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Performance of Parents and Hybrids for Growth and Yield Traits in Brinjal (*Solanum melongena* L.) under Salt Stress Condition

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ABSTRACT: The present study was carried out to know the performance of parents and their hybrids for different traits attributing to yield under salt stress condition in brinjal at Department of Vegetable Science, College of Horticulture, Bagalkot during 2020-21. Among the parents used for investigation G16, G14 and G27 were high yielding of 2.05, 1.82 and 1.75 kg per plant respectively and the hybrids G14 × G16 and G16 × G27 recorded highest estimated yield of 2.54 and 2.36 kg per plant, respectively in brinjal under salt stress (8dS/m NaCl) condition. The hybrid G14 × G16 was most promising for various traits which contribute to highest yield per plant under salt stress condition. Based on their performance under salt stress condition parents can be used for further breeding programme and hybrids could be exploited for cultivation under salt affected soils after assessment of yield stability and tolerance level under different salt sick regions. The successful breeding of brinjal genotypes and identification of hybrids that are high-yielding with resistance to salinity stress could be used to address food security and other related challenges in salt sick areas.

Keywords: F_1 hybrids, Mean performance, Salt tolerance and Yield.

INTRODUCTION

Brinjal (*Solanum melongena* L.) belongs to the family solanaceae and is commonly called by several names *viz.*, eggplant, aubergine, garden egg, baigan *etc.* India is the center of origin and diversity. It is a popular and principle fruit vegetable grown in India and other parts of tropical and subtropical regions with diploid chromosome number of 2n = 24 and belongs to the genus *Solanum*.

Brinjal is commonly known as poor man's meat due to its inherent high nutritive value, vitamin content, dietary fibers, free reducing sugars, anthocyanin, phenols, glycoalkaloids (solasodine) and amide proteins and hence plays vital role in nutritional security (Sarker *et al*., 2006; Mariola *et al*., 2013). The fruits of eggplant are widely used in various culinary preparations and well known for its medicinal properties as an excellent remedy for liver complaints and diabetic patients (Hedges and Lister 2007; Tiwari *et al*., 2009).

Estimates show that over 7.0 million hectares of land in India is highly saline (Anon, 2020). Presence of salts in soil make soil water unavailable to plant and hence effects adversely on plants overall physiology. This reduces crop productivity drastically. Salinity is one of the major problems which our farmers are facing and it needs an immediate attention to solve this problem.

Among the major constraints in crop production plant growth is greatly affected by abiotic stresses such as drought, salinity and temperature. Plants respond and adapt to these stresses in order to survive and complete life cycle. These abiotic stresses are severe limiting factors of plant growth and crop production. These abiotic stresses induce various biochemical and physiological responses in plants to acquire stress tolerance. The deleterious effects of salinity on plant growth are attributed to a decrease in osmotic potential of the growing medium, specific ion toxicity and nutrient deficiency (Hadimani, 2022; Talwar, 2020).

Salt stress-induced reduction of growth was greater in *Solanum melongena* than in *S. insanum*. The photosynthetic activity decreased in both species, except for substomatal CO_2 concentration in *S. insanum*, although the photosynthetic pigments were not degraded in the presence of NaCl. The levels of Na^+ and Cl^- increased in roots and leaves with increasing NaCl doses, but leaf K^+ concentrations were maintained, indicating a relative stress tolerance in the two accessions, which also did not seem to be a remarkable degree of salt-induced oxidative stress. The results suggest that the higher salt tolerance of *S. insanum* mostly lies in its ability to accumulate higher concentrations of proline and to a lesser extent Na^+ and Cl^- (Brenes *et al.,* 2020).

Lack of appropriate hybrids for salt stress area and utility is another major problem in popularizing the hybrids of brinjal under salt stress condition. Thus, it impulse for the progress in crop improvement through plant breeding by a better understanding and an appropriate exploitation of heterosis, implying the gain in vigour on crossing two parents (Shull, 1914). These studies would be helpful for selecting suitable parents for hybrid development and to select potent transgressive segregants, which can be further evaluated for enhanced yield potential and salt tolerance. Hence, this study is under taken to know the performance of parents and hybrids for growth, biochemical, physiological and yield traits in brinjal (*solanum melongena* L.) under salt stress condition.

