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Evaluation of brinjal genotypes under various levels of salinity

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Abstract
Accumulation of excess salt in the root zone resulting in the partial/complete loss of soil productivity is a worldwide phenomenon. The problems of soil salinity are most wide spread in the arid and semi arid region but salt affected soil also occurs extensively in sub-humid & humid climates, particularly in the coastal regions where the ingress of sea water through estuaries and rivers and through ground water causes large scale salinization. The present study aimed to evaluate the effect of salinity on seed germination, seedling characters and to find out the genetic salt tolerance or resistance cultivars during germination and seedling growth. In this study, germination percentage, seedling length, root length, shoot length, vigour index, salt tolerant index were assayed at three different salinity levels *viz*., 25mM NaCl, 50mM NaCl and 100mM NaCl and compared with control (0mM NaCl). The germination percentage and seedling growth were significantly reduced under high saline condition. The seedling length, root length, shoot length were also significantly reduced under saline stress situation. Among the 25 genotypes, IC136296, IC136041, IC136096 and IC136461 were found highly tolerant to saline condition which could be used as rootstock for produce saline tolerant grafting as well as developing saline tolerant/resistant hybrids.

Keywords: Brinjal, salinity, germination, vigour index, salt tolerant index

Introduction

Vegetables are playing a major role in human nutrition. Among the vegetable brinjal are one of the most important vegetable crops all over the world. Recently salinity is one of the major abiotic stresses that reduce plant growth and their productivity which is also affects every aspect of vegetable crop development including their morphology, physiological function and yield (Colla *et al*., 2010) [4]. It consistently has the greatest impact in reducing the area of cultivated land, often due to inappropriate irrigation techniques. To increase productivity, there is a need to produce salt-tolerant crops, which can grow successfully on salt-affected lands. The improvement of salinity tolerance or resistance of vegetables via breeding programs has been limited due to its genetic and physiological complexity (Flowers, 2004) [7]. One of the most effective ways to overcome salinity problems is the introduction of salt tolerant varieties/hybrids. Keeping these points in view, the present research was undertaken to investigate the response of brinjal genotypes to increase salinity levels during the germination and seedling emergence.

Materials and methods

The present investigation was conducted in the Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore Tamil Nadu, during the period 2016. In this study 25 genotypes of brinjal were collected from NBPGR, New Delhi which are used for this study. All the genotypes were evaluated under laboratory in FCRD design. A total number of 25 seeds in each genotype were used for germination study. The salinity level was created by using NaCl in three different concentration viz., T1: control - 0mM (only distilled water used where no NaCl added), T2: 25mM NaCl, T3: 50mM NaCl, and T4: 100mM NaCl. The seeds were soaked in distilled water and in respective concentration of sodium chloride solution for 10 minutes. Then the solution was drained and the soaked seeds were used to conduct the germination test in the laboratory under roll towel method. Each genotype with three different concentrations of NaCl and in distilled water were rolled separately and kept in germination chamber (±20 ^{0}C with RH 80-85 per cent). The whole set up was replicated twice. Once in three days the solution and distilled water was poured on the respective roll towel. On the 14th day of experiment, germination (%), shoot length (cm), root length (cm), seedling length (cm), vigour index and salt tolerant index (%)

were measured. The recorded data were analysed with two way analysis of variance using GLIM procedure of SAS (SAS, 1985) [11].

Result and discussion

Germination and seedling characters

The germination percentage, seedling length, shoot length and root length were significantly difference in all the treatments are given in Table 1. The germination percentage of brinjal was highly influenced by salt stress at higher concentration (100mM of NaCl). The mean of germination percentage ranged from 10.00 to 50.50% (100mM of NaCl) and from 80.00 to 97.00% (control). The highest germination percentage was observed in the genotype IC136296, IC136041, IC136461 and IC-136184 under 100mM NaCl treatment. This may be during germination under saline conditions, high osmotic pressure of saline water is created due to capillary rise leading to more salt density at seed depth than at lower soil profile which reduces time and rate of germination (Munns and Tester. 2008) [10]. Salt resistant seedling high salt concentration cause increased H_2O_2 content in both roots and leaves, hence salts should be removed to ensure proper growth and development (Maas. 1990) [9].

The mean of seedling length ranged from 3.25 to 13.30cm (100mM of NaCl) and from 9.20 to 29.10cm (control). The highest seedling length was observed in the genotype IC136461, IC137751, IC136451 and IC135997 under 100mM NaCl treatment. The seedling growth of salinized plant is limited predominantly by osmotic stress in species and genotypes having a low salt uptake rate. The similar results were obtained by Adams (1991) [1] in tomato.

