IMPACT OF OSMOTIC STRESS ON SEED GERMINATION OF ORNAMENTAL AND INVASIVE SPECIES

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This study helps identifying the risks of some ornamental species becoming invasive, as well as highlighting the constraints of the germination process under drought conditions.

INTRODUCTION

The large majority of crops and ornamental plants cultivated in different region of the world are not native to these territories. A small portion of these species, especially those introduced for ornamental purposes, may escape the human control and become invasive.

Biological invasions represent one of the the greatest threats to natural environments. The presence of invasive plant species generates strong competition for resources and a change in the composition and diversity of the aerial and subterranean communities, such as modifications of abiotic and biotic conditions, changes in hydrologic cycles (Carman and Brotherson, 1982) and, in general, a reduction in ecosystem services (Eviner et al., 2012).

The effects of climate change and associated extreme weather conditions are a problem for both rural and urban areas. The consequences of climate change for invasive species and native plant species are different due to their different traits.

Figure 1. Photographs of the different ornamental plants analysed in this study (Original)

MATERIAL AND METHODS

The plant material used were seeds from fifteen different ornamental species, collected or bought, as shown in Figure 1, some of them with a very high invasive character, according to the 'Invasive Species Compendium'.

Seeds of all species were germinated in standard 6 mm Petri dishes on filter paper moistened with 1.5 ml distilled water in the control treatment and with the correspondent increasing concentrations of PEG 6000 (Polyethylene Glycol), -0.25 MPa, -0.5 MPa, -0.75 MPa, -1 MPa. For each treatment, 100 seeds were sown in 4 Petri dishes (25 seeds per plate). The plates were placed in a growth chamber at 25°C under a 12-hour photo period (Figure 2).

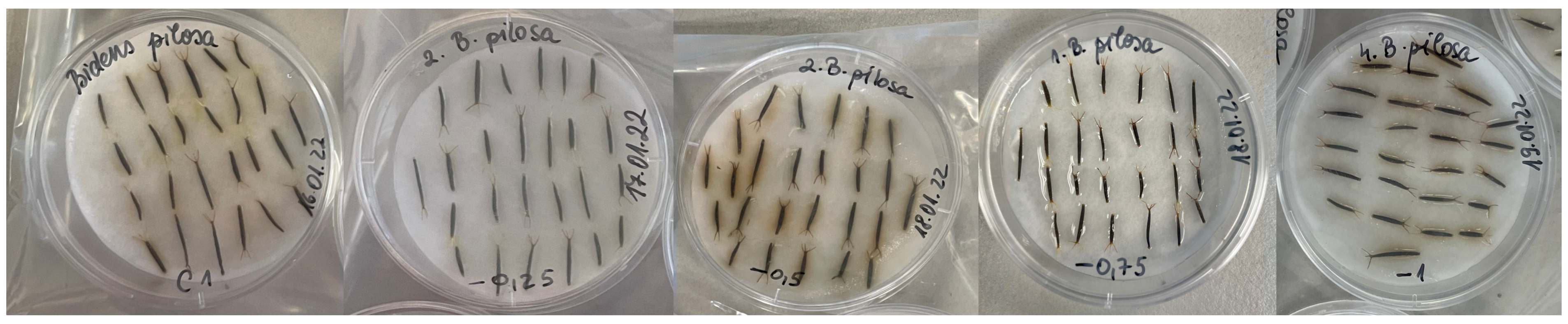

Figure 2. Petri dishes for one repetition of each treatment with *Bidens pilosa* seeds (Original)

The number of germinated seeds, measured as seeds with a 1 mm radicle emergence, was registered everyday along a 30 days period. The germination capacity was expressed as the percentage of germination and the germination rate as MGT (Mean Germination Time).

After 10 days of the germination assay germinated seeds were removed from the plates and the length of the radicle and hypocotyl were processed by Digimizer v.4.6.1 software (MedCalc Software, Ostend, Belgium, 2005–2016) (Figure 3).

Figure 4. Measurements of the radicle and hypocotyl length in *Bidens pilosa* after 10 days of germination, control and PEG concentrations of -0.25 MPa, -0.5 MPa, -0.75 MPa (Original)

RESULTS AND DISCUSSION

In all species analysed the process of germination was affected by the rising PEG concentrations. All parameters evaluated showed strong differences between values in the control and those from the treatments with PEG.

A drastic reduction in germination was recorded from -0.75 MPa, and no germination took place at -1 MPa for the species *Bidens pilosa, Cympopogon citratus, Eschscholzia californica, Oenothera biennis, Tagetes patula* 'Nana' *and Aquilegia hybrida* which stopped at -0.75 MPa PEG (Figure 4).

The highest tolerance to induced water stress during seed germination was established for *Pennisetum alopecuroides* (Figure 5).

