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**Seed germination, salt stress tolerance and seedling  
growth of *Opuntia ficus-indica*, invasive species in the  
Mediterranean Basin**

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## ABSTRACT

The present study was focused on the seed germination ecology and seedling growth of *Opuntia ficus-indica* (Cactaceae), a native species of arid and semi-arid regions of Mexico and, become invasive in the Mediterranean Basin.

The need of scarification with ten different methods as well as, the intra-specific variability, among the naturalized populations of this species in Sardinia (Italy), Sicily (Italy) and in the Valencian Community (Spain), in the responses to light (12/12 hours) and total darkness (0/24 h), constant (5, 10, 15, 20, 25 and 30°C) and alternating temperatures (25/10°C), salt stress (0, 125, 250, 500 mM NaCl) and germination recovery were evaluated. Moreover, biomass production and the growth rate during the early developmental stages of seedlings development were measured for all the investigated populations.

The most suitable method of scarification for this species resulted the nail-clippers chipping. The highest germination percentages (>80%) occurred for all the tested populations, under light conditions (12/12 h) at the temperatures of 20 and 25°C, with a decreasing trend at 15 and 30°C (ca. 60% of germination for both temperatures). The alternating temperature regime (25/10°C) was also evaluated by a considerably germination rate of ca. 60%. For all the tested populations the germination trend was similar under light and darkness conditions but, higher values of germination occurred under light conditions. *O. ficus-indica* seeds were able to germinate up to 500 mM NaCl but inter-population differences were observed. Nevertheless seeds from all populations showed a low ability to recover their germination after the NaCl exposure. The biomass seedling production was similar between the Sardinian and Sicilian populations, in which were observed the lowest values at the lowest tested temperature (15°C). Differently from the two Italian populations, in the Spanish one no differences in the biomass production among the tested temperatures were detected. The grow rate of the Spanish population was, like the seedlings biomass, different from those of Sardinia and Sicily.

This study confirmed the presence of a physical dormancy in *O. ficus-indica* seeds, due to lignified teguments in the seed testa and, a secondary dormancy induced by the exposition to salinity. The ability of seeds to germinate preferably in a range of temperatures between 20-25°C allowed this species to propagate itself both sexually (with a germination of the seeds during spring) and asexually (via vegetative propagation) even under the Mediterranean climate. Moreover, our research has shown that this species still show a germination

behaviour typical of its native regions. Even if many naturalized populations occurred in the Mediterranean ecosystems, it seems this species has not acquired the Mediterranean germination syndrome. The ability of seeds to germinate with high NaCl concentrations reveals a potential growth of *O. ficus-indica* in close coastline areas and in soils with high salt concentrations (e.g. lagoon areas). In conclusion this study provides new elements to plan a more efficient strategy to control and/or eradicate this species in coastal areas and in salt environments.