MATERIAL AND METHODS

The present study was undertaken at the fields of Vegetable Science unit of College of Horticulture, Bagalkot (Karnataka). Extent of salt tolerance and performance of genotypes under salt stress the five diverse parents *i.e* three tolerant and two susceptible were selected and sown in nursery during the month of June 2021 and transplanted to the grow bags during the month of July 2021 for attempting crosses in half diallel fashion. The selected genotypes from the screening experiment were used for making half diallel crosses. Emasculation was carried out in the evening one day prior to pollination with the help of forceps. Anthers were collected during the previous day of pollination, dried and pollens were collected from these anthers. The pollen was brushed on the receptive stigma at the time of anthesis. Crossed fruits were retained on the plant up to maturity stage. Later, the fruits were harvested and seeds were extracted by fermentation method.

The experiment was laid out in a factorial complete randomized block design in poly bags of size 18 inches in length and 18 inches in diameter for 10 F_1 hybrids along with their parents and commercial check (Shyamala) with two replications. Genotypes and salinity levels were considered as two factors for the screening. Among different salinity levels, the mean values obtained under 8dS/m NaCl were taken for statistical analysis. This screening was conducted during *Kharif* 2021. Other cultural operations were carried out as per recommended package of practices of the University of Horticultural Sciences, Bagalkote (Anon., 2018).

Approximately two tonnes of fine quality red soil has been procured from the Bagalkote having pH of 6.34 and salinity level of 0.98 dS/m which was free from stones and pebbles for which two tonnes of well decomposed farm yard manure has been added and filled in the black poly bags of 600 gauge having 18 × 18 inch dimension. Each polybag was filled with approximately eight-ten kilogram of soil mixture and watered copiously.

Sodium Chloride was used for preparation of different salinity level solution. Standards 2, 4, 6, 8 dS/m concentration were prepared by mixing the salts in the water. Whereas initial salinity of the pot culture media which was treated as control in this experiment. 58.44g of NaCl was dissolved in 1000ml of water which gives 1 molar, 10 ml from 1000ml salt solution was taken and made up the volume 1000ml which was 1EC. Each genotype was given 1000 ml of salts solution of different salinity at 3 days interval to create salt stress condition during the genotypes screening process. Normal portable water was applied as a control.

The mean of all the replications for each parents, hybrids and check for each of the characters was computed and used in analysis. Replication means of various characters of parents and hybrids were subjected to half diallel with factorial completely randomized design analysis (Kempthorne, 1957).

RESULT AND DISCUSSION

Plant height is an important parameter depicting the health of the plant. Plant height describes the soil nutrient status and nutrient uptake by the plant. Yield of any plant can be easily estimated from this parameter. Plant height at 90 DAT ranged from 20.50 cm (G25) to 38.00 cm (G14) among lines and 20.00 cm (G7 × G25) to 44.00 cm (G14 × G16) among crosses (Table 1). There was a 55.46 per cent reduction in the overall F_1's mean plant height at 90 DAT at 8dS/m NaCl compared to control as presented in the Table 2. Further, the parents, G16, G14 and G27 and the crosses G14 × G16 and G14 × G27 were least affected by salinity, indicating the superiority of parents and crosses in terms of plant height at 8dS/m NaCl. Salinity reduced the plant height as high level of salinity imposes the osmotic and ionic stresses on the plants which adversely effect morphological and physiological characters of the plant. High concentration of salt affects the plant height by modifying their morphological, anatomical and physiological traits (Muscolo *et al*., 2003) and also decreases the level of carbohydrates and growth hormones, that leads to the inhibition of the growth (Mazher *et al.,* 2007). With increase in salinity there was a decrease in the development of the xylem flow that may also restrict the growth in plant height. The results were in line with Ayub *et al.* (2020); Talwar (2020); Javeed *et al.* (2018) in brinjal, and Hadimani (2022) in tomato, who reported that plant height was negatively associated with the salinity levels.

