Kashyap and Kalloo (1983) have reviewed works of different authors on insect resistance in vegetable crops. Several accessions of *S. melongena* have been screened against this insect pest and Pusa Purple Long (Singh and Sikka, 1955) H-128, H-129 and H-158 (Srinivasan and Basheer,1961), Aushey (Lall and Ahmed, 1965; Dhankhar *et al.*, 1977), Thorn Pendy, Black Pendy, H-165 and H-407 (Panda *et al.*, 1971), SM-202, Sel. 519, Sel. 520, Sel. 521. and Solan-11 (Lal *et al.*, 1976), PPC-2, IC-1885, Aushey (Dhankhar *et al.*, 1977), Dorley (Nawale and Sonone, 1979), S-4, H-4, Punjab Chamkila, PPC and PPL (Gill and Chadha, 1979) Long Purple (Frempong and Buahin, 1977), PPC 17-4 and PVR-195 (Singh, 1981) have been reported to be tolerant or resistant. Singh and Sidhu (1980) reported that the cultivars PBR 129-5 and SM 17-4 were resistant to *L. orbonalis*.

In Rahuri, Maharastra, Raut and Sonone (1980) screened several cultivars against this pest, they have reported that the cultivars H-4, Pusa Purple Long, Pusa Kranti and SM-41 exhibited tolerance to fruit as well as to shoot infestation. Similar results were also reported by Subbaratnam and Butani (1981) from New Delhi, they reported that cultivars H-4, Pusa Kranti and A-61 were moderately tolerant to shoot and fruit borer, while

Arka Kusumakar was tolerant to this insect pest. Hence they have suggested that these cultivars might be incorporated in the pest management programme. Subbaratnam *et al.* (1981) again reported that PPC, Arka Kusumakar, H-4, A-61, Annamalai and Pusa Kranti showed resistant reaction towards borer infestation. In the same year (1981) Mehto and Lall reported resistance in Long Purple cultivar confirming the findings of Frempong and Buahin 1979. Singh in the year 1981 showed PPC 17-4, PVR-195 have tolerance against *L. orbonalis*. Naithani (1983) also reported tolerance in PPC and AM-62.

At Coimbatore, Srinivasan and Basheer (1961) trialed with 22 types of brinjal and reported that none was absolutely resistant to the borer pest of brinjal. The varieties, Coimbatore and Gudiyatham (H-158) were found to display least infestation. The types Arkadu (H-165), Vadugapalayan (H-202), Kurumbur (H-336) were next best types in respect of borer incidence.

Replicated field trials were conducted for the evaluation of the response of 19 varieties of egg plants or brinjal to shoot and fruit borer damage under natural infestation from 1964 to 1966 at Bhubaneswar. The mean percentage of shoot and fruit infestation indicated that Long White, Pusa Purple Round, Pusa Purple Long, Muktakeshi and Malipada (local) were susceptible where as Thorn Pendy, Black Pendy, H-165 and H-407 were significantly resistant to borer damage. The yield as well as field tolerance of resistant lines were also significantly higher than those of susceptible groups. The mechanism of resistance to shoot attack was attributed to compact vascular bundles in thick layer with lignified cells and low pith area. The tight and semi-tight fruit calyx in resistant lines are equally important in hindering the initial borer penetration into the fruits. The hard fruit rind and seeds arranged compactly in the mesocarp of such fruits have further provided a mechanism against borer damage (Panda *et al.*, 1971).

Lal *et al.* (1976) screened 69 strains and 6 *Solanum* species under field condition in upper Kulu valley of Himachal Pradesh. Five wild species viz. *S. sisymbriifolium, S. integrifolium, S. xanthocarpum, S. nigram* and *S. khasianum* were always found free from this pest, while *S. incanum* had 5.3 to 8.6% infestation during different years. Among cultivated types, SM-202, SM-145, S-497, S-519, S-520, S-521 and Solan 11 always showed resistance while SM-202, S-519 and S-520 were the highly resistant varieties with less than 6.3% damage during 1972 and 1973. During 1974, when the infestation in general was very high, these varieties had 11.5 to 20% infestation. The damage percent on fruit weight basis was generally more than that on fruit number basis. The highly susceptible varieties were Ramy Round Purple, Nurki, Pusa Purple Round, Japanee Long Black, Arka Shirish, S-453, S-475, S-476, S-496, S-499, S-530 and Solan-17. The highly resistant varieties had tightly arranged seeds in the mesocarp of the fruit. The colour of leaves, plant and fruits or the position of leaves on plants did not show any impact on the tolerance against the borer, *L. orbonalis*.

Dhankhar *et al.* (1977) tested 39 strains of *S. melongena* at Hissar (Haryana). Considerable genetic variability was observed for all the 9 relative susceptibility characters. The wild species showed the highest degree of tolerance to shoot and fruit borer followed by the cultivated strains, PPC-2 and Aushey.

Mehto and Lall (1981), conducted field trial in Bihar with 10 varieties of brinjal and found variability of resistance in order of Long Purple > PPL > Black Beauty > Muktakeshi > Early Crowdy > Banaras Giant > Oblong Round > Kulli > White Murgia.