The highest shoot and root length was observed in IC136461 followed by IC 137751 and under 100mM NaCl treatment. Root and shoot lengths are the important traits to be given consideration under any abiotic stress condition. In general a variety with longer root growth has ability to withstand the salinity. Both root and shoot lengths were reduced with increased NaCl concentration but roots were more damaged, with an increase in number of later roots and increases its thickness compared to shoots (Colla *et al*., 2010) [4]. Generally salinity affects plant growth by imposing both osmotic and ionic stresses (Castillo *et al*., 2007) [3]. Osmotic balance disturbed by high concentrations of NaCl which leads to physiological drought, thus decreasing plant water uptake and stomatal aperture, further leading to transpiration inhibition (Munns and Tester, 2008) [10]. In consequence, the plant is responding similarly to drought stress with regard to ionic stress, impairment is nutrient uptake and nutrient imbalance in salt stressed plants is widely reported in the literature (Flowers & Flowers, 2005) [6].

Vigour index and salt tolerant index

The Vigour index and Salt tolerant index were significantly difference in all the treatments are given in Table 2. The highest vigour index was observed in IC136461 followed by IC 137751 under 100mM NaCl treatment. All the genotype treated with distilled water showed improved vigour index as compared to NaCl treated seeds which were due to increased shoot length and root length of seedling than seeds treated with NaCl. They are much more vigourous than the NaCl seeds. The results are in confirmation with Hajer *et al*., 2006 [8]. The vigour index was significantly affected by salinity stress which caused a greater adverse effect. Similar findings were reported in tomato by Al-Harbi *et al*., 2008. Salt tolerant index is a more stable character and can be considered as a useful tool to screen abiotic stress tolerance genotype (Dutta and Bera, 2008) [5], among the treatments 100mM NaCl the genotype IC136296 showed significantly higher mean values followed by IC136041, IC136096 and IC13646. The lowest Salt tolerant index was observed in IC144515. This might be due to higher germination percentage with elevated root and shoot length leading to higher vigour index.

Table 1: Variation in germination and seedling characters of brinjal genotypes to different levels of salinity

Germplasm	Germination %				Seedling length (cm)				Root length (cm)				Shoot length (cm)			
	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
IC136461	93.50	88.50	69.00	43.50	29.10	25.30	19.50	13.30	16.70	15.80	11.50	9.15	12.80	9.50	8.00	4.15
IC137751	90.00	85.00	73.00	12.50	22.60	20.40	15.75	9.60	17.30	11.20	10.50	6.25	5.30	9.20	5.25	3.35
IC203589	90.50	65.50	50.00	13.50	14.60	13.45	11.15	6.65	10.20	9.40	8.00	4.30	4.40	4.05	3.15	2.35
IC144520	80.50	60.00	33.50	12.50	19.10	16.15	10.90	6.85	15.70	11.65	6.50	3.50	3.40	4.50	4.40	3.35
IC136237	95.50	60.00	23.50	14.50	15.30	13.50	12.20	5.10	11.30	8.50	7.50	3.50	4.00	5.00	4.70	1.60
IC136546	87.50	62.00	50.50	10.00	12.20	11.00	8.75	4.00	8.10	6.50	5.50	2.50	4.10	4.50	3.25	1.50
IC136041	96.00	90.50	85.00	50.50	9.80	8.50	7.70	6.65	5.70	5.50	4.50	4.65	4.10	3.00	3.20	2.00
IC135912	80.00	20.00	50.00	20.00	15.20	13.30	9.45	4.40	9.60	8.50	6.45	2.20	5.60	4.80	3.00	2.20
IC127023	90.00	81.00	62.50	14.50	14.50	12.50	11.00	8.75	8.50	7.50	5.00	5.75	6.00	5.00	6.00	3.00
IC136290	80.00	75.00	63.00	22.50	15.20	13.20	10.15	5.65	9.60	8.10	6.50	3.50	5.60	5.10	4.25	2.15
IC136251	90.00	73.00	60.00	17.00	10.30	9.35	7.85	4.00	6.30	5.35	5.50	2.00	4.00	4.00	2.35	2.00
IC136296	97.00	79.00	63.50	50.50	9.20	8.50	6.15	5.90	5.10	4.40	3.65	3.50	4.10	4.10	2.50	2.40
IC136451	91.50	78.50	23.50	12.00	18.20	16.05	11.05	9.60	13.60	9.05	7.05	6.60	4.60	7.00	4.00	3.00
IC136184	93.50	60.50	50.50	12.50	11.90	10.20	7.75	6.80	7.30	5.10	4.25	4.40	4.60	5.10	3.50	2.40
IC135997	86.50	73.50	61.00	46.50	19.20	17.50	13.35	9.20	14.60	12.50	9.35	6.20	4.60	5.00	4.00	3.00
IC090160	86.50	60.50	20.50	10.00	12.50	11.95	9.60	7.45	7.50	7.00	6.50	4.45	5.00	4.50	3.10	3.00
IC136096	96.00	88.50	69.00	49.50	14.20	13.50	10.70	9.50	8.90	8.50	6.70	5.50	5.30	5.00	4.00	4.00
IC136061	86.50	73.50	60.00	12.50	9.30	8.55	7.05	3.80	4.60	5.55	4.05	2.80	4.70	3.00	3.00	1.00
IC144515	89.00	69.50	50.50	10.00	13.65	11.75	9.60	3.50	8.50	6.25	5.30	2.50	5.15	5.50	4.30	1.00
IC089888	87.00	81.50	70.50	50.50	9.95	8.15	6.70	3.55	6.75	4.15	3.70	2.15	3.20	4.00	3.00	1.40
IC136090	90.50	80.00	40.00	12.50	13.40	12.15	10.75	5.05	7.25	6.90	6.25	3.95	6.15	5.25	4.50	1.10
IC135912	90.00	60.00	40.50	10.00	9.30	8.45	6.85	4.00	4.30	4.95	3.50	2.95	5.00	3.50	3.35	1.05
BSB-1	86.00	40.50	30.50	10.00	9.95	7.95	5.50	3.50	6.50	4.50	3.25	2.25	3.45	3.45	2.25	1.25
SRS-5965	84.00	50.50	35.50	12.00	10.80	9.60	8.15	3.25	6.40	5.30	4.15	1.75	4.40	4.30	4.00	1.50
12492	85.00	60.00	40.50	10.00	11.15	10.70	8.80	5.85	6.65	5.50	4.80	3.35	4.50	5.20	4.00	2.50
Mean	88.50	68.66	51.04	21.58	14.02	12.47	9.86	6.24	9.08	7.01	6.00	3.99	4.96	4.94	3.88	2.25
Factors	T	G	TxG		T	G	TxG		T	G	TxG		T	G	TxG	
SEd	1.39	3.48	6.70		0.25	0.63	1.26		0.16	0.40	0.80		0.93	0.23	0.46	
CD (0.05)	2.74	6.86	13.70		0.50	1.24	2.48		0.31	0.79	1.59		0.18	0.46	0.92	