Root biomass is an important parameter for brinjal plant to determine its potential of survival against salinity stress. In the present study, root biomass at 90 DAT ranged from 8.85 (G7 × G14) to 12.55 g/plant (G14 × G16) among crosses and 7.90 (G7) to 11.55 g/plant (G16) among lines (Table 1). There was a 30.03 per cent reduction in the overall F_1's mean root biomass at 90 DAT at 8dS/m NaCl compared to control as indicated in the Table 2. There was a gradual decrease in the root biomass with increase in salt concentration due to osmotic effect on plant root, toxicity effects of accumulated ions in plant tissue and the specific effect of constituent ions or combination of all these under higher salt stress (Bernstein, 1962; Allison, 1964). The reduction in root development may be due to toxic effects of NaCl as well as unbalanced nutrient uptake by the plants (Datta *et al.*, 2010). The present results were in line with Javeed *et al*. (2018); Emad *et al*. (2016); Mustafa *et al.* (2016); Talwar (2020) in brinjal.

Root length is an important parameter for brinjal plant to determine its potential of survival against salinity stress and deeper root length may the avoid salinity stress. Root length at 90 DAT ranged from 18.80 cm (G7 × G25) to 32.25 cm (G14 × G16) among crosses and 16.30 cm (G25) to 28.35 cm (G16) among lines (Table 1). There was a 38.34 per cent reduction in the overall F_1's mean root length at 90 DAT at 8dS/m NaCl compared to control as presented in the Table 1. It was noticeable that, there was a decrease in root length under salt stress condition. It may be because of limited cell growth owing to low water potential in the external environment, nutritional imbalance and ion toxicity. Reduction of root length might be due to reduced plant metabolic activity leading to poor plant growth. Similar trend with respect to root development under salt stress was reported by some researchers like Talwar (2020); Javeed *et al.* (2018) in brinjal.

Number of fruits per plant describes the plants ability of reproduction i.e. fruit and flower production. Number of fruits per plant varied significantly among the genotypes which ranged from 4.30 (G7 × G25) to 35.00 (G14 × G16) among crosses and 4.50 (G7) to 30.60 (G16) among lines (Table 1). There was a 66.77 per cent reduction in the overall F_1's mean number of fruits per plant under 8 dS/m NaCl compared to control as indicated in the Table 2. Number of fruits per plant were decreased while brinjal plant was exposed to high salinity level. With the increase in salinity, plant becomes fluffy in nature due to storage of water and other metabolites in leave to tackle the salinity stress and all the pressure of the plant shifts to improving the growth characters like plant height, leaf area and canopy width. Similarly, Mustafa *et al.* (2016) observed that, number of fruit per plant was reduced in brinjal due to reduced metabolic activities and reduced photosynthesis rate. Similar results were reported by Navarro *et al.* (2010) in chilli. Fruit length and fruit diameter determines the actual size of the brinjal fruit. In case of round fruited eggplant, more will be the fruit width as compared to long fruited brinjals and both are also determines the actual health of fruits and secondary metabolites taken by the plant. Significant differences was noticed among genotypes for fruit length and it was varied from 6.80 (G25 × G27) to 10.20 cm (G7 × G14) and 6.40 (G25) to 10.75 cm (G7) among crosses and lines respectively (Table 1). There was a 9.35 per cent reduction in the overall F_1's mean fruit length under 8 dS/m NaCl compared to control as presented in the Table 2. Fruit width ranged from 6.80 (G7 × G27) to 16.10 cm (G16 × G27) among crosses and 7.20 (G7) to 16.55 cm (G27) among lines (Table 1). There was a 33.08 per cent reduction in the overall F_1's mean fruit width under 8 dS/m NaCl compared to control as indicated in the Table 2. Similar results were found by Javeed *et al.* (2018), Selvakumar and Thamizhiniyan (2011) in brinjal. Average fruit weight varied significantly among the genotypes which ranged from 43.69 (G25 × G14) to 72.35 g (G14 × G16) among crosses and 40.75 (G25) to 67.12 g (G16) among lines (Table 1). There was a 12.78 per cent reduction in the overall F_1's mean average fruit weight under 8 dS/m NaCl compared to control as indicated in the Table 2. the results in line with report of Talwar (2020) and Ghaemi *et al.* (2016) in brinjal. Fruit yield is an important parameter of the plant. Adaptation of any genotype or plant depends upon its yield potential. Success or failure of any genotype depends upon its yield potentiality. Yield per plant also determines the genotype potential for fruit yield characteristics. Parents and hybrids differed significantly among themselves for fruit yield per plant which ranged from 0.19 (G7 × G25) to 2.54 kg (G14 × G16) among crosses and 0.20 (G25) to 2.05 kg (G16) among lines (Table 1). There was a 72.45 per cent reduction in the overall F_1's mean fruit yield per plant under 8 dS/m NaCl compared to control as indicated in the Table 2. In the present study observed that the application of saline water decreased total yield per plant due to its effect on osmotic potential and consequent reduction of water absorption by the plant and water flow towards fruits and also salinity affects fruit yield by disturbing water balance, creating an imbalance in plant nutrition and affecting plant physiological and biochemical processes.