Out of 150 cultivars of brinjal screened for 3 years, the cultivars Sm 17-4, Pusa Purple Cluster (PPC) and PBR 129-5 were identified as most resistant, and the cultivar Punjab Chamkila as the most susceptible to the brinjal shoot and fruit borer. Intensive testing of these cultivars for two more years indicated that the cultivar SM 17-4 had upto 1:10 as the ratio of infested to the healthy fruits as compared to 1 : 5 in case of PPC and PBR 129-5 and only 1:2.4 in case of Punjab Chamkila (Singh and Sidhu, 1986).

According to Bajaj *et al.* (1989) the fruit of the cultivar SM 17-4, relatively field resistant to *L. orbonalis* had higher glycoalkaloid content and peroxidase and polyphenol oxidase activities than the susceptible cultivar, Punjab Chamkila. However, higher anthocyanin content was found in the susceptible variety. It has been suggested that glycoalkaloids in association with phenolic compounds may be conferring resistance to egg plant fruits towards this pest.

Out of 150 lines tested by Singh and Chadha (1991), Cvs. SM 17-4, PBR 129-5 and Punjab Barsati were the most resistant but Punjab Chamkila was highly susceptible cultivar. Resistance was attributed to a large number of small sized fruits/pl with shorter inter/intra cluster distances, late and longer fruiting period.

Mandal *et al.* (1994) screened 41 cultivars of egg plant from North Bengal terai, and found Nishchindipur Local, Nurki, Shyamla Dhepa, Navkiran, Kalo Dhepa, IR-8-Baramasi, Banaras Long Purple, BB_1, and Murshidabad Local as fairly resistant having crop loss from 11.76% to 19.52%. The highly susceptible varieties were R-14, Sufal, Pusa Purple Round, Pyratuni, KB-20 and KB-2. The damage percent varied from 41.17 to 52.73 and 41.36 to 51.73 on the bases of fruit weight and fruit number respectively.

Mukhopadhyay and Mandal (1994) recommended varieties having tolerance or even multiple resistance viz. Shyamla Dhepa, Kalo Dhepa, Improved Muktakeshi, Banaras Long Purple and BB_1, for incorporation in the breeding programme and integrated pest management for rabi cultivation of brinjal under the very exclusive climate of Darjeeling Terai.

According to Srivastava and Lal (1995), Shoot and fruit borer is a serious problem in brinjal particularly in round varieties as compared to long varieties. Over 50 varieties and hybrids of prominent regional brinjal germplasm collected from different sources were screened against this pest under field conditions at I.A.R.I., New Delhi during 1994 and 1995. After each picking observations were undertaken and different grades of infested fruits were made on the basis of number and on the basis of weight against borer. None of the varieties and hybrids was found resistant to the borer. The variety SM-202 showed highly resistant to borer. The variety SM-202 showed high resistance while varieties SM-17, Pusa Purple Cluster, Pant Samrat and SM-202 × PPL were found moderately resistant on number and weight basis.

Resistance source of germplasm among hybrid

Bakash and Iqbal (1949) employed crosses of *S. incanum*, *S. khasianum*, *S. macranthum* with *S. melongena*. In the cross with *S. incanum*, the F_2 hybrids showed appreciable resistance to frost as well as shoot and fruit borer. Another hybrid (selected F_4 plant) between Pusa Purple Long and *S. indica* showed field resistance to *L. orbonalis*. (Rao and Kumar 1980). These works had been mentioned by Kashyap and Kalloo (1983) in their review article on insect resistance in vegetable crops.

F_3 progenies of *Solanum melongena* with *S. incanum* showed appreciable resistance against borer pests of brinjal (Rao, 1981). Kalloo and Berch (1990) cited resistance of hybrid egg plant against pests and diseases.

2.3.1. Screening of brinjal germplasm under semi-protected condition for IPM

By growing some of the promising varieties viz. Coimbatore, H-158, IC-1855, and H-128 and by spraying D.D.T. 0.1% or endrin 0.02% 3-4 times at fortnightly interval (commencing the treatments 3-4 weeks after transplanting), the vegetable growers can eliminate the borer completely and also obtained increased yield (Srinivasan and Basheer, 1961).

Under chemically protected/semi-protected condition the cultivar PBR 129-5 having multiple resistance for the borer and jassid gave highest borer free fruit yields (158 Qtls/ha) followed by highly borer resistant but jassid susceptible variety SM 17-4 (146.6 Qtls/ha). Under protected conditions the cultivar PBR 129-5 resulted in highest yields but the borer resistant PPC and SM 17-4 gave poorer yield performance than the borer

Table 1. Source of resistance to shoot and fruit borer

Source of resistance	Reference
PPL	Singh and Sikka, 1955
H-128, H-129, H-158	Srinivasan and Basheer, 1961
S. sisymbriifolium, Aushey	Lall and Ahmad, 1965
Thorn Pendy, Black Pendy, H-165, H-407	Panda *et al.*, 1971
Ex Beckwai, IHR-191	Krishna and Vijay, 1975
S. xanthocarpum, *S. sisymbriifolium*, *S. integrifolium*, *S. nigram*, *S. khasianum*, *S. incanum*. SM-202, S-519, S-520, SM-145, Solan-11.	Lal *et al.*, 1976
IC-1885, Aushey, *S. sisymbrifolium* PPC-2,	Dhankhar *et al.*, 1977
Dorley	Nawale and Sonone, 1977b
Long Purple	Frempong and Buahin, 1981
H-4, PPL, Pusa Kranti, SM-41	Rout and Sonone, 1980
PPC, Arka Kusumakar, H-4, A-61 Annamalai, Pusa Kranti	Subbaratnam and Butani, 1981
SM-17-4, PPC, PBR 129-5	Singh and Sidhu, 1986
Banaras Giant, S-34, Arka Kusumakar, SM-215, S-258, SM-62 SM-2, S-2070, Six Seer.	Pawar *et al.*, 1987
SM 17-4, PPC	Singh and Sidhu, 1988
SM 17-4	Bajaj *et al.*, 1989
Pusa Purple Cluster	Dash and Singh, 1990
PBr 129-5, SM 17-4, ARU-2C, Punjab Barsati, Pusa Purple Round	Tewari and Krishnamoorthy, 1985, Dilbagh Singh and Sidhu, 1988, Dilbagh Singh, 1991.
Shyamla Dhepa, Navkiran, Kalo Dhepa, Banaras Long Purple, BB_1, IR 8-Baramasi, NIL, Murshidabad Local	Mukhopadhyay and Mandal, 1994 Mandal *et al.*, 1994

