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Evaluation of Cassava Genotypes or Salt Tolerance in Nursery

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The present investigation was carried out during 2017 at Tapioca and Castor Research Station, Tamil Nadu Agricultural University, Yethapur to evaluate the performance of cassava genotypes under salt stress in nursery period of 30 days. The experiment was initiated with 15 genotypes and three levels of salt treatments *viz*., 40, 80 and 120 mM NaCl and control also maintained without salt treatment. The results revealed that, cassava genotypes TCMS7 and Me681 performed well under highest salt concentration of 120 mM NaCl and recorded more root length of 7.67 cm and 4.6 cm and root volume of 1.78 cc and 1.67 cc respectively followed by Kungumarose and H226. Also they were maintained more shoot length of 19.5 cm (Me 681) and 11.45 cm (TCMS7) under 120 mM NaCl compared to other genotypes in the nursery period of 30 days. Me 681 and TCMS 7 also recoded minimum reduction in number of root production in salt imposed plants. From this experiment, Me 681, TCMS7, H226, Kungumarose and Sree Athulya were selected for further field level investigation.

Key words: Cassava, Salt stress, Root length, Root volume, Shoot length.

Cassava (*Manihot esculenta* Crantz.) is one of the major tuber crop cultivated in Tamil Nadu valued for its starch and sago. This is one of the most drought-tolerant crops which can be successfully cultivated on marginal soils and gives reasonable yield where many other crops do not grow well and hence it has earned the reputation as a “famine reserve crop.” In India, it is cultivated mainly in Kerala, Tamil Nadu, Karnataka and Andhra Pradesh. Kerala and Tamil Nadu account for about 80% of the total acreage of the crop in India. Cassava is the most widely grown root crop in the world and the tuberous roots are the principle source of calories for many of the world’s poorest people (Nweke *et al*., 2002; FAO, 2014). This crop is being cultivated in large scale in Salem, Namakkal, Erode, Cuddalore, Villupuram, Dharmapuri and Kanyakumari districts of Tamil Nadu.

Salinity stress adversely affects crop yield throughout the world reducing agricultural production, whether it is for subsistence or economic gains. At present, due to the varying climatic conditions and depletion of ground water, the concentration of salt in irrigation water is getting increased. During irrigation, salt deposition takes place in the soil resulting in unproductive condition (Church *et al*., 2013; Nunn, 2013). Salinization of groundwater is becoming an increasing problem in many parts of the cassava growing area in Tamil Nadu. There is a strong link between drought tolerance and cyanide concentrations (Ernesto *et al*., 2002), but there are no published studies on whether salinity-induced physiological drought also result in higher levels of cyanide, and possible threats to health and food security. Salinity is also known to affect the micronutrient concentration in plants (Gegios *et al*., 2010).

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The released varieties and farmers collections are low tuber and starch yielding and highly susceptible to salt stress. Evaluation of suitable salt-tolerant accession is necessary if cassava is to continue to expand its role as a staple crop in future. The salt tolerant cassava accessions will be highly useful for cultivation in parts of Salem, Namakkal and Erode districts of Tamil Nadu in the changing scenario. Hitherto no studies on salt tolerance of cassava in Tamil Nadu, hence, this work has been carried out to identify suitable cassava genotypes for salt tolerance with high tuber yield and starch content.