Table 1: ***Per se*** **performance of crosses and parents for growth and yield parameters in brinjal under salinity stress induced by 8 dS/m NaCl under grow bags.**

Sr. No.	Genotypes	Plant height (cm)	Root biomass (g/plant)	Root length (cm)	Fruit length (cm)	Fruit width (cm)	Number of fruits per plant	Average fruit weight (g)	Yield per plant (kg)
	Crosses	90DAT	90DAT	90DAT					
1.	G7 × G25	20.00	8.95	18.80	10.10	6.90	4.30	43.86	0.19
2.	G7 × G14	24.00	8.85	20.00	10.20	7.00	12.40	57.62	0.71
3.	G7 × G16	29.00	9.95	19.75	9.80	7.10	14.50	57.01	0.83
4.	G7 × G27	31.00	9.30	20.75	10.10	6.80	13.60	44.00	0.60
5.	G25 × G14	28.00	9.25	20.95	7.40	10.25	13.50	43.69	0.59
6.	G25 × G16	27.00	10.65	20.20	7.85	9.50	12.00	60.94	0.73
7.	G25 × G27	26.00	9.40	20.45	6.80	10.15	12.80	60.22	0.77
8.	G14 × G16	44.00	12.55	32.25	9.00	15.85	35.00	72.35	2.54
9.	G14 × G27	23.50	9.70	22.55	7.40	14.55	12.60	59.70	0.75
10.	G16 × G27	42.00	11.85	31.50	8.55	16.10	33.80	69.80	2.36
	Lines								
11.	G7	22.00	7.90	18.75	10.75	7.20	4.50	46.19	0.21
12.	G14	38.00	11.10	26.20	8.15	15.65	29.10	62.40	1.82
13.	G16	37.50	11.55	28.35	8.40	15.65	30.60	67.12	2.05
14.	G25	20.50	9.35	16.30	6.40	9.90	4.80	40.75	0.20
15.	G27	37.50	11.20	25.90	8.25	16.55	27.25	64.21	1.75
16.	CC	40.00	11.45	26.50	7.95	15.10	29.70	66.20	1.97
	SEm±	1.11	0.21	1.01	0.31	0.28	0.74	1.81	0.08
	CD at 5%	3.34	0.64	3.04	0.93	0.86	2.24	5.46	0.23
	CD at 1%	4.62	0.88	4.21	1.28	1.19	3.09	7.55	0.32

G7- Udupi Special, G14- Mariyarikulam, G16- K12D10-36-3, G25- CBB-50, G27- Upparahatti Local, CC - Commercial Check (Shyamala), DAT- Days after transplanting

Table 2: Comparative overall mean performance of F_1 hybrids of brinjal under salinity stress induced by 8 dS/m NaCl under grow bags.