susceptible Punjab Chamkila because of the formers susceptibility to the jassid. The varieties PBR 129-5 and SM 17-4 can thus be adopted for cultivation with a coverage of integrated pest management programme depending upon the complexity of pest problem and type of chemical protection given to the crop (Singh and Sidhu, 1986).

2.3.2. Varietal screening for Jassid resistance

Fakuda (1952) in Tiwan reported that the brinjal varieties Indomarunasu and Malayan 12 were found to be resistant to the cotton jassid, supporting small jassid population and suffering less damage than the susceptible varieties, Shinkuro and Tokyo-Yamanasu.

Mote (1978) made a field trial with 48 egg plant cultivars. The cultivars H-4, Round Green, Dorly, Aushey, Jumblimulayam, Long Purple showed the lowest number of jassid nymphs/30 leaves.

Subbaratnam and Butani (1981) reported that the cultivars S-5, Pusa Kranti, H-4 and A-61, showed resistance to *A. biguttula biguttula* in a field trial under normal infestation among the 18 cultivars.

Mukhopadhyay and Mandal (1994) reported that KB-9, Pusa Purple Round, Pusa Purple Long, Banaras Giant White, L-13, KB-5, Improved Muktakeshi, Navkiran, BB_1 and KB-10 had less infestation of jassid and therefore, were tolerant to the pest.

Bhandari (1985) screened 55 varieties of brinjal at B.C.K.V. Kalyani, Nadia, during rainy season and found Makra had lowest mean population of jassid during crop season and the other varieties like C-37, Bardhaman White, Pusa Purple Long, C-43, C-44, C-40, PBr-7, C-19, C-39, C-23, C-14, Banaras Giant, C-32, C-25, C-17 and C-41 did not differ significantly from Makra at 5% level. Makra and C-14, only two varieties were regarded as tolerant to both jassid and aphid.

Causes of jassid resistance :

The resistant varieties harboured a small jassid population, suffered less damage, and exhibited antibiosis by way of slower nymphal development, low nymphal survival and reduced fecundity-cum-fertility. Fakuda (1952) reported that the thickness of colenchyma cells in leaves, and the length and density of hairs on the undersite of leaves of resistant varieties of brinjal, prevented the 1st instar nymphs from feeding successfully. In Okra, however, only mid-rib hair density contributed to jassid resistance (Bindra and Mahal, 1979).

Bindra and Mahal (1981) reported varietal resistance in egg plant to cotton jassid, of 29 egg plant cultivars screened in the field. Cultivars like Junagadh sel-1, Aushey, R-34, H-4 and T_3 were resistant to A. *biguttula biguttula* due to various morphological characteristics viz. long hairs and high density of hairs on the mid-rib and lamina, more erect hairs on the mid-rib and thin leaf lamina.

Mote (1982) noted average number of jassid nymphs per 5 plants at 35-105 days after transplanting. The cultivars namely, Kalyanpur, T_3, Round Green, Pusa Purple Round, Muktakeshi were reported to be attacked by lowest number of jassid nymphs. All the resistant cultivars were noted for large number of hairs on their leaf under surfaces.

Similarly, Subbaratnam *et al.* (1983) recorded infestation of *S. melongena* at weekly interval. The thickness of the leaf lamina and mid-rib were positively correlated with the infestation. The other characters, the thickness of lateral veins, density and length of mid-rib hairs did not appear to have any correlation with jassid infestation.

2.3.3. Screening for aphid resistance

Chelliah and Sambandam (1971) made an experiment on evaluation of egg plant accessions for resistance to *Aphis gossypii* Glover. They observed that out of 205 accessions only 49A showed consistant resistance. In trial with other accessions this gave high yields of good quality fruit. The accession 49A was released with the name Annamalai. Ramaswamy *et al.* (1972) also reported that the cultivar Annamalai was resistant to *A. gossypii* and produces good quality fruits.

Subbaratnam and Butani (1981) conducted a field trial taking 18 cultivars for resistance against pest complex. In their experiment, the cultivar S-5 only showed resistance to *A. gossypii.*

In an experiment made by Sambandam and Chelliah (1983) reported that the insect resistance was heritable and all the progenies of Ac. 49A were uniformly resistant.

Bhandari (1986) screened brinjal germplasm at B.C.K.V. during rainy season of 1985. Out of 55 varieties and lines screened for their reaction to aphids and jassids infestation, C-10, C-14, C-16, C-21, C-24, Green Long and Makra have consistently low level of aphid infestation and may be considered some what less susceptible than the others.

