Salt tolerance in Ligustrum sinensis Lour. for urban green areas.

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Salt tolerance in *Ligustrum sinensis* Lour. for urban green areas

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INTRODUCTION

Salinity stress due to low quality water, salt-affected soils or the use of antifreeze solutions is one of the most serious problems for ornamental plant in urban green areas. Damages can be caused by the contact of salts with foliar or root tissues that induces diffused or local necroses and alteration of chlorophyll content or by an increase of the osmotic pressure. Differences between salt sensitive and tolerant plants are due to different abilities to prevent salts from reaching toxic levels in transpiring leaves (Chartzoulakis and Loupassaki, 1997; Roshandel and Flowers, 2009).

In towns, the areas most subjected to this problem are the sides of the roads and the road lanes. Therefore, salt tolerance of plants grown in these areas must be considered in landscaping design, parks, xeriscape, and public areas (Morales et al., 1998; Sanchez-Blanco et al., 2003; Devecchi and Remotti, 2004; Caser et al., 2010). Despite the potential ability of several ornamental shrubs to adapt to adverse conditions, only few species belonging to the genera *Pyracantha* L. and *Cotoneaster* Medik. are commonly used in public areas (Cassaniti et al., 2008) while poor information are currently available about other species. Thus, information about salt resistance in ornamentals are needed in order to select species suitable for urban environments. With the aim to select proper species, useful in landscape and revegetation projects, this study evaluated the tolerance of Ligustrum sinensis Lour. for its use in Mediterranean green areas.

MATERIALS AND METHODS

The experiments were carried out in the glasshouses at the Experimental Centre of Agricultural Faculty of University of Turin (Italy).

A trial to measure the resistance to salinity of *L. sinensis* was carried out employing six applications with different salt concentrations twice a month. The research protocol foresaw the use of a control (water) and two different concentrations (125 mM and 250 mM) of NaCl applied by immersion or perfusion. For each treatment five plants with two replicates were investigated, in a total of 120 plants per species.

Salts were applied about every two weeks and after each application the effects were evaluated. Colour variation by means of spectrophotometer CM-2600 Konica Minolta Sensing Inc. (Osaka, Japan) and visual evaluation, based on a scale of 6 classes (Table 1), were measured. SPAD values were calculated using Chlorophyll Meter SPAD-502 Konica Minolta Sensing Inc. (Osaka, Japan; Torres Neto et al., 2005) and leaf chlorophyll content was evaluated on 12 leaves by cutting, immersion in 10 ml of 100% methanol, homogenization for about 30 s using a Janke and Kunkel IKA ®-Labortechnik ULTRA-TURRAX T25 and finally measured using a double ray spectrophotometer Perkin-Elmer Lambda 15 UV/VIS Spectrophotometer (Massachusetts, USA) at the wavelengths of 650 nm and 665 nm.

All data were submitted to UNI-ANOVA (2X2 factorial arrangement) using the software SPSS Inc. (Chicago, Illinois) and means were separated applying REGW-F test ($P<0.05$).

RESULTS AND DISCUSSION

The selection of ornamental plants with high performance and harsh environmental tolerance is of interest in landscape horticulture, urban greenspace design, and xerogardening. For this, the aesthetic value of plants under stress conditions needs to be considered. *L. sinensis* may represent an interesting species for urban environments but limited information are available on its salt tolerance.

The UNI-ANOVA in Table 2 showed no statistical significance interaction among the fixed factors (NaCl concentration and application method) on the yellowing damage. While a statistical effect of the salt concentration was highlighted during all the experiment, except in the 1st survey. During all the trial damages were < 5%, revealing a low toxic effect of salt. The highest damage (0.92) was obtained at the 4th survey in plants treated with 250 mM NaCl. In particular, during the last two surveys a significant effect of both salt concentration (125 and 250 mM) was found in comparison with the control. Between the application method, plants treated by immersion showed the highest damages during all the experiment.

