Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(3): 181-185
Received: 16-03-2017
Accepted: 17-04-2017

SK Dhaka
Department of Horticulture, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan), India

RA Kaushik
Department of Horticulture, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan), India

Laxman Jat
Department of Horticulture, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan), India

Ramavtar Choudhary
Department of Horticulture, S.K.N. Agriculture University, Jobner (Rajasthan) India

Correspondence
SK Dhaka
Department of Horticulture, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan), India

Heterosis Breeding in Eggplant: A Review

SK Dhaka, RA Kaushik, Laxman Jat and Ramavtar Choudhary

Abstract
Eggplant, originated from India, is the most important crop among solanaceous vegetables of the world. The improvement work was concentrated in several organizations with the objective to develop high yielding varieties which are resistant to biotic and abiotic stresses. During recent past, hybrids in vegetables have become very popular and bringing huge returns to the farmers. At national and state level, approximately 30 hybrids have been identified and released by SAU's, ICAR's and private seed companies. These hybrids have high yield potential, good adaptability and recommended for commercial cultivation in different agro-climatic conditions. This paper presents a holistic view of the heterosis breeding in India in terms of hybrid development and hybrid seed production.

Keywords: Heterosis, Eggplant, Hybrids, Variety

Introduction
Eggplant, brinjal or aubergine (*Solanum melongena* L.) is a very important common man's vegetable in India. Due to its versatility use in Indian food, brinjal is often described as the '*king of vegetables*'. The area under its cultivation is 6.80 lakh hectares with a production of 118 lakh tonnes contributing 8.4 per cent of total area and production (NHB, 2010) [36]. Brinjal was one of the first vegetable crops adopted by farmers as hybrids, which occupied more than 50 per cent area under F_1 hybrids in different parts of the country and is a significant source of income approximately 14 lakh small and marginal farmers.
In recent years, there has been increased preference among Indian farmers for cultivation of hybrid in vegetable crops. This has resulted in intense R&D activities by the Indian as well as multinational seed companies (Sidhu, 1998) [56]. Promising eggplant hybrids of public and private sectors have been enlisted in Table 1. Hybrid vegetables are well known in Japan, the Netherland, the USA and Canada, where the vegetable seed industry, in general, is well organized and highly developed, where more than 90 per cent of the total eggplant seed are of hybrid origin. The productivity of eggplant in India is very low (17.2 t/ha) as compared to 41.2 tonnes in the France, where the F_1 hybrid constitute most of the economical cultivars. The required goals of increasing productivity in the quickest possible time can be achieved only through heterosis breeding which is feasible in this crop (kakizaki, 1931) [25]. Hence, the present study was under taken with an objective of studying the extent of heterosis in different crosses and then utilization in future crop improvement programmes.

Importance of heterosis breeding
Eggplant continues to be a choice of breeders for exploitation of heterosis due to hardy nature of crop, comparatively large size of flowers and large number of seeds in a single act of pollination. Highly varied consumer acceptance from region to region also demands for development of a large number of high yielding F_1 hybrids. Exploitation of hybrid vigor has become a potential tool for improvement in brinjal (Pal and Singh 1949, Mishra 1961, Samandam 1962, Dhankar *et. al*. 1980, Chadha and Sidhu 1982) [39, 32, 50, 21, 14]. In India, several reports are available on hybrid vigor in brinjal. Pal and Singh (1949) [39] reported that hybrid in brinjal showed 48.8-56.6 per cent increased yields over the better parent. Mishra (1961) [32] also observed increased yields in brinjal hybrids. The cost of hybrid seed production is not high as compared to other vegetables and this can be further reduced by the use of male sterile lines.

Breeding objectives
Breeding activities in eggplant have been targeted at the development of high-yielding, early, better quality and disease resistant varieties. The color of the fruit and size and shape, the proportion of seeds to pulp, short cooking time and lower solanine levels are important traits in Assessing quality.

As brinjal is susceptible to several pests, and diseases such as wilt, *Phomopsis*, little leaf and root-knot nematodes and to insects such as shoot and fruit borer, jassids, epilachna beetle, etc. the development of pest resistant varieties is a major challenges. Plants are susceptible to both low and high temperature; therefore attempts are being made to develop chilling or frost- tolerant and heat-tolerant varieties (Singh and Kumar, 2005) [58].