2.3.4. Screening brinjal germplasm for epilachna beetle

Sambandam *et al.* (1976) made an experiment with the egg plant accessions No.5 and No.105 (both moderately resistant) to *E. vigintioctopunctata,* No.10 (highly susceptible) and *S. torvum* (highly resistant). Preferential feeding and antibiosis were the main factors affecting resistance. The susceptible accession had the highest total and amino nitrogen, amino acids, starch, crude fibre and K-content, where as the moderately or highly resistant accessions had the higher reducing and non-reducing sugars, chlorophyl P, total and O-dihydroxyphenol contents.

Pandey and Shanker (1975) reported the effect of 10 different food plants on the development of *E. vigintioctopunctata* (F.), a pest of solanaceous and cucurbitaceous plants, and egg plant (Brinjal) was found to be the most favourable and pumpkin the least.

2.4. Variability studies

The genetics of metric trait, centres round the study of its variation. The basic idea in the study of variation is its partitioning into its components attributed to aforesaid causes. The magnitude of heritable inability and more particularly its genetic component is the most important aspect of genetic constitution of the breeding material which has a close bearing on its response to selection.

The phenotype of quantitative traits in principle is the joint product of genotype and environment. Hence, the estimates of variability and its heritable components for the yield contributing characters in the available germplasm are a pre-requisite for a breeding programme for high yield. Achieving high yield necessiates selection on the basis of characters that have high heritability values.

2.4.1. Vegetative character

Sarkar *et al.* (1990) reported that high heritability for number of primary branches/pl and thickness of the skin in pointed gourd (*Trichosanthes* *dioica* Roxb). Highly significant differences were recorded for the characters, plant height, number of branches/pl, time taken to maturity in green chilli (Kumar *et al.*, 1993).

Variability was also discussed by many other workers in vegetable crops namely Rattan *et al.* (1983) in tomato, Solanki *et al.* (1988) in pea, Ahmed and Tanki (1992) in carrot, Baruah *et al.* (1993) in sweet gourd, Radha Krishna and Korla (1994) in cauliflower.

Singh *et al.* (1974) discussed the genetic variability, heritability and genetic advance in *S. melongena* L. The author noted highly significant differences among 24 varieties for all the characters studied. A wide range of variation was found in all the characters except for the number of primary branches (6.10-9.60). In general, a major portion of the variation was contributed by genetic components while the environmental variation played minor role. The genetic coefficient of variation helps in the measurement of the range of the genetic diversity in a character and provides a means to compare the genetic variability in the quantitative characters.

Kabir and Som (1993) reported that in brinjal wide range of variation was exhibited for plant height and period needed for flowering. GCV and PCV found to be lower for vegetative characters but 70.04% heritability was found for primary branches/pl.

2.4.2. Reproductive characters

Hazra *et al.* (1989) conducted experiment to estimate coheritability values among different pod yield contributing characters of dolichos bean revealed that coheritability values of pod yield/pl with yield components namely, days to flower, 10 pod weight, breadth of pod and pod number/

pl were greater than heritability estimate of pod yield/pl itself, suggesting potential for improving pod yield of dolichos bean (*Dolichos lablab*, Roxb. L.) by simultaneous selection for pairs of characters.

Saha *et al.* (1990) found high GCV and heritability associated with high genetic advance for pod yield/plant in french bean.

Natarajan (1994) reported high heritability estimates for days to flowering and mean fruit weight in tomato.

Ahmed *et al.* (1990) found genetic variability in 64 lines of Chilli (*Capsicum annum* L.) for plant fruit and yield characters. The results indicated considerable genetic variability for fruit yield and other traits. Estimates of components of variance revealed higher genotypic variance for all the characters than environmental variance. Heritability estimates in general were found high in all the characters. Higher genetic advance and genetic gain observed for fruit / pl, average fruit weight, fruit girth, fruit yield/pl and fruit length coupled with higher heritability indicated a large scope for the improvement of these characters by selection.

Highly significant differences were recorded for the characters, plant height, number of branches/pl, time taken to maturity, fruit length, fruit girth, number of fruit/pl and ascorbic acid content in green chilli. High heritability coupled with high genetic advance were observed for characters like number of fruit/pl, number of seeds/ft, ascorbic acid content and yield/ pl indicating the predominance of additive gene action (Kumar *et al.*, 1993). High heritability with high genetic advance was also reported by Anuradha and Narayana Gowda (1994) in gladiolus for number of cormels and 10 cormel weight.

Singh *et al.* (1977) reported high amount of GCV for fruit weight (48.46) in brinjal. Fruit length and yield/pl were the other characters in order which gave high GCV. The heritability estimates were in general high for all characters except in case of fruit weight (7.59). The high value of heritability suggests that all the characters are under genotypic control. In accord to Dharmegowda *et al.* (1979), narrow sense heritability estimates were 63.48 and 67.48% for number of fruit/pl and number of seeds/ft respectively in brinjal.

In brinjal high heritability and high genetic gain have also been observed for number of flowers/cluster, number of fruits/cluster and number of fruits/pl (Kabir, 1981). High estimates of heritability were reported by Singh *et al.* (1976) for all the characters except for yield/pl.

Kabir and Som (1993) discussed the genetic variability in some of the reproductive characters. They observed 78-86% heritability for fruit diameter and 107.64% genetic gain as percent of mean for fruits/cluster.