Irrigation with saline water affected the other evaluated leaf characteristics in different way (Table 3). The differences between the beginning and the end of the trial were calculated. Concerning leaf chlorophyll content, immersion administration induced a significant increase compared to the perfusion, while no statistical variations were found among salt concentration. On the other hand, administration of 250 mM NaCl on plants revealed the lowest SPAD value (24.9). The highest value (35.4) was obtained in the control.

Colour variations evaluated by means of a spectrophotometer showed which treatment better preserved the original aesthetic and ornamental characteristics (Caser et al., 2010). Overall, few differences were detected. In general, all the leaves showed a similar decrease of L* and the colour changed to red (increase of a*) and blue (decrease of b*). No statistical effect of salt concentration were found for the L* and a* parameters, while for b* the lowest variation was found in plants treated with 0 mM and 250 mM (-12.8 and -12.6, respectively). A detrimental effect of the immersion method resulted for L* (-11.4) and b* (-17.24).

Results pointed out that *Ligustrum* genus resistant to salinity. In particular, taking into account both visual and spectrophotometer evaluations, *L. sinensis* appeared more resistant than *Buxus* species previously studied (Caser et al. 2010). This species may be used as a cover plant in roadway vegetation, where NaCl is present as aerosol or dissolved in the soil solution.

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TABLES

Table 1. Description of classes for visual evaluation of leaf damage caused by yellowing.

Classes	*Description*
0	Healthy leaf (<5% leaf)
1	Leaf with barely obvious damage (5-24% leaf)
2	Leaf with obvious damage (25-44% leaf)
3	Leaf with marked damage (45-64% leaf)
4	Leaf with very marked damage (65-84% leaf)
5	Dry leaf (>84% leaf)

Table 2. Main effects of salt concentration, administration type, and interaction among fixed factors on leaf yellowing values during the six surveys.

	Surveys					
	1st	2nd	3rd	4th	5th	6th
	Mean class values					
Salt (NaCl)						
0 mM	0.08	0.50a	0.51a	0.51b	0.30b	0.31b
125 mM	0.13	0.41b	0.45b	0.46b	0.50a	0.51a
250 mM	0.13	0.51a	0.51a	0.92a	0.51a	0.53a
P	ns	*	*	**	**	*
Application method						
Immersion	0.20a	0.50a	0.51a	0.52a	0.53a	0.57a
Perfusion	0.04b	0.44b	0.46b	0.40b	0.34b	0.33b
P	**	*	*	**	**	**
Interactions						
Salt X Application	ns	ns	ns	ns	ns	ns

Mean values showing the same letter are not statistically different at $P \leq 0.05$ (according to the REGW-F test). The statistical relevance of Between-Subjects Effects' Test (=$P \leq 0.05$, **= $P \leq 0.001$, ns=non significant).

Table 3. Main effects of salt concentration, administration type, and interaction among fixed factors on leaf chlorophyll content (Chl), SPAD, and colour variation.

	Chl ($\mu g/mm^2$)	SPAD	Colour variation		
			L*	a*	b*
Salt (NaCl)					
0 mM	0.83	35.4a	-8.1	4.7	-12.80b
125 mM	0.69	32.0b	-11.1	4.9	-16.98a
250 mM	0.78	24.9c	-9.9	4.0	-12.67b
P	ns	**	ns	ns	*
Application method					
Immersion	0.85a	30.1	-11.4a	4.8	-17.24a
Perfusion	0.69b	31.5	-8.0b	4.2	-11.06b
P	*	ns	*	ns	*
Interactions					
Salt X Application	ns	ns	ns	ns	ns

Mean values showing the same letter are not statistically different at $P \leq 0.05$ (according to the REGW-F test). The statistical relevance of Between-Subjects Effects' Test (=$P \leq 0.05$, **= $P \leq 0.001$, ns=non significant).