Table 1: Hybrid Varieties: A good numbers of hybrid varieties have been developed and released at national and state level which is given below

S. No.	Name of the hybrid	Source
1	Arka Navneet, Arka Anand	IIHR
2	Azad Hybrid, Azad Kranti	CSAUAT
3	Brinjal Hybrid (BH-1), Brinjal Hybrid (BH-2), Brinjal Hybrid-2 (GBH-2), Krishna, Phule Harit	MPKV
4	Kashi Komal (IVBHL-54), Kashi Sandesh (VRBHR-1)	IIVR
5	Narendera Hybrid (Brinjal-1), Narendea Hybrid (Brinjal-6)	NDUAT
6	Neelima	KAU
7	Pant Brinjal (Hybrid-1)	GBPUA&T
8	Pusa Anmol, Pusa Hybrid-5, Pusa Hybrid-6, Pusa Hybrid-9	IARI
9	Swarna Shobha, Swarna Ajay	HARP
10	ABH-1, ABH-2, ARBH-201	Ankur Seeds
11	Manju	Syngenta
12	MHB-1, MHB-9, MHB-10 (Kalpataru), MHB-39	Mahyco

Specific breeding objectives in eggplant in Indian context are

a. Exploitation of heterosis for increasing productivity
b. Incorporation of resistance against insect pests including fruit and shoot borer
c. Breeding wilt and other disease resistance-host plant resistance
d. Development of cultivars of better quality and yield
e. Development of locally preferred cultivars which are distinct in appearance

Review of literature on the exploitation of heterosis for different characters in eggplant

The term heterosis was coined by Shull in 1914. Heterosis refers the superiority of F_1 in one or more characters over its parents obtained by crossing two genetically dissimilar individuals. Generally, the term hybrid vigor is used to denote heterosis in the dissimilar direction and the heterosis over mid parent, better parent and standard check (ruling variety/hybrids) is designated as heterosis, heterobeltiosis and standard heterosis respectively.

The phenomenon of heterosis or hybrid vigour in plant is well known today and breeders exploit it for higher production. The earliest recorded instances of artificial hybridization in eggplant were evidently those carried out by Bailey and Munson in the United States in 1889, however none of the hybrids exhibited heterosis but were intermediate between the parents (Bailey and Munson, 1892) [6]. The first positive report of heterosis in the eggplant came from Munson (1892) [34]. Subsequently, Halsted (1901) [23] reported that one of his cross was double the size of the parents and also yielded more. In the Philippines, Bayla (1918) [8] hybridized some local varieties and found that the hybrids were more vigorous, stronger and healthier than the respective parental lines. In Japan, Nagai and Kida (1926) [35] studied certain quantitative characteristics in the hybrids and found that heterosis was manifested in total yield and its traits. Tatesi (1927) [63] observed higher productivity in certain crosses between Japanese brinjal varieties. Kakizaki (1928) [26] reported the occurrence of remarkable hybrid vigour in the crosses with regard to seed weight, stem diameter and height in brinjal. Schmidt (1935) [51] in USSR observed that the character of earliness was dominant and even transgressive in certain eggplant crosses. Daskaloff (1941) [19] indicated the possibility of utilization of heterosis in commercial eggplant production in Germany.

Averjanova (1941) [2] from Bulgaria reported high yields from hybrid eggplants. Odland and Noll (1948) [37] experimented with sixteen hybrid types and recorded that in every case the hybrids out yielded their respective parents besides being early. Capinpin and Alviar (1949) [13] reported that hybrid seeds exhibited higher germination percentage, the hybrid plants were superior to the parental lines in early flowering and setting of fruit, greater number of fruits per plant, longer fruit, greater mean of equatorial diameter of the fruits and greater mean weight of the fruits, Daskalov (1955) [20] from Bulgaria reported high yields from hybrid eggplants.

In India the first attempt to hybridize eggplant appears to have been made by Rao in 1934, however, in the cross between two wide varieties, a high degree of partial sterility due to abortive pollen was observed. Venkataramani (1946) [66] reported that hybrid egg plants were taller, spread more, flowered earlier than the early parent and yielded more than either parent. In the same year, Pal and Singh (1946) [38] reported that majority of the hybrids exhibited heterosis with respect to seed germination, plant height, plant spread, number of branches, early flowering, number of fruits per plant, fruit size and fruit yield.