2.4.3. Susceptibility components

While screening for 39 strains of brinjal, Dhankhar *et al.* (1977) found considerable genetic variability. The wild species showed the highest degree of tolerance to shoot and fruit borer followed by PPC-2 and Aushey as indicated by percent infested fruits/pl in normal and ratoon crop under field condition. Estimates of components of variance revealed higher genotypic than error variance for number of infested fruits, holes/pl and larvae/pl. Therefore, selection on phenotypic basis for these characters would be more useful for relative susceptibility to shoot and fruit borer.

Several workers also worked on the genetic variability and heritability in some other vegetables like pumpkin (Gopalakrishnan *et al.*, 1980), carrot (Prasad and Prasad, 1980) etc.

2.5. Correlation and path analysis

Selection of one trait invariably affects number of associated traits which evokes the need in finding out the interrelationship of various yield components both among themselves and with yield. Selection of genotypes for high yield through yield components is judged to be more rational. Measurement of phenotypic and genotypic correlations between yield and other characters have been of great importance and is necessary, if selection for a simultaneous improvement of yield and its components is to be effective.

When more variables are included in a correlation study, the indirect associations become more complex. In such a situation, the path coefficient analysis devised by Wright (1921) provide an effective means of finding out direct and indirect causes of association and allows a detailed examination of specific forces acting to produce a given correlation and measures the relative importance of each casual factor.

According to Hanchinal *et al.* (1979), seed yield showed positive significant correlations with plant height, number of branches, number of pods and dry pod yield in winter, whereas in summer, highly significant positive correlations were obtained with number of seeds and dry pod yield in cowpea *Vigna unguiculata* (L.) Walp. The variation between two seasons in respect of correlation values for differnt traits with seed yield may be attributed to the extreme environmental fluctuations. Very high positive correlation was noted between seed yield and dry pod yield for both the seasons. 100 seed weight was negatively correlated with number of pods and number of branches for both the season. Plant height, number of branches and number of seeds revealed that the number of branches should be considered as one of the important characters in increasing the yield although the apparent correlation is negative. Further, it is suggested that rather than the direct effects of number of seeds and plant height, it is the indirect effect of seeds through branches which is more important in deciding the yield.

Saha *et al.* (1990) reported that the pod yield of french bean (*Phaseolus vulgaris* L.) was positively and significantly correlated with plant height, pod number/pl and pod weight.

In brinjal, it has been reported that there is a strong association between the number of fruits and yield/pl (Srivastava and Sachan, 1973; Singh and Nandpuri, 1974; Singh and Singh, 1980; Kabir, 1981). Srivastava and Sachan (1973) also mentioned that number of fruits/pl had a direct bearing on fruit yield. Several workers showed that both fruit weight and fruit number had a high direct contributions to yield. Thus fruit yield can be improved by selecting for those two components, giving more importance to fruit weight. Data on yield and five other characters from 19 egg plant varieties showed that yield was positively correlated with length, weight and number of fruits and negatively correlated with days to flowering, plant height and fruit girth, but fruit girth showed the greatest direct effect on yield/pl followed by fruit length and fruit weight (Singh and Singh, 1981).

Correlation among different constituents showed that the total phenols had a significant negative correlation with chlorophyll, PPO/mg/protein, PPO/mg/protein/mg orthodihydroxy phenols and significant positive correlations with PO units/g., true protein and orthodihydroxy phenols on fresh weight basis. The correlation coefficient in case of orthodihydroxy phenols was negative and significant with chlorophyll and PPO/mg protein (Sidhu *et al.,* 1982).

Yield of brinjal was positively correlated with fruits/pl, plant height and branches/pl at the phenotypic and genotypic levels and with fruit length : circumference ratio at the genotypic level (Sinha, 1983). Path analysis indicated that fruits/pl and fruit length : circumference ratio had the maximum direct effect on yield combined with GCV and heritability value. Salehuzzaman and Alam (1983) registered yield in egg plant is a complex character which is a product of its components. Wheather one should select for the components on for yield itself will depend upon their heritabilities and genetic interrelationships among yield and its component.

Patil and Shinde (1984) pointed out that in 50% of the cases, heterosis in fruit yield was positively associated with the heterosis in fruit/cluster and fruits/pl.

Chadha and Paul (1984) reported that values for expected genetic advance were high for yield/pl, fruits/pl and borer infected fruits/pl. Yield/pl was positively correlated with fruit/pl, borer infected fruits/pl and plant height. According to Sharma *et al.* (1985) infested yield was directly affected by total yield and indirectly fruit diameter. Total yield was directly affected by fruit number.

According to Sharma *et al.* (1985) total yield/pl was positively correlated with fruit number at both the phenotypic and genotypic levels. Plant height and fruit length also contributed to yield, although their correlations were not consistent over the 2 years. Infested yield/pl was correlated with the percent of infested yield and fruit diameter, the latter correlation suggesting that the round fruits are most susceptible to borer attack. According to Singh *et al.* (1988) total phenols in brinjal had significantly negative correlations with anthocyanin and non-significant but negative relationship with chlorophyll. Dry matter was positively related to chlorophyll.

Mandal and Dana (1992) reported that yield/pl in brinjal had highly significant positive genotypic association with days to 50% flowering. Fruit diameter had maximum direct positive effect on fruit yield followed by number of primary branches/pl, number of fruits/pl, number of secondary branches/pl and plant height. Since fruit diameter and number of primary branches/pl had low heritability values, fruit and secondary branch numbers and plant height would be the important yield components for selection of superior genotypes.