Material and Methods

The present investigation was carried out during 2017 at Tapioca and Castor Research Station, Tamil Nadu Agricutltural University, Yethapur to evaluate the performance of cassava genotypes under salt stress in nursery period of 30 days. The cement structures were established with the height of 0.3 m and width of 1.32 m for adding salt water. The experiment was initiated with 15 genotypes (CO 2, Thailand, Me 681, Sree Athulya, Burma, CO(TP)5, Kunguma rose, TCMS 9, YTP 1, Sree Vijaya, TCMS 6, Sree Jaya, TCMS 7, H226 and Rasi 20) and three levels of salt treatments *viz*., 40, 80 and 120 mM NaCl and control also maintained without salt treatment. Experiment was replicated twice in a Completely Randomized Design. Salt water treatments were imposed once in three days from day one of planting to 30 days after planting as per the method followed by Ros Gleadow *et al.* (2016). Structures were flushed weekly with water to prevent accumulation of salt in the soil. Recommended package of practices for cassava nursery was followed. Plants were uprooted on 30 DAP and number of roots, root volume, shoot length and root length were recorded in three plants in all replication, average was worked out and expressed in numbers, cubic centimeter and centimeter respectively.

Results and Discussion

Cassava setts were grown in three levels of salt treatment and also control was maintained without salt for 30 days duration of nursery period.

Table 1. Effect of salt stress on number of roots and root volume of cassava genotypes

Treatments	Control		40 mM NaCl		80 mM NaCl		120 mM NaCl	
Genotypes	No. of roots	Root volume (cc)	No. of roots	Root volume (cc)	No. of roots	Root volume (cc)	No. of roots	Root volume (cc)
CO2	8.00	1.00	3.00	0.50	2.33	0.17	2.67	0.33
Thailand	10.00	0.67	5.00	1.00	2.33	0.67	0.33	0.17
Me 681	11.33	0.67	11.00	0.77	10.67	0.90	10.67	1.67
Sree Athulya	4.67	1.67	3.33	1.33	6.33	0.67	2.00	0.20
Burma	8.33	0.33	2.33	0.50	4.00	0.67	2.33	0.33
CO(TP)5	3.67	1.33	1.33	0.33	0.33	0.17	0.33	0.47
Kunguma rose	9.67	1.17	9.67	1.50	6.73	0.83	4.7	0.53
TCMS 9	6.67	0.50	4.00	0.67	2.67	0.50	4.00	0.50
YTP 1	9.00	0.67	7.00	1.00	6.33	0.67	3.33	0.33
Sree Vijaya	8.33	0.83	7.00	0.83	3.33	0.50	3.00	0.50
TCMS 6	12.67	0.67	6.67	0.67	3.33	0.83	3.00	0.33
Sree Jaya	8.33	1.00	4.67	0.67	6.33	0.83	2.00	0.23
TCMS 7	10.00	1.00	9.70	1.17	6.83	1.67	5.33	1.78
H226	7.67	0.67	7.00	0.67	3.33	0.50	4.33	0.47
Rasi 20	2.33	0.60	2.33	0.50	0.00	0.00	0.00	0.00
Mean	8.04	0.85	5.60	0.81	4.32	0.64	3.20	0.52

	No. of roots			Root volume		
	T	V	T x V	T	V	T x V
SEd	0.51	1.00	1.99	0.18	0.36	0.72
CD (P=0.05)	1.02	1.98	NS	NS	0.70	NS

Irrespective of the genotypes, number of roots varied significantly in all the treatments. Among the genotypes, Me 681 and TCMS 7 were recorded significantly more number of roots (10.67 and 5.33 respectively) and root volume (1.78 and 1.67 cc respectively) in 120 mM NaCl treatment. Irrespective