Singh and Kumar (1988) [57] observed the highest heterosis over better parent (162.5%) for fruit yield. Saha *et al* (1991) [49] reported that maximum heterobeltiosis for plant height and number of branches per plant was 26.4 and 48.45 per cent respectively. Hybrids of Pant Rituraj x Pusa Purple Long, Pant Rituraj x 7-3 and Pant Rituraj x Pusa Purple Cluster were considered the best performers by Chadha *et al* (1990) [15]. In general, the hybrids performed better than the parents with regard to vigour, vegetative growth and fruit yield also reported by Singh and Gopalakrishnan (2000) [50]. Das and Barua (2001) [17] also observed the majority of the crosses showed highly significant heterosis for yield and most of the yield attributing characters, similar observation were reported by Kaur *et al* (2001) [28, 29]. Chadha *et al* (2001) [16] reported the heterosis over the better parent ranged from 11.63 to 37.21 per cent for days to 50 per cent flowering, -25 to 8.33 per cent for branches per plant, -46.49 to 10.73 per cent for fruit length, -65.31 to 1.02 per cent for fruit diameter, and -42.30 to 70.34 per cent for marketable fruit yield per plant. Similarly, Patil *et al* (2001) [42] observed heterotic effects in the range of -80.13 to 121.94 per cent over mid-parent and better parent (BP) and showed merits for commercial exploitation due to fruit weight (150.27 g), length of fruit (13.22 cm), seed per

cent (9.57%) and placenta per cent (90.43%) along with yield of fruits (3.19 kg/plant).

According to Babu and Thirumurugan (2001) [3] observed a negatively significant heterosis over its better parent and showed the highest percentage heterosis for plant height, number of branches per plant, fruit length, number of fruits per plant, fruit weight and fruit yield per plant. On the other hand, Kaur *et al* (2001a) [28] reported that the degree of heterosis and heterobeltiosis in relation to total soluble sugar (TSS), phenols and glycoalkaloids, and fruit dry matter. Ashwani and Khandelwal (2003) [1] suggested that significant positive heterosis over better and mid-parents for fruit yield per plant and other attributes. The better and mid-parent heterosis ranged from 21.06 to 166.03 per cent and from 23.33 to 197.81 per cent, respectively. According to Mohanty and Prusti (2003) [33] Ravaiya emerged as the highest yielder, with a yield potential of 27.98 t/ha and a standard heterosis of 61.55 per cent. Bavage *et al* (2005) [7] observed the extent of heterosis over commercial control for plant height, days to 50 per cent flowering, percent fruit set, fruit length:diameter ratio, number of early fruits per plant and total yield per plant these findings are also supported by Panda *et al* (2005) [40]. The results of heterobeltiosis (-56.76 to 93.32%), useful heterosis (-18.85 to 190.77%) and standard heterosis (-39.98 to 118.64%) for fruit yield per plant over environment were also presented by Baig *et al* (2005) [4]. Better performance for fruit number per plant with lesser fruit borer resistance performed by Prabhu *et al* (2005) [43].

An analysis of hybrid vigour over better parent for fruit yield, yield components, quality and physiological characters revealed maximum expression of heterosis for total soluble sugars followed by total phenols, leaf area per plant and fruit yield per plant were proved by Suneetha and Kathiria (2006) [61, 62]. Similar results were obtained by Suneetha *et al* (2006) [61, 62] based on high yielding, relatively late and tall with greater plant spread and leaf area per plant, compared to their parents. The expression of heterosis was maximum over better parent for total soluble sugars, and for leaf area per plant over the control. Heterobeltiosis and standard heterosis more that 20 per cent were also recorded for the number of days to first picking, 100-seed weight and fruit yield per plant. Quamruzzaman *et al* (2006) [45] the estimates of better parent heterosis ranged from 3 to 90 per cent and the mid-parent heterosis ranged from 30 to 105 per cent. Kamalakkannan, *et al* (2007) [27] used the hybridization b/w the crosses White Brinjal x Annamalai, EP 378 x PLR 1 and Kunnam x Annamalai exhibited superior *per se* performance for fruit yield per plant and shoot and fruit borer (*Leucinodes orbonalis*) tolerance, with high standard heterosis for fruit yield per plant. Standard heterosis up 222.77 per cent was recorded by the cross White Brinjal x Annamalai for fruit yield per plant. Joshi *et al.* (2008) [24] observed best heterotic combinations over standard control for days to 50 per cent flowering, plant height, fruit length and diameter and showed highest economic heterosis for most yield attributing characters. Timmapur *et al* (2008) [64] suggested the possibility of the high heterosis, heterobeltiosis and standard heterosis for fruit length, fruit diameter, number of fruits per plant and marketable yield per plant.