Information on mean, range, phenotypic and genotypic variance, genetic advance, heritability and correlation coefficients is derived from data on 10 yield related traits in 14 exotic and 2 local genotypes of brinjal grown during the winter season 1987-90 at Jorhat, Assam. Fruit yield was significantly correlated with plant height and fruit diameter (Bora and Shadeque, 1993).

Correlation and path coefficient analysis were also elaborately discussed by many workers for different vegetable crops namely, Pal *et al.* (1988) in onion; Sharma *et al.* (1993) and Prasad *et al.* (1993) in bottle gourd, and Tewatia and Banerjee (1993) and Kalita *et al.* (1994) in garden pea.

Singh and Singh (1980) worked on tomato and reported significant correlation in positive and negative direction between yield and its contributing characters. Bhagchandani and Choudhury (1980) also reported correlation and path analysis in carrot.

2.6. Genetic divergence

The importance of genetic diversity in breeding for high yield has long been recognised. The use of multivariate analysis (Mahalanobis's D^2 statistic) has well been demonstrated for choosing the parents for hybridization programme. Multivariate analysis by means of Mahalanobis's D^2 statistic and canonical analysis are powerful tools in quantifying the degree of divergence between biological populations and to assess the relative contribution of different components to the total divergence both at inter and intra cluster levels.

The present study aims at analysing the genetic divergence of 41 genotypes of egg plant in the years 1991-92 and 1992-93. For this purpose, altogether 21 characters from among vegetative growth, reproductive growth and susceptibility components towards shoot and fruit borer attack were taken for analysis. The study of genetic divergence under different environmental conditions would help to identify "stable diverse genotypes" grouped in stable clusters. Genotypes included in the stable clusters with a high order of divergence will be expected to provide best breeding material.

Eighteen genotypes of okra were evaluated for genetic divergence in respect of 16 vegetative and productive characters. The 18 genotypes fell into 5 clusters. Cluster 1 with 7 genotypes was the largest followed by cluster III with 6 genotypes. Cluster II and IV had two genotypes each, while cluster V had only one. For selecting genetically divergent parent for hybridization, fruit characters should be given due consideration (Abul Vahab *et al.,* 1994).

According to Hazra *et al.* (1993) there was no close correspondence between geographical distribution and genetic divergence in cowpea (*Vigna unguiculata* (L) Walp.) genotypes belonging to 3 cultigroups, *unguiculata, biflora* and *sesquipedalis*.

Mehra and Peter (1980) reported that based on D^2 values 27 genotypes of Chilli (*Capsicum annuum* Linn) were clustered into 9 gene constellations. NP-46, Jwala, G_3, AC-46 and AC-56 were close to each other. The fruit yield/pl contributed maximum towards the genetic divergence. The canonical variate analysis and metroglyphs confirmed the genetic group as obtained through Mahalanobis D^2 statistic. In another investigation, Sundaram *et al.* (1980) observed no relationship between genetic and geographic diversity in 50 varieties of chilli (*Capsicum frutescens*). The number of branches and number of fruits/pl were the chief contributors towards genetic divergence.

In tomato, Singh and Singh (1980) studied the components of genetic divergence for yield viz. days to flower, number of fruit, fruit size, number of locules/ft, days to maturity, number of fruits/bunch, primary branches/ pl and plant length, in 30 varieties. The maximum divergence was contributed by the number of fruits/bunch, followed by fruit size and number of primary branches/pl. The 30 varieties were grouped in 8 clusters. The clustering pattern showed that genetic divergence was not parallel in geographical distribution.

Generally, the clustering pattern of varieties revealed that geographical diversity was not always related to genetic diversity as observed by Mehndiratta and Singh (1971) and Mital *et al.* (1975) in several crops and Sachan and Sharma (1971) in tomato.

2.7. Chemical Control

A synopsis of chemical control of the key pest (*L. orbonalis*) of brinjal experimented is furnished in the Table 2 highlighting the name of the pesticides, dosage, efficacy and the author(s).

2.8. Heterosis in brinjal

2.8.1. Vegetative characters

Plant height at first flowering :

According to Venkataramani (1946), F_1 hybrids were taller than the taller parent and also gave higher yield. Singh *et al.* (1978) recorded positive heterosis of 0.7 to 23.7% over better parent for plant height. But Patil and Shinde (1984) reported that plant height was negatively associated with heterosis for yield.

Plant height at first harvesting :

Mandal *et al.* (1994) reported a positive heterosis over the better parent expressed by the hybrids from crosses : PPC × 17B (53%), PPC × MK (46.42%) and MK × PPL (7.56%). The heterosis for plant height at first