Table 2. Effect of salt stress on shoot and root length of cassava genotypes

Treatments	Control		40 mM NaCl		80 mM NaCl		120 mM NaCl	
Genotypes	Shoot length (cm)	Root length (cm)	Shoot length (cm)	Root length (cm)	Shoot length (cm)	Root length (cm)	Shoot length (cm)	Root length (cm)
CO2	11.83	5.17	7.50	1.83	3.00	0.67	3.33	0.83
Thailand	12.00	4.17	11.33	2.17	11.00	2.17	1.67	0.50
Me 681	27.00	3.67	26.83	4.33	22.00	4.80	19.50	4.60
Sree Athulya	15.83	2.00	15.00	3.70	5.00	3.67	2.67	0.83
Burma	11.33	6.50	6.67	2.00	8.00	2.50	7.00	2.17
CO(TP)5	13.33	3.50	3.83	4.00	1.50	0.83	2.17	0.50
Kunguma rose	15.87	5.17	14.67	6.33	13.17	4.67	10.78	3.83
TCMS 9	17.83	5.50	13.33	2.83	7.50	2.50	8.33	2.33
YTP 1	19.00	3.83	13.50	4.00	13.33	4.50	10.33	3.83
Sree Vijaya	15.17	6.43	13.00	3.50	11.50	3.33	8.50	2.83
TCMS 6	17.50	6.00	14.50	6.17	11.67	5.33	9.50	3.17
Sree Jaya	17.17	3.33	16.00	2.33	15.00	3.33	10.50	1.50
TCMS 7	17.53	6.83	12.17	3.50	11.83	2.83	11.45	7.67
H226	17.83	3.50	17.17	3.33	13.00	2.50	10.90	4.67
Rasi 20	15.33	1.67	10.67	0.67	0.00	0.00	0.00	0.00
Mean	16.30	4.48	13.08	3.38	9.83	2.91	7.78	2.62

	Shoot length (cm)			Root length (cm)		
	T	V	T x V	T	V	T x V
SEd	0.67	1.30	2.61	0.39	0.75	1.51
CD (P=0.05)	1.33	2.58	5.16	0.77	1.49	NS

of the genotypes, number of roots was reduced at 120 mM NaCl whereas root volume was increased at higher concentration in Me 681 and TCMS 7. The present data was supported by Ros Gleadow *et al*. (2016).Kunguma rose (4.7), TCMS 9 (4.0), H226 (4.33) produced 4.7, 4.0 and 4.33 number of roots under 120mM NaCl respectively and they were on par with each other. H 226 maintains its root volume from control (0.67 cc) to 120 mM (0. 47 cc) NaCl with minimum reduction. CO 2, Sree Athulya, and Sree Jaya performed poorly under 120 mM NaCl treatment and they were on par with each other in recording number of roots and root volume. Rasi 20 produced 7.0 roots with 0.5 cc under 40 mM but it did not produce any roots under 80 and 120mM NaCl (Table 1).

Irrespective of the salt concentration, salt stress had positive effect on root length in the cassava genotypes of Me 681, Kungumarose, YTP1, Sree Vijaya, TCMS6 and H226 and they were on par with each other. This might be due to diversion of photosynthates to roots as adaptive mechanism for absorbing nutrients and water for further surveillance under salt stress. Among the genotypes, Me681 produced lengthy root in 120mM (4.60cm), TCMS6 in 80mM (5.33cm) and TCMS7 in 40mM (6.83cm) NaCl. In other hand, all the salt treatments significantly reduced the shoot length in all the genotypes. Already this was proven by Park and Back (2012). Among the genotypes, Me681 naturally produced high shoot length (27.0 cm) and minimum reduction was observed in 40 (26.83 cm) and 80mM (22.0 cm) salt treatments. Also in 120mM NaCl treatment, it recorded highest shoot length of 19.50cm followed by TCMS 7(11.45cm), Kungumarose (10.78 cm), H226 (10.70 cm). Chandrasekhar *et al*. (2011) stated that significant reduction was observed in shoot length when plants were grown under salt or heavy metal stress. When the plants exposed to salt stress it increases reactive oxygen species production which is harmful for the cell components and cell division was affected and shoot length reduced.

It is concluded that, cassava is sensitive to low to moderate concentrations of salt, particularly at early stages of development. Salt-tolerant varieties are necessary if cassava is to continue to expand its role as a staple crop in future. From this experiment, Me 681 and TCMS7 was identified as salt tolerant, H226 and Kungumarose as moderately tolerant and Sree Athulya as susceptible genotypes. Further,, these selected salt tolerant cassava genotypes can be used as donors for breeding programme.

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