Bhakta *et al*. (2009) [9] reported significant positive heterosis for fruit yield per plant. The heterobeltiosis and economic heterosis ranged from -37.35 to 26.86 per cent and -36.63 to 54.21 per cent, respectively. Bisht *et al*. (2009) [11] reaveled significant and positive hererosis over better parents and mid-parent in all the characters except for days to first flowering and days to first harvesting the negative heterosis is considered. According to Das *et al*. (2009) [18] most of the hybrids exhibited positive relative heterosis and heterobeltiosis for most of the characters. Fruit yield and its component traits based on *per se* performance and standard heterosis, three hybrids viz. White brinjal x Annamalai, white brinjal x PLR 1, Kunnam x Annamalai were found to be promising for heterosis breeding was confirmed by Shanmugapriya *et al* (2009) [53]. The results of high magnitude of heterosis (115.84%) for fruit yield per plant over better parent were presented by Sao and Mehta (2010). Dharwad *et al* (2011) [22] summarized the efforts to improve heterosis for yield and yield componants *viz*., number of branches per plant, fruit weight and number of fruits per plant. For fruit yield per plant significant standard heterosis over its parents also reported by Kumar *et al*. (2012) [59]. In the similar year by Ram and Singh observed the maximum positive heterosis (69.23%) over economic parent (Type-3). Singh *et al.* (2012) [59] reported significant heterosis over the better parent in HE-12 x Aruna for first fruit set, BR-112 x Aruna for fruit length and diameter, Pant Samrat x Punjab Neelam for number of fruits per plant, H-7 x Aruna for fruit weight and H-9 x S-16 for total yield per plant.

Bhushan and singh (2013) [10] obtained best heterotic combinations over standard check for days to 50 per cent flowering, plant height, fruit length and fruit diameter. Ten parents and their 60 hybrids were evaluated for yield and yield attributing characters. The results indicated that highest standard heterosis was obrerved (46.86%) for total fruit yield per plant (Biswas *et al*., 2013) [12].

Makani *et al.* (2013) [31] observed the appreciable heterosis over mid, better and standard parent for all the traits. Patel *et al*. (2013) [31] in a study recorded positive and significant heterosis for yield per plant over better parents (five crosses) and mid-parent (six crosses). The earliness, days to 50 per cent flowering with negative values of heterosis was considered to be better and desirable. With respect to yield and shoot borer infestation, the crosses EP-65 x Pusa Uttam and EP-5 x APAU Bagmathi exhibited maximum heterosis over best parent and highest negative heterobeltiosis respectively. The hybrid EP-65 x Pusa Uttam (-18.40%) showed highest significant and negative best parent heterosis for fruit borer infestation. Hence, this hybrid can be suggested for commercial cultivation (Praneetha *et al*., 2013) [44]. Conducted a study to find out the significant and standard heterosis for fruit yield in desirable direction by Shafeeq *et al*. (2013) [52].

Reddy and Patel (2014) [48] observed high heterosis response in most of the hybrids which supports the role of non-additive gene effects. The maximum heterosis for fruit yield per plant was observed 103.59 per cent and 245.26 per cent for number of fruits per cluster. Shinde *et al*. (2014) [54] measured the significant variation among the hybrids for all traits and recorded high levels of heterosis for days to 50 per cent flowering, plant height, number of primary branches, fruit length, average fruit weight, fruit diameter and yield per hectare. According to Venkata *et al*. (2014) [65] reported high heterosis response in most of the hybrids which supports the role of non-additive gene effects. The heterobeltiosis for Cercospora leaf spot field resistance significantly high in the hybrid, KS-7570 x KS-8822 (-66.41%). Indirect selection for traits such as, fruits per plant, fruit length, fruit diameter, branches per plant and disease resistance could be done in order to achieve higher yield through heterosis breeding in eggplant.