Table 2. Chemical control of shoot and fruit borer

Name of pesticide and combinations	*Dosage and formulation*	*Efficacy*	*Author (s)*
DDT Endrine	0.1% dust 0.08% Powder	fair	Banerjee and Basu (1955)
DDT	0.1% WP	highest	Srinivasan and Gowder (1959)
Sevin	50% WP	good	Thevasagayam and Canagasingham (1961)
Carbaryl (Sevin)	0.2% WP	effective	David (1964)
Dylox (Dipterex)	0.1% WP		David (1963) Jotwani and Swarup (1963)
Endrin	0.02%	fair	Lal and Ahmed (1965)
BHC Lindane + DDT or Carbaryl	5% dust 0.05% " 0.025% "	fair	Srivastava and Khare (1968)
Dichlorovos or Endosulfan	0.05% spray	safer control	Deshmukh and Udean (1972)
Endrine Carbaryl Gama BHC Dimethoate	0.02% 0.25% - -	fair	Lal (1973)
Parathion	0.04 %	better	Roy *et al.* (1973)
Diazinone	2-2.5 kg/h	better than disulfaton and phorate	Satpathy (1973)
Diazinone/Disul fatan + Carbaryl or Endosulfan	2.5 kg/h granule + 0.15% spray	for season long protection	
Carbaryl	0.25% granule	best	Gahukar and
Carbaryl + DDT or Endrine	0.25% (2 : 1) 0.05% dust.	 good	Bagal (1976)
Carbaryl	1 kg a.i/ha	best	Krishnaiah *et al.* (1976)

Name of pesticide and combinations	*Dosage and formulation*	*Efficacy*	*Author (s)*
Carbaryl Phosphamidon Carbaryl + Phosphamidon	0.1% 0.4% 0.05% 0.2%	best	Nair and Nair (1976)
Endosulfan or Phosphamidon	0.05% spray	effective	Sinha (1976)
Trichlorphan Chlorfevinphos	0.05% 0.05%	best on shoot best on fruits	Nawala and Sonone (1977)
Phorate / Aldicarb. + Carbaryl / Quinalphos	1kg. Gra. 0.2 / 0.05%	 effective	Mote (1978)
Carbofuran	6 kg/h granule	successfully control	Nath and Chakraborty(1978)
Lindane and mixture.	-	superior	Gera and Gupta(1979)
Diazinon, Carbaryl and Parathion mixs.		"	
Endosulfan	0.07%	better.	Shah (1979)
Diphel (a prep, of *Bacillus thuringiensis* var *Kurstaki*) + Insecticides	 sublethal dose	superior than insecticides alone.	Baskaran and Kumar (1980)
Fenvalerate (Sumicidin 20 EC.) Permethrin. (Permethrin 20 EC.)	0.1kg/h, EC. 0.1kg/ha., EC.	effective	Mohan *et al.*(1980)
Fenvalerate Cypermethrin	30 g a.i./ha.. 15 g a.i./ha..	highly effective	Tewari *et al.* (1984)
Fenvalerate	0.01% spray	good	Datar and Ashtaputra (1984)
Fenvalerate and Permethrin Cypermethrin Deltamethrin	0.015% 0.03% 0.002%	15 days persistance 10 days " 7 days "	Awasthi (1985)
Fenvalerate and Permethrin Deltamethrin Endosulfan	0.25 kg a.i. / ha 0.05 kg/h 0.75 kg a.i./h	superior control	Yein (1985)

Name of pesticide and combinations	*Dosage and formulation*	*Efficacy*	*Author (s)*
Cypermethrin	0.015% spray	best	Khaire *et al.*(1986)
Deltamethrin Permethrin Cypermethrin Methomyl Quinalphos Endosulfan	-	best control.	Mohan and Prasad (1986).
Triflumuron + Fenobucarb	0.0325 % 0.025 %	most effective	Srinivas *et al.* (1986)
Carbofuran + Cypermethrin	50 kg a.i/ha 0.006 %	economic control of all major pests	Power *et al.* (1987)
Flucythrinate Methamidophos Benfuracarb	0.008% 0.15% 0.02%	effective	More *et al.* (1987)
Quinalphos	-	good	Sangma *et al.*(1988)
Quinalphos	0.05%	best	Sontakke *et al.* (1990)
Cypermethrin + Carbaryl	0.01%	most effective	Agnihotri *el at.* (1990)
Endosulfan	-	superior	Islam and Quiniones (1990)
Endosulfan	25 ULV	better	Bothera and Dethe (1991)
Deltamethrin	0.005%	most effective	Thanki and Patel (1991)
Thiodicarb + Monocrotophos	0.15% 0.04%	most effective	Dhamdhere and Sharma (1991)
Cypermethrin	30 g a.i. /ha. spray	best	Srinivasan and Krishnamoorthy (1992)
Cypermethrin	55 g a.i. / ha	best	Umapathy and Baskaran (1991)

harvesting in brinjal had also been reported by Dharmegowda *et al.* (1979), Patil and Shinde (1984) and some other workers.

Number of primary branches :

According to Mandal *et al.* (1994) offsprings of the crosses 17B × PPL and PPC × 17B showed significant positive heterosis over better parent, while the other crosses showed significant negative heterosis except BD-16 × MK which had non-significant value (0.56%). This result conforms that of Singh *et al.* (1978) Singh (1980), Balamohan *et al.* (1983) and Patil and Shinde (1984).

Number of secondary branches :

According to Mandal (1989), the extent of heterosis for number of secondary branches/plant ranged from. - 44.75% (NIL × 17B) to 307.71% (PPC × 17B) over their respective mean parents and it ranged from - 164.00% (17B × MK) to 205.22% (PPC × 17B) over better parent. These views did agree with the observation made by Patil and Shinde (1984).

Number of days to flower :

Crosses with negative values were considered desirable which in turn gave an early yield. Significant negative heterosis over better parent suggested mostly non-additive gene action (Mandal *et al.*, 1994). This view did agree with Patil and Shinde (1984).

