

Evaluation of Lettuce Genotypes for Salinity Tolerance



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Introduction

- Salinity of soil and irrigation water is a growing problem for agricultural production in the world.
- Lettuce (*Lactuca sativa* L.) is one of the most important salad vegetables and considered a relatively salt sensitive vegetable.
- One approach to enhance lettuce production in saline soils and water is to develop salt tolerant cultivars, which may be achieved by exploiting inter- and intraspecific variability.

Objective

- To screen lettuce germplasm and cultivars for their salinity tolerance.

Plant growth and treatment

Plant materials

After preliminary screening of 3800 germplasm accessions and cultivars, 174 lettuce varieties and germplasm accessions (54 butterhead, 39 crisphead, 34 romaine, 32 loose leaf, and 15 wild genotypes) were selected and screened for their tolerance to salinity.

Plant growth

Two trials, each with three replications, were conducted from November 18, 2014 to December 22, 2014 and December 18, 2014 to January 21, 2015, in a greenhouse located in Salinas, CA.

One week after seeding, uniform seedlings were transplanted into plastic pots (1 L) filled with sands. Plants were thinned to one plant per pot and watered every day with Hoagland nutrition solution (electrical conductivity or EC: 2.5 ds/m).

Treatment

Salinity stress was obtained by adding NaCl/CaCl₂ solution of 10/5 and then 20/10 mM in the nutrition solution for 2-d intervals at each concentration, and then by adding 30/15 mM NaCl/CaCl₂ (EC: 8.4 ds/m) for 4 weeks.

Measurements

Leaf chlorophyll index (SPAD) was measured on the two largest leaves from each plant. Shoot fresh and dry weight.

Statistical analysis

Treatment means were separated by Student's t test at the 0.05 level of probability using the JMP program (SAS Institute Inc., Cary, NC).



Table 1. Effects of salinity on fresh and dry weight, and chlorophyll index in butterhead lettuce