References

1. Ashwani RC, Khandelwal RC. Hybrid vigour in brinjal (*Solanum melongena* L.). Annals of Agri. Res. 2003; 24(4):833-837.
2. Averjanova OP. Intervarietal crossing in eggplant. Jaravigacija. 1941; 34:106-108.
3. Babu S, Thirumurugan T. Studies on heterosis effect in brinjal (*Solanum melongena* L.). Journal of Ecoto & Envi Moni. 2001; 11(3/4):259-262.
4. Baig KS, Patil VD, Patil PV. Heterosis for fruit yield and its components over environments in brinjal. *Annals of Plant Phy*. 2005; 19(2):212-216.
5. Bailey LH, Munson WM. Experience with egg plants. *New York* (Cornell) *Station Bulletin.* 1889; 26:9-20.
6. Bailey LH, Munson WM. Experiences with eggplants, New York (Cornell), *Station Bulletin.* 1892; 49:338-345.
7. Bavage MS, Madalageri MB, Mulge R. Hybrid performance in round fruited brinjal (*Solanum melongena* L.). *Karnataka J of Hort.* 2005; 1(4):95-97.
8. Bayla LH. Hybridization of eggplants. *Philippines Agril. Forestry.* 1918; 7:66-71.
9. Bhakta RS, Patel DU, Patel SJ, Patel NK, Kodappully VC. Hybrid vigour in eggplant (*Solanum melongena* L.). *Reserch on Crops*. 2009; 10(2):357-361.
10. Bhushan KB, Singh YV. Expression of heterosis for quantitative traits in brinjal (*Solanum melongena* L.). Pantnagar J of Res. 2013; 11(3):402-404.
11. Bisht GS, Singh M, Singh SK, Singh MC, Rai M. Heterosis Studies in brinjal (*Solanum melongena* L.). *Vegetable Sci.* 2009; 36(2):217-219.
12. Biswas L, Mehta N, Ansari SF. Hybrid Vigour Studies in Brinjal (*Solanum melongena* L.). *Global J of Sci Frontier Res Agri and Vete.* 2013; 13(9):320-325.
13. Capinpin JM, Alviar MA. Heterosis in eggplant. *Philippines Agril. Forestry*. 1949; 33:126-141.
14. Chadha ML, Sidhu S. Studies on hybrid vigour in brinjal (*Solanum melongena* L.). Indian J of Hort. 1982; 39:233-238.
15. Chadha ML, Joshi AK, Ghai TR. Heterosis breeding in brinjal. Indian J of Hort. 1990; 47(4):417-423.
16. Chadha S, Singh B, Kumar J. Heterosis in brinjal. *Karnataka J of Agrl Sci.* 2001; 14(4):1130-1133.
17. Das G, Barua NS. Heterosis and combining ability for yield and its components in brinjal. *Annals of Agrl Res.* 2001; 22(3):399-403.
18. Das S, Manual AB, Hazra P. Study of heterosis in brinjal (*Solanum melongena* L.) for yield attributing traits. Journal of Crop and Weed. 2009; 5(2):25-30.
19. Daskaloff CH. The study of heterosis in the eggplant (*Solanum melongena* L.) and the possibility of its practical utilization. *Forschungsdienst.* 1941 12:617-618.
20. Daskalov H. Some achievements of Bulgarian horticulture. *Agrobiologija*. 1955; 4:291-298.
21. Dhankhar BS, Mehrotra N, Singh K. Heterosis in relation to yield components and shoot and fruit borer (*Leucinodes orbonalis* Gn.) in brinjal (*Solanum melongena* L.). *Genetica Agraria*. 1980; 34:215-220.
22. Dharwad NA, Patil SA, Salimath PM. Heterosis and combining ability analysis for productivity traits in brinjal (*Solanum melongena* L.). Karnataka J of Agrl Sci. 2011; 24(5):622-625.
23. Halsted BD. Experiments in crossing eggplants. *New Jersey Agricultural Experiment* hybrid vigour in the brinjal and bittergourd. *The Indian J. Gene. Pl. Bree.* 1901; 6:19-33.
