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Germination Behaviour of Soybean Varieties under Different Salinity Stress

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Abstract

Salinity is one of the most widespread environmental stresses heavily on the crop affects fertility. In order to study the effect of salinity on germination and seedling growth of soybean varieties (BSS-2 and JS-335), an experiment was conducted under different salinity stress (Nacl and Na_2So_4) concentrations. The results showed that salinity stress caused by Nacl and Na_2So_4 reduced both germination and seedling growth of both varieties of soybean. JS-335 appeared more tolerant under different Nacl concentrations and more sensitive under different Na2So4 concentrations than BSS-2.

Keywords: Soybean, germination, seedling growth, salinity stress, tolerance

INTRODUCTION

Soil salinity is a major factor limiting plant productivity, affecting about 95 million hectares worldwide .The UNEP (United Nations Environment Program) estimates that 20% of the agricultural land and 50% of the cropland in the world is salt-stressed. Salinity in soil or water is one of the major stresses and especially in arid and semi arid regions, can severely limit crop production. Seed germination is defined as the emergence of the radicle through the seed coat. Salt stress negatively affected seed germination; either osmotically through reduced water absorption or ionically through the accumulation of Na^+ and Cl^- causing an imbalance in nutrient uptake and toxicity effect. Soybean is an important kharif pulse crop .In the present study the germinability of two varieties of soybean (BSS-2 and JS-335) with a view to understanding the germination percentage and early seedling growth under different salinity conditions has been compared.

MATERIALS AND METHODS

In order to study the effect of salinity on germination and seedling growth of soybean varieties (BSS-2 and JS-335) an experiment was conducted in sterilized petridishes of 9 cm. containing thin cotton pads, covered over by filter paper circles. Seeds of two varieties of soybean (BSS-2 and JS-335) of homogenous size were selected and surface sterilized with 2% solution of sodium hypochlorite (for 5 minutes) and then thoroughly washed with distilled water. Stresses of Nacl and Na_2So_4 were examined on germination in the concentration of 0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4 and 0.5 M solutions. Respective concentrations were used for soaking the seeds and germinating medium in all treatments except control where sterilized distilled water used. The seeds with visible emergence of radicles were taken as germinated and such seeds were scored every 24 hrs to 240 hrs. after soaking. Mean germination percentage was calculated on the basis of mean replicates. Length of radicles and hypocotyls were measured separately in cm. after 96 hours. Radicles and hypocotyls along with cotyledons were weighed on digital balance for fresh weights.

RESULT AND DISCUSSION

Stress caused by Nacl solution reduced all the germination percentage from 90% to 30% in case of BSS-2, from 85% to 20% in case of JS-335. Seeds of both the varieties showed germination only upto 0.3M concentration of Nacl solution (Table no.- 1.1) . Length and fresh weight of seedlings reduced gradually with increased Nacl concentration. JS-335 had maximum seedling length and fresh weight while BSS-2 had the minimum under different concentrations.

Table 1.1: Effect of different Nacl concentration on the germination and early seedling growth of soybean varieties (BSS-2 and JS-335)

Germination %

Treatments	BSS-2	JS-335
Control	90	85
0.05M	65	70
0.1M	70	90
0.15M	70	70
0.2M	45	60
0.25M	35	45
0.3M	30	20
0.4M	--	--
0.5M	--	--

Seedling length after 96hr. (in cm)

Treatments	BSS-2			JS-335		
	R	H	T	R	H	T
Control	4.041	5.492	9.533	5.751	6.525	12.276
0.05M	2.590	1.657	4.247	8.064	4.223	12.284
0.1M	2.423	1.869	4.474	4.696	1.904	6.600
0.15M	1.497	0.767	2.264	1.822	0.702	2.524
0.2M	0.783	1.170	1.953	1.193	0.736	1.929
0.25M	0.471	0.873	1.344	0.721	0.567	1.288
0.3M	0.248	0.767	1.015	1.933	0.618	2.551
0.4M	--	--	--	--	--	--
0.5M	--	--	--	--	--	--