genotypes	fresh weight (FW, g)			dry weight (DW, mg)			DW/FW		SPAD		
	control	salt	%	control	salt		control	salt	control	salt	
PI 342515	2.5±0.37	2.2±0.39	-12	147±21	134±23	0.0583	0.0623	21.8±0.70	24.0±0.74		
PI 358020c	3.1±0.32	2.7±0.35	-12	177±17	207±26	0.0596	0.0763	16.6±0.90b	20.5±1.87a		
Morgana	2.7±0.43	2.4±0.42	-13	167±30	160±25	0.0654	0.0692	28.0±0.74	30.0±1.67		
Amerika	2.0±0.21	1.8±0.19	-14	115±11	113±12	0.0564	0.0646	22.0±0.84	24.7±0.93		
Nadine	2.0±0.29	1.6±0.23	-23	130±18	113±17	0.0580	0.0725	21.4±1.04	23.6±1.30		
PI 503605a	2.3±0.14	1.8±0.25	-24	142±9	122±17	0.0635	0.0682	18.2±3.33	20.6±1.89		
Borough Wonder	2.0±0.17	1.5±0.31	-25	134±13	102±21	0.0663	0.0688	16.9±0.48	18.7±0.81		
Campan	2.7±0.28a	2.0±0.17b	-25	160±18	132±12	0.0572	0.0649	23.2±1.02	24.5±0.67		
Evry	2.3±0.34	1.8±0.15	-26	134±18	123±18	0.0605	0.0691	19.7±0.46b	22.6±0.80a		
Canada Boston	1.9±0.11a	1.4±0.10b	-26	108±5	92±6	0.0546	0.0639	20.9±1.34	24.7±1.19		
Sitonia	2.0±0.15a	1.5±0.14b	-27	114±10	98±9	0.0568	0.0662	23.4±0.95	26.9±1.29		
Atlas Non-Bolting	3.1±0.20a	2.3±0.25b	-27	187±9	162±17	0.0597	0.0707	29.9±1.14b	35.1±0.85a		
PI 342448	1.4±0.18	1.0±0.17	-29	88±16	75±14	0.0677	0.0804	14.6±0.56b	17.2±0.83a		
Brauner Troztkopf	2.3±0.17a	1.6±0.16b	-30	158±28	113±12	0.0681	0.0699	17.5±0.43b	19.9±0.71a		
PI 503632	2.5±0.28	1.7±0.20	-30	147±19	127±14	0.0659	0.0739	18.3±0.44b	20.8±0.67a		
PI 358019a	3.4±0.37a	2.3±0.46b	-30	207±23	181±34	0.0612	0.0780	15.8±0.51b	19.9±1.61a		
Salad Bibb	1.6±0.03a	1.1±0.10b	-31	120±24	93±25	0.0747	0.0837	34.1±1.23	34.4±1.38		
North Pole	2.9±0.28a	2.0±0.16b	-32	180±18	138±12	0.0605	0.0707	18.3±1.20	19.4±0.60		
Margarita	2.8±0.16a	1.8±0.18b	-33	156±18	125±10	0.0665	0.0701	29.2±1.54	33.2±1.50		
Futura	3.3±0.17a	2.2±0.30b	-33	198±14	154±23	0.0597	0.0697	17.3±0.68	18.9±0.44		
Valore	2.9±0.26a	1.9±0.15b	-34	171±23	126±10	0.0633	0.0662	15.2±0.86b	19.1±0.94a		
Sandrina	3.5±0.15a	2.3±0.18b	-34	192±6a	152±11b	0.0557	0.0667	15.7±0.58b	18.9±0.59a		
Massilia	3.0±0.29a	2.0±0.31b	-34	175±19	134±21	0.0619	0.0669	25.7±0.78	28.6±1.12		
Bonanza	2.5±0.33a	1.7±0.20b	-34	169±21	117±14	0.0643	0.0704	32.8±0.41b	36.5±0.95a		
Sissy	2.7±0.11a	1.8±0.33b	-35	159±10	133±27	0.0602	0.0745	24.3±0.54b	31.3±1.32a		
May Queen	3.0±0.31a	1.9±0.33b	-35	180±20	138±28	0.0600	0.0734	15.7±0.33b	19.5±1.29a		
Nancy	1.9±0.17a	1.2±0.13b	-35	118±9	96±12	0.0585	0.0768	20.8±1.28	23.3±1.37		
Plenos	4.9±0.58a	3.0±0.29b	-38	251±35	197±20	0.0552	0.0658	18.1±0.59b	24.8±1.21a		
Raphaella	3.0±0.15a	1.9±0.25b	-39	163±9a	120±15b	0.0555	0.0648	29.0±0.69	30.7±2.39		
Vitus	3.5±0.43a	2.1±0.22b	-39	211±27a	141±15b	0.0637	0.0668	18.2±0.71	19.9±1.35		
Continuity	4.2±0.27a	2.5±0.16b	-40	233±18a	172±10b	0.0583	0.0683	25.0±0.77b	31.0±1.87a		
Devonshire Cream	2.4±0.20a	1.4±0.19b	-40	152±14a	104±14b	0.0667	0.0736	15.8±0.28a	18.6±0.71b		
Ewex	3.3±0.21a	2.0±0.19b	-41	210±26a	156±12b	0.0677	0.0778	17.8±0.81	19.5±0.80		
PI 503606	3.3±0.23a	1.9±0.16b	-41	187±14a	128±10b	0.0603	0.0662	15.8±1.90	16.0±0.45		
PI 342516	2.2±0.33a	1.4±0.25b	-41	155±14a	93±16b	0.0636	0.0685	19.9±0.86	19.9±1.14		
PI 289029	3.9±0.41a	2.3±0.17b	-42	221±25a	157±12b	0.0577	0.0682	15.3±0.79b	19.7±0.39a		
Burpee's Bibb	2.9±0.45a	2.2±0.29b	-42	215±27	147±18	0.0582	0.0660	34.8±0.91b	38.6±0.87a		
PI 289036c	3.8±0.19a	1.6±0.28b	-43	181±11a	119±21b	0.0656	0.0748	18.8±1.05	21.6±0.72		
Bourguignonne	3.9±0.40a	2.2±0.09b	-43	240±25a	149±7b	0.0594	0.0669	13.8±0.78b	17.2±0.99a		
PI 289025	2.8±0.16a	1.6±0.19b	-43	191±9a	119±14b	0.0672	0.0738	15.0±0.32a	17.4±0.40b		
Dark Green Boston	4.4±0.49a	2.5±0.37b	-44	257±27a	165±17b	0.0668	0.0724	31.8±5.32	26.9±1.87		
PI 289023a	3.2±0.24a	1.8±0.16b	-44	189±14a	129±12b	0.0590	0.0736	13.1±0.95b	18.2±1.70a		
Escort	3.2±0.15a	1.7±0.30b	-45	208±13a	135±24b	0.0672	0.0777	24.7±1.15b	28.2±0.79a		
Mignone Dark Green	3.6±0.43a	2.0±0.21b	-45	201±22a	141±16b	0.0590	0.0708	25.3±1.06	27.7±1.37		
PI 373915	3.2±0.26a	1.7±0.15b	-46	178±18a	119±10b	0.0590	0.0686	15.0±0.80b	18.4±0.99a		
Butter King	3.1±0.21a	1.6±0.20b	-48	180±12a	104±12b	0.0585	0.0661	21.4±0.81b	25.1±1.21a		
Red Boston	3.6±0.31a	1.9±0.32b	-48	225±23a	145±17b	0.0649	0.0760	16.1±0.46	17.9±0.80		
Burpeeana	4.1±0.52a	2.1±0.25b	-48	219±20a	145±21b	0.0561	0.0669	34.1±1.11b	39.9±1.53a		
Butter Crunch	4.3±0.20a	2.2±0.05b	-49	274±13a	173±4b	0.0635	0.0778	32.1±1.30	32.0±1.81		
PI 342453b	2.8±0.20a	1.4±0.13b	-49	168±12a	102±8b	0.0626	0.0717	18.1±1.25	19.7±1.07		
Tania (S50)	3.1±0.22a	1.6±0.19b	-49	180±13a	117±16b	0.0613	0.0729	24.8±0.78	22.0±2.29		
Bibb	4.3±0.47a	2.1±0.40b	-51	255±28a	139±26b	0.0604	0.0663	40.0±3.67	39.6±1.56		
Mayfair	2.5±0.08a	1.2±0.28b	-52	148±7a	83±17b	0.0596	0.0717	20.2±3.58	18.1±0.67		
PI 358015b	3.1±0.39a	1.5±0.15b	-54	179±23a	104±10b	0.0618	0.0718	18.7±0.84b	23.7±1.50a		
PI 373914	1.6±0.17a	0.7±0.07b	-54	115±19a	59±7b	0.0721	0.0791	11.5±0.68b	17.7±0.77a		
PI 289062	3.4±0.37a	1.4±0.14b	-58	189±22a	106±9b	0.0584	0.0746	15.4±0.48b	19.3±0.59a		