Table 2: Variation in Vigour index and Salt tolerant index (%) of brinjal genotypes to different levels of salinity

Germplasm	Vigour index				Salt tolerant index (%)			
	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
IC136461	2720.85	2239.05	1345.50	578.55	100.00	82.29	49.45	21.26
IC137751	2034.00	1734.00	1149.75	120.00	100.00	85.25	56.53	5.90
IC203589	1321.30	880.98	557.50	89.78	100.00	66.67	42.19	6.79
IC144520	1537.55	969.00	365.15	85.63	100.00	63.02	23.75	5.57
IC136237	1461.15	810.00	286.70	73.95	100.00	55.44	19.62	5.06
IC136546	1067.50	682.00	441.88	40.00	100.00	63.89	41.39	3.75
IC136041	940.80	769.25	654.50	335.83	100.00	81.77	69.57	35.70
IC135912	1216.00	266.00	472.50	88.00	100.00	21.88	38.86	7.24
IC127023	1305.00	1012.50	687.50	126.88	100.00	77.59	52.68	9.72
IC136290	1216.00	990.00	639.45	127.13	100.00	81.41	52.59	10.45
IC136251	927.00	682.55	471.00	68.00	100.00	73.63	50.81	7.34
IC136296	791.20	671.50	390.53	297.95	100.00	84.87	49.36	37.66
IC136451	1665.30	1259.93	259.68	115.20	100.00	75.66	15.59	6.92
IC136184	1112.65	617.10	391.38	85.00	100.00	55.46	35.18	7.64
IC135997	1660.80	1286.25	814.35	427.80	100.00	77.45	49.03	25.76
IC090160	1081.25	722.98	196.80	74.50	100.00	66.86	18.20	6.89
IC136096	1377.40	1194.75	738.30	470.25	100.00	86.74	53.60	34.14
IC136061	804.45	628.43	423.00	47.50	100.00	78.12	52.58	5.90
IC144515	1214.85	816.63	484.80	35.00	100.00	67.22	39.91	2.88
IC089888	865.65	664.23	472.35	179.28	100.00	76.73	54.57	20.71
IC136090	1212.70	972.00	430.00	63.13	100.00	80.15	35.46	5.21
IC135912	837.00	507.00	277.43	40.00	100.00	60.57	33.15	4.78
BSB-1	855.70	321.98	167.75	35.00	100.00	37.63	19.60	4.09
SRS-5965	907.20	484.80	289.33	39.00	100.00	53.44	31.89	4.30
12492	947.75	642.00	356.40	58.50	100.00	67.74	37.60	6.17
Mean	1243.24	872.99	510.54	140.07	100.00	68.86	40.93	11.63
Factors	T	G	TxG		T	G	TxG	
SEd	19.19	47.97	95.94		1.40	3.52	7.03	
CD (0.05)	37.84	94.59	189.19		2.77	6.93	13.87	

Conclusion

In this study, concluded that the IC136296 followed by IC136041, IC136096 and IC136461 under 100mM NaCl treatment were found to be high saline tolerant genotype. The salt tolerant brinjal genotype identified for their field appraisal. Such a tolerant genotypes can be utilize for further breeding programs for developing superior variety/hybrids or used as rootstock for produce saline tolerant grafted seedling under saline condition.

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