Seedling fresh weight after 96hr. (in mg)

Treatments	BSS-2			JS-335		
	R	H	T	R	H	T
Control	558	3939	4497	613	4084	4697
0.05M	389	3160	3499	998	5504	6502
0.1M	187	3743	3930	517	3639	4157
0.15M	209	3373	3582	163	3489	3652
0.2M	72	3714	3786	119	2349	2468
0.25M	74	2905	2979	154	2749	2903
0.3M	74	2123	2197	245	2633	2878
0.4M	--	--	--	--	--	--
0.5M	--	--	--	--	--	--

Seedling length after 144 hr. (in cm)

Treatments	BSS-2			JS-335		
	R	H	T	R	H	T
Control	5.079	6.390	11.469	6.917	7.754	15.121
0.05M	2.795	2.540	5.335	8.186	2.656	10.842
0.1M	3.163	1.559	4.722	3.173	0.715	4.338
0.15M	0.577	0.374	0.951	1.544	0.540	2.537
0.2M	0.610	0.356	0.966	0.886	0.434	1.320
0.25M	0.359	0.326	0.685	0.573	0.298	0.871
0.3M	0.359	0.284	0.643	0.260	0.435	0.695
0.4M	--	--	--	--	--	--
0.5M	--	--	--	--	--	--

Seedling fresh weight after 144hr. (in mg)

Treatments	BSS-2			JS-335		
	R	**H**	**T**	**R**	**H**	**T**
Control	593	4283	4876	822	5023	5848
0.05M	345	3574	3919	780	3980	4760
0.1M	235	2797	3032	644	3897	4541
0.15M	74	2425	2499	329	3721	4050
0.2M	57	1552	1609	119	3355	3474
0.25M	51	1310	1361	78	3042	3120
0.3M	48	1171	1219	44	2785	2829
0.4M	--	--	--	--	--	--
0.5M	--	--	--	--	--	--

The stress caused by Na_2SO_4 solution (Table no.- 1.2) reduced the germination percentage from 90% to 15% in case of BSS-2, from 90% to 10% in case of JS-335.There is no germination above 0.4M in both the varieties. Seedling growth was observed upto 0.2M concentration in case of BSS-2 and upto 0.15M in case of JS-335. Length and fresh weight of seedlings reduced gradually with increase of concentration of Na_2So_4 in both the varieties. More severe effect was noticed in case of JS-335.

Table 1.2: Effect of different Na2So4 concentration on the germination and early seedling growth of soybean varieties (BSS-2 and JS-335)

Germination %

Treatments	BSS-2	JS-335
Control	90	90
0.05M	50	65
0.1M	65	75
0.15M	70	45
0.2M	50	30
0.25M	35	10
0.3M	15	10
0.4M	--	--
0.5M	--	--

Seedling length after 96hr. (in cm)

Treatments	BSS-2			JS-335		
	R	**H**	**T**	**R**	**H**	**T**
Control	4.114	5.477	9.591	5.731	6.091	11.822
0.05M	3.273	6.044	9.317	5.574	3.279	8.853
0.1M	0.843	1.552	2.395	1.430	0.831	2.261
0.15M	0.661	1.465	2.126	0.946	0.420	1.366
0.2M	0.252	0.549	0.801	0.555	0.388	0.943
0.25M	0.263	0.418	0.681	0.486	0.498	0.984
0.3M	--	--	--	0.126	0.340	0.466
0.4M	--	--	--	--	--	--
0.5M	--	--	--	--	--	--

Seedling fresh weight after 96hr. (in mg)

Treatments	BSS-2			JS-335		
	R	**H**	**T**	**R**	**H**	**T**
Control	541	3928	4469	595	4069	4664
0.05M	506	6051	6557	922	4143	5065
0.1M	145	3093	3238	195	3230	3425
0.15M	81	2886	2967	185	2851	3036
0.2M	53	2690	2743	110	2468	2578
0.25M	38	2300	2338	95	2208	2303
0.3M	--	--	--	73	688	761
0.4M	--	--	--	--	--	--
0.5M	--	--	--	--	--	--