Number of days taken from transplanting to picking :

There was no early ripening of brinjal fruits among the fruits (Venkatarammani, 1946). Studies on *per se* performance and degree of heterosis carried out in eleven important characters of brinjal reveals the fact that mean of hybrid was higher than those of the parents over all the characters except days to first flowering as well as picking (Chadha *et al.,* 1990).

2.8.2. Reproductive characters

Length of fruits :

Dahiya *et al.* (1987) made crosses between 10 female forms and 4 male testers. Hybrids showed significant positive heterosis over the superior parent and best parent for fruit length, weight, number, yield and total sugar content.

Mandal *et al.* (1994) recorded maximum positive heterosis (51.57%) in 17B × PPL followed by MK × PPL (30.33%). The significant positive heterosis over better parent might be due to over-dominance which supported the results found by Singh (1980), Balamohan *et al.* (1983) and Patil and Shinde (1984).

Maximum circumference of fruit :

According to Mandal *et al.* (1994) negative heterosis of 2.23% was recorded for this relation in the cross between PPC × MK followed by 17B × MK (- 3.49%). Heterosis with respect to equatorial diameter was reported by concilio and sanguinate (1982). Significant negative heterosis over better parent indicated the presence of incomplete dominance contradicting the inference of Patil and Shinde (1984) who described that the phenomenon was due to over-dominance.

Number of fruits/plant :

The best hybrids with heterosis for yield and number of fruits/pl and total sugar content were Ludhiana Local Long × PH-4. and Ludhiana Local Long × PPL. This was recorded by Dahiya *et al.* (1987).

Randhawa and Sukhija (1973) also observed heterosis over better parents for this character in the crosses employed. Thakur *et al.* (1968) reported heterosis for number of fruits/plant upto 34.06%. Mandal *et al.* (1994) reported a significant positive heterosis over better parents for this character in nine hybrids out of 10. Maximum heterosis over better parent was observed in case of the cross BD-21 × BD-16 (96.49%) followed by NIL × 17B (92.36%). These views were also in agreement with the findings of several other workers and most of them had opined that the heterobeltiosis occurred in number of fruits/pl was due to over dominance.

Weight of fruit :

According to Mandal *et al.* (1994), hybrids obtained from majority of the crosses usually showed negative heterosis for weight of fruits. Only three crosses, namely, 17B × PPL (29.35%), PPC × BD-21 (15.54%) and PPC × MK (4.22%) showed positive heterosis. The result was not so encouraging as compared to the findings of Singh (1980) who recorded comparatively higher level of heterosis for this trait.

Yield/plant :

Experiments conducted mostly in Japan and India have shown distinct manifestation of heterosis in egg plant (*Solanum melongena* L.). Nagai and Kida (1926) were probably the first to observe hybrid vigour in crosses among some Japanese varieties. Kakizaki (1931) noted that the highest-yielding F_1 hybrids gave 14.8% increased yield.

According to Daskaloff (1937) the average increase in yield for all crosses in Bulgaria ranged from 21.7 to 27.65%. The hybrids ripended earlier, and crosses that showed promise for economic utilization possessed greater viability of seeds and general resistance to unfavourable environmental conditions, and to shedding of flowers in particular. In a later work, Daskaloff (1937) reported increased yield ranging between 10 and 44% in crosses with exotic varieties.

Venkataramani (1946) reported that the F_1 hybrids were taller than the taller parent and also gave increased yield. Pal and Singh (1946, 1949) noted that hybrids in brinjal showed 48.8 to 56.6% increased yield over the better parent.

In another cross the F_1 hybrids exceeded the mean yield of the parents owing to the production of higher number of fruits than to the increase in fruit size (Odland and Noll, 1948).

Goto (1952) recorded marked increase in yield in the F_1 generation of a series of crosses between the Japanese varieties. Peter and Singh (1973), Singh *et al.* (1978), Cheah *et al.* (1981) Viswanathan (1973) and Sindle *et al.* (1977) also reported hybrid vigour in brinjal.

According to Dharmegowda *et al.* (1979), PPC × Arka Kusumaker exhibited highest heterosis with regard to yield/pl to the extent of 94.64% which was recommended for commercial exploitation.

Ten quantitative and two qualitative characters were evaluated in crosses involving six lines and four testers by Balamohan *et al.* (1983). A total of 22 crosses exhibited heterosis for yield. SM-19 × SM-2 was the highest yielding. Heterosis for yield in this cross was attributed to increase in number of branches, fruit length and number of fruits. Similar observation with respect to yield/pl was also observed by several workers (Ram *et al.*, 1981; Concilio *et al.*, 1983; Nualsri *et al.*, 1986; Gopinath *et al.*, 1986).

On the basis of observations heterosis and combining ability for five yield components in 45 F_1, hybrids from a 10 × 10 half-diallel of egg plant, Kandasamy *et al.* (1983) reported highest yielding hybrids were Pusa Purple Long × Punjab Bahar; Pusa Purple Long × S-373 and Annamalai × S-96.

Significant heterobeltiosis was exhibited by different F_1's ranging from 16.25 (17B × BR-112) to 136.82% (PPC × 17B). The maximum increase over better parent in the cross PPC × 17B might also be due to heavy bearing in PPC (Mandal *et al.*, 1994).

2.8.3. Susceptibility components

The hybrids obtained from BR-103 × White Long and from BR-112 × Aushey had shown significant heterobeltiosis with respect to yield components and shoot and fruit borer (*Leucinodes orbonalis*) resistance (Dhankhar *et al.*, 1983).