24. Joshi N, Singh YV, Bhushan KB. Heterosis for different quantitative traits in brinjal (*Solanum melongena* L.). *Pantnagar J. of Res.* 2008; 6(2):266-269.
25. Kakizaki Y. Hybrid vigour in eggplant and its practical utilization. Journal of Here. 1931; 21:253-258.
26. Kakizaki Y. Hybrid vigour in *Solanum melongena* L. (Japanese). *Agri. Hortic.* 1928; 3:371-380.
27. Kamalakkannan T, Karuppaiah P, Sekar K, Senthilkumar P. Line x tester analysis in brinjal for yield and shoot and fruit borer tolerance. Indian J. of Hort. 2007; 64(4):420-424.
28. Kaur J, Patel JA, Patel MJ, Bhanvadia AS, Acharya RR. Heterosis for fruit yield and its components in brinjal (*Solanum melongena* L.). *Capsicum & Egg. News.* 2001; 20:102-105.
29. Kaur J, Patel JA, Patel MJ, Patel MN, Patel AD, Bhanvadia AS. Superiority of brinjal hybrids for quality traits. *Capsicum & Egg. News*. 2001; 20:98-101.
30. Kumar SR, Arumugam T, Anandakumar CR, Balakrishnan S, Rajavel DS. Heterosis expression, interrelationship, direct and indirect effects of component characters on yield in intervarietal crosses of eggplant. African J. l of Biote. 2012; 12(45):6366-6375.
31. Makani AY, Patel AL, Bhatt MM, Patel PC. Heterosis for yield and its contributing attributes in brinjal (*Solanum melongena* L.). *The bioscan*. 2013; 8(4):1369-1371.
32. Mishra G. Indian J. Hort. 1961; 19:305-317.
33. Mohanty BK, Prusti AM. Response of brinjal hybrids in vertisols of Orissa. Orissa J. of Hort. 2003; 31(1):98-100.
34. Munson WM. Notes on eggplants, Maine Agriculture Experimental Station. *Annual Rep.* 1892, 76-89.
35. Nagai K, Kida M. An experiment with some crosses of eggplant. *Japanese J. Gene.* 1926; 4:10-30.
36. NHB. Indian Horticulture Database. National Horticulture Board. 2015, 5.
37. Odland ML, Noll CJ. Hybrid vigour and combining ability in eggplant. *Proceedings of the Ame. Soci. For Hort. Sci.* 1948; 51:417-422.
38. Pal BP, Singh HB. Studies in hybrid vigour II. Notes on the Manifestation of hybrid vigour in brinjal and bittergourd. Indian J. of Gen. and Pl. Bree. 1946; 6:19-33.
39. Pal BP, Singh HB. Exploitation of heterosis in brinjal. *Indian Fmg*. 1949; 10:378-380.
40. Panda B, Singh YV, Ram HH. Manifestation of heterosis for certain economic characters in round-fruited brinjal (*Solanum melongena* L.) under Tarai conditions of Uttaranchal, India. Journal of Appl. Hort. 2005; 7(2):121-123.
41. Patel JP, Singh U, Kashyap SP, Tiwari SK, Singh DK, Singh M. Hetrosis for productivity traits in brinjal (*Solanum melongena* L.). *Vegetable Sci.* 2013; 40(1):80-82.
42. Patil SD, Warade SD, Badgujar CD. Heterosis studies in brinjal (*Solanum melongena* L.). Journal of Soi. And Cro. 2001; 11(1):47-51.
43. Prabhu M, Natarajan S, Pugalendhi L. Studies on heterosis and mean performance in brinjal (*Solanum melongena* L.). *Vegetable Sci.* 2005; 32(1):86-87.
44. Praneetha S, Sarasvathy T, Veeraragavathatham D, Pugalendhi L. *Per se* performance and heterosis for shoot and fruit borer (*Leucinodes orbonalis* Gn) resistance and yield in brinjal (*Solanum melongena* L.). Electronic J. of Pl. Bree. 2013; 4(1):1061-1066.