Seedling length after 144 hr. (in cm)

Treatments	BSS-2			JS-335		
	R	**H**	**T**	**R**	**H**	**T**
Control	5.064	6.412	11.476	6.904	7.748	14.652
0.05M	2.486	1.806	4.292	6.341	4.322	10.663
0.1M	0.626	0.943	1.569	1.635	0.859	2.494
0.15M	0.367	0.273	0.640	0.400	0.397	0.797
0.2M	0.342	0.205	0.547	--	--	--
0.25M	--	--	--	--	--	--
0.3M	--	--	--	--	--	--
0.4M	--	--	--	--	--	--
0.5M	--	--	--	--	--	--

Seedling fresh weight after 144hr. (in mg)

Treatments	BSS-2			JS-335		
	R	**H**	**T**	**R**	**H**	**T**
Control	612	4271	4883	669	5044	5713
0.05M	135	2788	29233	359	6067	6426
0.1M	115	2068	2183	141	3170	3311
0.15M	82	2026	2108	114	2756	2835
0.2M	59	1991	2050	--	--	--
0.25M	--	--	--	--	--	--
0.3M	--	--	--	--	--	--
0.4M	--	--	--	--	--	--
0.5M	--	--	--	--	--	--

The stress caused by Nacl solution had severe effect on germination as well as early seedling growth of both varieties. In concentrations above 0.3M there was no germination of seeds in both the varieties. JS-335 appeared more tolerant as compared to BSS-2. BSS-2 indicated maximum salt sensitivity. Kole and Gupta (1982) have reported beneficial effect of lower concentration which was corroborated in the present finding in case of JS-335 at 0.05M after 96 hrs germination. In fact many workers (Khan, M. A. et al.1984; Mehta et al. 1985; Almansouri et al., 2001; Bajji et al. 2002; Al-Thabet et al. 2004; Jamil et al. 2006; Bybordi and Tabatabaei, 2009; Jeannette et al., 2002; Kandil et al. 2015) have found deleterious effect of Nacl on different plants.

The application of Na_2So_4 indicated most significant effect on JS-335 with complete inhibition of seedling growth above 0.15M concentration where as tolerance was maximum in BSS-2 which had seedling growth in 0.2M concentration after 144 hrs. In this context it may be noted that, by and large, stress be of Nacl or Na_2So_4 hit the elongation of radicle most as has been observed by Sarin (1961) , Romo et al. (1985), Delaney et al. (1986) and Pirzad et al. (2011). They have also obtained the adverse effect of the stress and also observed the differences in the magnitude with respect to chloride or sulphate ions. It is also assumed that in addition to toxic effects of certain ions, higher concentration of salt reduces the water potential in the medium which hinders water absorption by germinating seeds and thus reduces germination. It is assumed that germination rate and the final seed germination decrease with the decrease of the water movement into the seeds during imbibitions. Salinity stress can affect seed germination through osmotic effects .Salt induced inhibition of seed germination could be attributed to osmotic stress or to specific ion toxicity. Germination percentage also significantly decreased as the level of salinity of the medium increased These results are similar in line with Jeannetter et al. (2002).

CONCLUSIONS

Increasing salinity delayed the beginning and ending of germination and reduced final germination percentage, inhibiting germination completely above 0.3M salinity. Salinity stress caused by Nacl and Na_2So_4 reduced both germination and seedling growth in both the soybean varieties. JS-335 appeared more tolerant under different Nacl concentrations and more sensitive under different Na2So4 concentrations than BSS-2. Obviously, acceptable growth of plants in arid and semiarid lands which are under exposure of salinity stress is related to ability of seeds for best germination under unfavourable conditions, so necessity of evaluation of salt resistance soybean plant species are important at primary growth stage.

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