Characters	Non-Stress (control)	Salt stress (8 dS/m)	Changes in mean value under stress condition compared to non-stress condition	Change in per cent mean under salt stress conditions compared to non-stress condition
Plant Height at 90 DAT (cm)	66.12	29.45	-36.67	-55.46
Root biomass at 90 DAT (g)	14.35	10.04	-4.31	-30.03
Root length at 90 DAT (cm)	36.85	22.72	-14.13	-38.34
Fruit length (cm)	9.62	8.72	-0.90	-9.35
Fruit width (cm)	15.57	10.42	-5.15	-33.08
Number of fruits per plant	49.50	16.45	-33.05	-66.77
Average fruit weight(g)	65.26	56.92	-8.34	-12.78
Yield per plant (Kg)	3.63	1.00	-2.63	-72.45

DAT – Days after transplanting,

Results are in accordance with Talwar (2020); Ghaemi *et al.* (2016) in brinjal, Pengfei *et al.* (2017); Zhang *et al.* (2017); Juan *et al.* (2005); Singh *et al.* (2004); Hadimani (2022) in tomato, Hussein *et al.* (2012); Akhtar *et al.* (2017) in chilli.

CONCLUSION

The parents G16, G14 and G27 were good performing for all characters taken under study, in this perspective they could be exploited further in different breeding programmes for development of salt tolerant hybrids. The promising hybrids G14 × G16 and G16 × G27 can be further subjected to selection to isolate desirable hybrids in brinjal for salt tolerance.

FUTURE SCOPE

The crosses G14 × G16 and G16 × G27 were the superior hybrids selected for yield under salt stress condition (8 dS/m). These crosses can be further assessed for their yield stability to confirm their potentiality and also their adaptability to different salt affected areas before exploiting them on commercial scale as a salt tolerant hybrids. The parents G16, G14 and G27 are produced good yield per plant and they can be used in identifying superior new heterotic combinations under salt stress condition.

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Conflict of Interest. None.

REFERENCES

Akhtar, A. H., Ahmad, F., Kharal, M. A., Khalid, I., Latif, M. and Jamshaid, M. U. (2017). Screening of Pepper (*Capsicum annuum* L.) Genotypes Against Salinity Stress. *J. Environ. Agricul. Sci., 11*, 51-58.

Allison, L. E. (1964). Salinity in relation to irrigation. *Adv. Agron., 16*, 139-180.

Anonymous (2018). *Intigrated Horticultural Crops Management* (Kannada). University of Horticultural Sciences, Bagalkot, pp. 65-72.

Anonymous (2020). Annual Report of Central Soil Salinity Research Institute (CSSRI), Karnal.

Ayub, Q., Mehmood, A., Hayat, U., Shahzad, Q. and Ahmad, S. (2020). Effect of salinity on physiological and biochemical attributes of different Brinjal (*Solanum melongena* L.) cultivars. *Pure Appl. Biol., 9*(4), 2190-2198.

Bernstein, L. (1962). Salt affected soils and plant. *Arid Zone Res., 18*, 139-174.

Brenes, M., Solana, A., Boscaiu, M., Fita, A., Vicente, O., Calatayud, A., Prohens, J. and Plazas, M. (2020). Article physiological and biochemical responses to salt stress in cultivated eggplant (*Solanum melongena* L.) and in *S. insanum* L., a close wild relative. *Agronomy*, *10*, 651.

Datta, J. K., Nag, S., Banerjee, A. and Mondal, N. K. (2010). Impact of salt stress on five varieties of wheat (*Triticum aestivum* L.) cultivars under laboratory condition. USA.

Emad, Y. B., Jaradat, S., Al-Kofahi, S., Ahmed, A. Al-Hammouri and Alkhatib, R. (2016). Growth, water relation and physiological responses of three eggplant cultivars under different salinity levels, *Jordan J. Bio. Sci., 9*(2), 123-130.

Ghaemi, A. A., Golabi, H. M., Ali, M. F. (2016). Interaction effects of water salinity and hydroponic growth medium on eggplant yield, water-use efficiency and evapotranspiration. *Int. Soil Water Cons. Res., 4*, 99-107.

Hadimani, A. (2022). Genome-wide association mapping for salinity tolerance and heterosis in tomato (*Solanum lycopersicum* L.). *Ph.D. Thesis*, Univ., of Horti. Sci. Bagalkot.