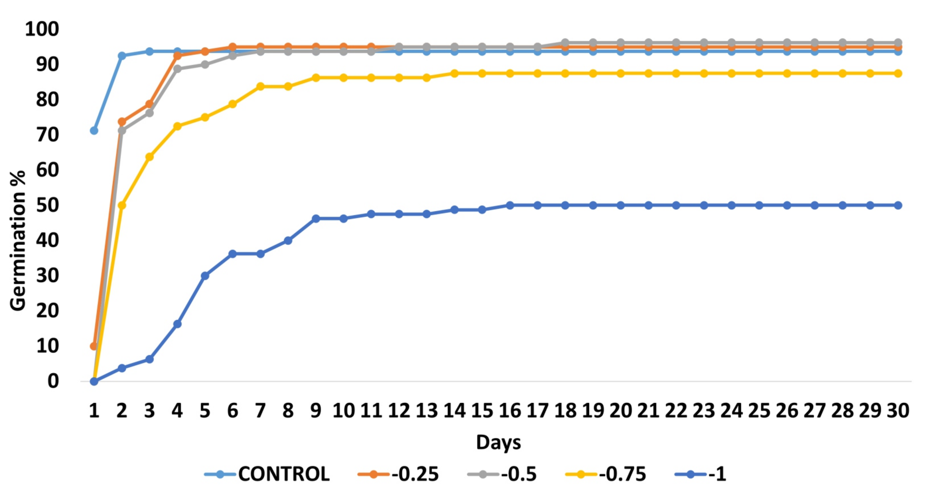

Figure 5. Evolution of seed germination as cumulative germination percentages over 30 days in *Pennisetum alopecuroides* at increasing osmotic pressures with the control until -1 MPa PEG.

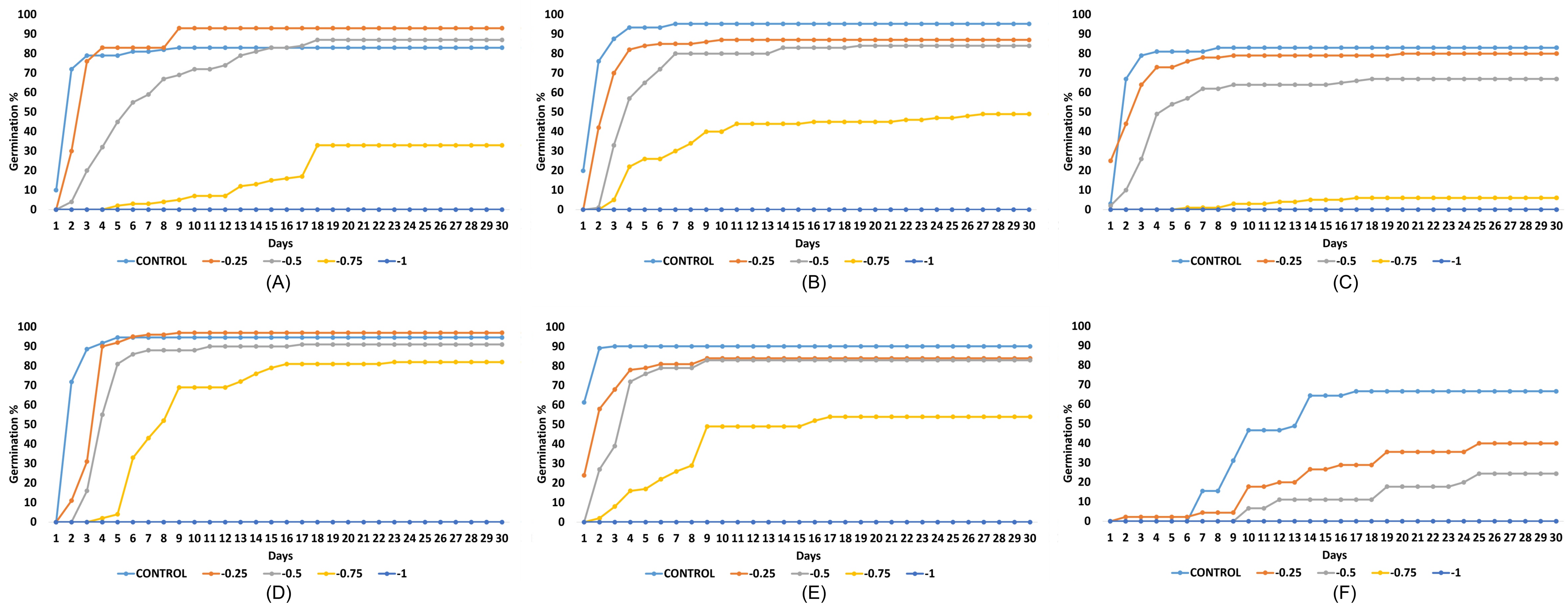

Figure 4. Evolution of seed germination as cumulative germination percentages over 30 days in *Bidens pilosa* (A), *Cymbopogon citratus* (B), *Eschscholzia californica* (C), *Oenothera biennis* (D), *Tagetes patula* 'Nana' *(E)*, and *Aquilegia hybrida* (F) at increasing osmotic pressures obtained with PEG from 0, the control, to a maximum of -1 MPa PEG.

CONCLUSIONS

Differences between species and between treatments were significant. The most tolerant to osmotic stress were *Cortaderia selloana, Pennisetum alopecuroides* and *Pennisetum setaceum*, and the most susceptible was *Aquilegia hybrida*. PEG germination was mainly related to the ecological requirements of the plants, those of arid areas tolerating better the osmotic stress.

Ornamental plants are not just species and/or varieties that provide aesthetic pleasure, but can improve the environment and our quality of life.Thus, ornamental plants can be used to restore disturbed landscapes, control erosion, reduce energy and water consumption and improve the aesthetic quality of urban, periurban and rural landscapes and amenity areas

REFERENCES

Anderson, N.O., Galatowitsch, S. M., and Gomez, N. (2006). Selection strategies to reduce invasive potential in introduced plants. *Euphytica* 148, 203–206.

Bewley, J. D., and Black, M. (1994). Dormancy and the control of germination. In Seeds (pp. 199-271). Springer, Boston, MA.

Eviner, V. T., Garbach, K., Baty, J. H., and Hoskinson, S. A. (2012). Measuring the effects of invasive plants on ecosystem services: challenges and prospects. *Invasive Plant Sci. Manag.* 5, 125–136. doi: 10.1614/IPSM-D-11-00095.1