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Original Article

Nutrients in Two and Three Cotyledon Seedlings of *Peganum harmala* L. Under Soil Salinity

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Abstract

Key words: *Peganum harmala*, soil salinity, *Fe*-deficiency, three cotyledons.

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The final seed germination of *Peganum harmala* L. was significantly decreased at soil salinity of 2.6, 8.6 and 10.8 DS/m, compared with adequate concentration. *Fe* content in three cotyledon seedlings was significantly correlated with the percentage of final seed germination ($rs = 0.94$, $P = 0.0048$), under different concentrations of soil salinity. Normal nutrient order (in two cotyledon seedlings) changed at 10.8 DS/m of soil salinity. Two cotyledon seedlings adapted in the increasing concentrations of soil salinity better than three cotyledon seedlings. Three cotyledons are associated with iron deficiency and can result of *Fe*-deficiency at least during embryogenesis. The results indicate that the variation in cotyledon number of *P. harmala* L. is related with soil salinity, resulting in at least *Fe* deficiency.

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Introduction

In seed plants, embryogenesis is an important process to produce a new generation. External such as drought, salinity as well as endogenous factors such as phytohormones, proteins, transcription and other substances can affect embryogenesis (Unnikrishnan *et al*., 1990; Khorolsuren & Jamsran, 2005; Umehara *et al*., 2007). Previous studies reported that salinity effects on seed germination and early seedling growth (Rahman & Ungar, 1990; Gulzar *et al*., 2001; Bayuelo-Jimenez *et al*., 2002; Jamil *et al*., 2005, 2006; Lombardi & Lupi, 2006; Cordazzo, 2007; Necajeva & Ievenish, 2008; Bybordi & Tabatabaei, 2009; Sivasankaramoorthy *et al*., 2010; Akbarimoghaddam *et al*., 2011), and approved that the formation of three cotyledons is related with embryogenesis (Taylor & Mundell, 1999; Al-Hammadi *et al*., 2003; Conner & Agrawal, 2005).

The purpose of this study was to describe whether the variation in cotyledon number of *Peganum harmala* L. is related with soil salinity.

Materials and Methods

Seeds of *P. harmala* and soil (0-20 cm depth) were sampled in Ekhiin Gol oasis (N43°14’679; E099°00’411; alt. 971 m), on 28 August 2001. *P. harmala* grows in clay-loam soil with pH=7.57, 10.8 DS/m of electrical conductivity and soluble *Ca* is 2460 ppm; *Mg* – 390; *Fe* – 422; *Cu* – 13.26 and *Mn* – 6.21 in soil. Soluble salts in water were extracted and prepared water solutions of different salt concentrations. Seed germination was determined at 25±1°C for 10 days in the seed germinator, without dormancy breaking treatments, using Petri dishes and moist blotter by salt solutions with 2.6, 4.7, 5.7, 6.8, 8.6 and 10.8 DS/m of conductivity. Seedlings for nutrient analysis were sampled in second day