Hedges, L. J. and Lister, C. E. (2007). Nutritional attributes of spinach, silver beet and eggplant. *Crop Food Res. Confidential* Rep. No. 1928.

Hussein, M. M., Faham, S. Y. and Alva, A. K. (2012). Pepper plants growth, yield, photosynthetic pigments, and total phenols as affected by foliar application of potassium under different salinity irrigation water. *Agric. Sci., 3*, 241-48.

Javeed, Z., Ahmed, M., Mehdi, S. M., Riaz, U., Sardar, A., Ehsan, M., Saleem, A., Anum, W., Zulqadar, S. A. and Ahmed, Z. (2018). Screening of brinjal (*Solanum melongena* L.) genotypes against salinity. *Indian J. Hortic., 3*, 25-32.

Juan, M., Rivero, R. M., Romero, L. and Ruiz, J. M. (2005). Evaluation of some nutritional and biochemical indicators in selecting salt-resistant tomato cultivars. *Environ. Experim. Bot., 54*, 193-201.

Kempthorne, O. (1957). An introduction of genetics statistics. John Wiley and Sons, New York, USA. pp. 458–471.

Mariola, P, Isabel, A, Santiago, V, Maria, H, Pietro, G, Francisco, J. H. and Jaime, P. (2013). Breeding for chlorogenic acid content in eggplant: interest and prospects. *Not. Bot. Horti. Agrobo*., *41*(1), 26-35.

Mazher, A. M. A., Quesni, E. M. F. and Farahat, M. M., 2007, Responses of ornamental and woody trees to salinity. *World J. Agric. Sci., 3*, 386-395.

Muscolo, A., Panuccio, M. R. and Sidari, M. (2003). Effects of salinity on growth, carbohydrate metabolism and nutritive properties of kikuyu grass (*Pennisetum clandestinum* Hochst). *Pl. Sci., 30*, 1103-1110.

Mustafa, Z, Ayyub, C. M., Amjad, M. and Ahmad, R. (2016). Morphological responses of eggplant (*Solanum melongena* L.) to salinity stress. *Transylvanian Rev., 10*, 24-34.

Navarro, J. M., Garrido, C., Flores, P. and Martínez, V. (2010). Effect of salinity on yield and fruit quality of pepper grown in perlite. *Spanish J. Agric. Res., 8*, 142-150.

Pengfei, Z. Masateru, S. and Yanyan, D. (2017). Effects of salinity stress at different growth stages on tomato growth, yield and water use efficiency. *Comm. Soil Sci. Plant Analysis 5*, 35-42.

Sarker, R. H., Yesmin, S. and Hoque, M. I. (2006). Multiple shoot formation in eggplant (*Solanum melongena* L.). *Plant Tissue Cult. Biotech*., *16*, 53–61.

Selvakumar, G. and Thamizhiniyan, P. (2011). Effect of the *Arbuscular Mycorrhizal* (am) fungus *glomus intraradices* on the growth and yield of chilli (*Capsicum annuum* L.) under salinity stress. *World Appl. Sci. J., 14*, 1209-14.

Shull, G. H. (1914). Duplicate genes for capsule form in bursa-pastoris. *Zeitschr. f. indukt. Abstamm. U. Vererb*., *12*, 97-149.

Singh, A. K., Pan, R. S., Rai, M. and Krishna Prasad, V. S. R. (2004). Heterosis for yield and its contributing attributes in brinjal (*Solanum melongena* L.). *Veg. Sci*., *31*, 146-148.

Talwar, D. (2020). Identification and characterization of salt tolerant genotypes and salt tolerant gene in brinjal (*Solanum melongena* L.). *Ph.D. Thesis*, Punjab, Agric. Univ., Ludhiana.

Tiwari, A., Rajesh, S. J., Piyush, T. and Nayak, S. (2009). Phytochemical investigations of crown of *Solanum melongena* L. fruit. *Int. J. Phytomed*., *1*, 9-11.

Zhang, C., Zheng, E. and Zhang, Z. (2017). Evaluation of high yield cultivation and regulated deficit irrigation system of soyabean based on grey relation projection model. *Water Saving Irrigation*, *6*, 38-45.

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