Table 4. Effects of salinity on fresh and dry weight, and chlorophyll index in wild lettuce

genotypes	fresh weight (FW, g)			dry weight (DW, mg)			DW/FW		SPAD		
	control	salt	%	control	salt		control	salt	control	salt	
PI 253468	2.1±0.19	1.7±0.20	-18	162±15	153±35	0.0732	0.0878	32.2±0.59	34.9±1.35		
PI 491108a	0.6±0.08	0.5±0.06	-27	63±9	52±7	0.1011	0.1132	36.5±0.70b	39.5±0.99a		
PI 202349	1.0±0.13	0.7±0.08	-33	113±14	78±9	0.1109	0.1089	28.5±1.65b	32.0±0.54a		
PI 491013	3.2±0.29a	2.0±0.14b	-37	224±17a	143±9b	0.0679	0.0707	29.0±1.24	31.1±1.54		
PI 251247	2.2±0.21a	1.3±0.15b	-39	151±14	109±13	0.0700	0.0816	27.0±0.50	29.8±2.27		
PI 142871a	1.7±0.20a	1.0±0.17b	-43	129±15	92±15	0.0814	0.0955	28.8±1.32	29.5±1.76		
PI 289015c	1.8±0.13a	1.0±0.05b	-44	127±6a	78±3b	0.0686	0.0768	22.9±0.91b	26.1±0.70a		
PI 491173	0.9±0.11a	0.5±0.05b	-44	71±8a	44±6b	0.0755	0.0856	25.4±0.72b	28.5±0.77a		
PI 250020	3.7±0.27a	2.1±0.18b	-44	264±20a	186±15b	0.0740	0.0897	25.0±0.88b	30.8±1.29a		
PI 289015a	2.0±0.21a	1.1±0.10b	-45	159±17a	81±8b	0.0756	0.0728	24.8±0.93	26.1±0.89		
PI 251246	3.2±0.24a	1.8±0.19b	-45	236±22a	151±14b	0.0714	0.0861	28.0±1.09b	31.2±0.40a		
PI 273579	3.9±0.30a	2.0±0.16b	-47	259±21a	173±14b	0.0696	0.0849	30.0±1.34	30.8±1.65		
PI 289015b	2.4±0.21a	1.2±0.08b	-48	194±11a	110±7b	0.0786	0.0885	23.8±0.36b	26.1±0.89a		
PI 187238c	3.9±0.28a	2.1±0.20b	-48	253±20a	148±16b	0.0675	0.0716	23.0±0.79b	26.7±1.26a		
PI 491154	1.3±0.12a	0.7±0.04b	-50	105±10a	61±4b	0.0848	0.0940	27.5±0.79b	30.9±0.92a		

