Poissons Regression as Explanatory Model of the Germination of Annual and Perennial Species Under Heat Shock and Water Stress

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Thermal shock is known to be an important stimulus for the germination of soils-stored seeds in fire-phone plant communities [1]. Although overall germination response of different species is known to vary, the interaction between germination and tolerance to desiccation in soil is poorly understood [2].

This work analyzes the effect of wet and dry heat treatments on the germination of seven common species from the Central West of Spain. Seeds were collected with the objective to develop a suitable protocol for the germination of species native to the Iberian Peninsula with the ultimate aim to promote their germination when desired in land revegetation project, or to reduce their presence when non-desired in crops. Simultaneously, a mathematical model of seed germination is proposed as selection criterion of critical values: favorable temperatures and desiccation periods for seed germination take up position near critical values.

Imbibed seeds of the five species were placed in Petri dishes in moist soils and heated in ovens set to 30^0C and 50^0C for 0.5, 1, 4, 8 and 16 days. Each combination of species, heat and desiccation periods were set in four replicates After heating, seeds were incubated for 35 days on a 10/14 dark/light regime and germination was recorded daily. Data were analyzes by means of a Kruskal-Wallis test to check for differences in final percentages of germination between species and heat treatments and between combinations of temperatures and desiccation periods. A log-lineal model was also applied to test for independence of variables affecting germination.

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Temperature of 30^0C was the most successful for germination of pre-imbibed seeds as well as the shortest desiccation periods (0.5 days) at 50^0C. It is observed a decrease in germination at increased periods of desiccation, with the exception of that of eight days. The legume, *Medicago arabiga*, was the one benefiting the best from the wet treatment at 30 C. The maximum temperature required to prevent germination varied among species and was variable with duration of heating. The model that best explains seed germination is a Poisson's regression which takes the form:

$$log\ r_{ijk} = \beta_0 + \beta_1 T_i + \beta_2 S_j + \beta_3 D_k$$

where T represents temperature ($i = 1, 2$); S, species (j=1,...,5); D, days of desiccation after imbibition (k=1,...,5) and r_{ijk} the final germination percentages. Water availability in soil is a significant factor controlling germination even during the wet season [2]. The quick and great response of some species when water supply fluctuates contributes towards a superior ability to colonize almost any kind of habitats. Modelling of seed germination represents a valuable tool to predict success in the introduction of species for rehabilitation as well as in the control of non-desired weeds.

References

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