45. Quamruzzaman AKM, Uddin MN, Rahman MM, Salam MA, Jamil MK. Genetic architecture of yield in eggplant (*Solanum melongena*). Pakistan J. of Scient and Ind. Res. 2006; 49(2):134-139.
46. Ram K, Singh P. Heterosis and inbreeding depression in relation to other genetic parameters in egg plant. *Asian J. of Bio Sci*. 2012; 7(2):163-168.
47. Rao TKB. Partial sterility in the first generation plants of crosses between wide varieties of common eggplant. *Curent Sci*. 1934; 2(8):258-286.
48. Reddy EEP, Patel AL. Heterosis studies for yield and yield attributing characters in brinjal (*Solanum melongena* L.). Scholarly J. of Agrl. Sci. 2014; 4(2):109-112.
49. Saha MG, Hossain AKMA, Hoque KR, Bhowmik A. Genetic analysis of plant height and number of branches in brinjal (*Solanum melongena* L.). Annals of Bangl. Agri. 1991; 1(2):91-97.
50. Sambandam CN. Heterosis in eggplant (*Solanum melongena* L.). *Economic Botany*. 1962; 16:71-76.
51. Schmidt MV. A contribution to breeding and seed production in peppers and eggplants. *Nikita State Botanical garden, Crimean Regional Experiment Station Vegetable Culture*, 105 (cf. Plant Breeding Abstract. 9: 403, 1939), 1935.
52. Shafeeq A, Hanchinal RR, Kolakar SS. Heterosis breeding in Brinjal. Inte. J. of Pl. Sci. 2013; 8(2):377-380.
53. Shanmugapriya P, Ramya K, Senthilkumar N. Studies on combining ability and heterosis for yield and growth parameters in brinjal (*Solanum melongena* L.). *Crop Imp.* 2009; 36(1):68-72.
54. Shinde KG, Bhalekar MN, Patil BT. Heterosis studies in brinjal (*Solanum melongena* L.). Journal of Agri. Res. and Tech. 2014; 39(1):136-138.
55. Shull GH. Duplicate genes for capsule form in *Bursabursa pastoris. Zeitschriftfuer Induktive Abstammungs-und Vererbungslehre*. 1914; 12:97-149.
56. Sidhu AS. Current Status of Vegetable Research in India.World Conference on Horticulture Research, Italy, Rome, 1998.
57. Singh B, Kumar N. Studies on hybrid vigour and combining ability in brinjal (*Solanum melongena* L.). *Veg. Sci.* 1988; 15(1):72-78.
58. Singh M, Kumar R. Genetic Resources, Chromosome Engineering and Crop Improvement Series. 2005; III1:10.
59. Singh K, Sidhu AS, Kumar A. Heterosis for fruit yield and its components in brinjal (*Solanum melongena* L.). J. of Hort. Sci. 2012; 7(2):142-144.
60. Singh PK, Gopalakrishnan TR. Hybrid vigour for yield and biotic stresses in brinjal. Hortl. J. 2000; 13(2):43-50.
61. Suneetha Y, Kathiria KB. Heterosis for yield, quality and physiological characters in late summer brinjal. *J. of Res. ANGRAU*. 2006; 34(4):18-24.
62. Suneetha Y, Kathiria KB, Kathiria PK, Srinivas T. Studies on heterosis for yield, quality and physiological characters in summer brinjal. *Crop Res.* 2006; 31(1):120-124.
63. Tatesi T. On the first generation hybrid of eggplants. *Central Bulle. On Hort.* Japan. 1927; 187:19-21.
64. Timmapur PH, Dharmatti PR, Patil RV, Kajjidoni ST, Naik K. Heterosis for yield in brinjal (*Solanum melongena* L.). Karnataka J. of Agrl. Sci. 2008; 21(3):476-478.
65. Venkata NB, Dubey AK, Tiwari PK, Dabbas MR. Line x Tester analysis for yield components and cercospora leaf spot resistance in brinjal (*Solanum melongena* L.). Elec. J. of Pl. Bree. 2014; 5(2):230-235.
66. Venkataramani KS. Breeding brinjals (*Solanum melongena*) in Madras. Hybrid vigour in brinjal. Proceedings of Academic Sci. Sec. 1946; 23:262-273.