Mathematical Modelling of the Germination of Annual and Perennial Species after Exposure to Nutritious Salts and Varying pH

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Wildfires are an integrated component of ecosystems under Mediterranean-type climate. In the first post fire year it is commonly observed a flush of seed germination [1]. It has been proposed that the environmental changes in soils induced by fire (increased values of N and Ca as well as modified pH values), might act as a trigger for germination [2]. The effect of nitrogenous compounds on germination was tested on eight species from fire-prone shrubby woodland in central-western Spain. The nitrogenous compounds (salts) were NH_4NO_3, KNO_3, and Cl_2Ca, at concentrations of 25 mM and 50 mM. Each combination of salt and concentration was adjusted to four different pH values (4.7, 5.7, 6.7, and 7.7).

It was studied the independence of variables obtaining a log-lineal saturated model which indicates dependency between them [3]. Then, for each combination of treatments (i.e. nutritious salt, concentration and pH) we have compared the germination between the different species. Simultaneously for each species, it was studied the effect of each combination of a pair of treatments. The best explanatory model for the combined effect of the four factors is a Poisson's regression model, which final equation is $\log r_{ijkl} = \widehat{\beta_0} + \widehat{\beta_1} * SAL_i + \widehat{\beta_2} * CONCENT_j + \widehat{\beta_3} * PH_k + \widehat{\beta_4} * ESP_l$ where $i = 1, 2, 3, j = 1, 2, k = 1, ..., 4$ and $l = 1, ..., 8$.

NH_4NO_3 at any concentration and pH induced significant positive germination in *Daucus carota*, *Dactilys glomerata*,*Medicago arabiga*,*Saponaria officinalis* and *Phoeniculum vulgare*. On the other hand germination of *Cynosurus cristatus*, *Rumex crispus* and *Phalaris paradoxa* was significantly inhibited under the same treatments. Similar behaviour of species was observed under the application of KNO_3. The exceptions were *S. officinalis* with a reduced germination at concentration of 50 mM and pH 4.7 and *C. cristatus* at 25 mM and pH of 4.7 with the lowest germination. Germination of *C. cristatus*, *M arabiga* and *S. officinalis* was enhanced by Cl_2Ca at almost any combination of concentration and pH; germination of *C. crispus* and *P. paradoxa* was positively inhibited at any combination of concentration and pH. The remaining species showed an erratic pattern of germination with fluctuations induced for particular combinations of salt concentration and pH. In general, the best germinator under most of the treatments was *S. officinalis*, a species classified as 'euri', whereas the worse germinator was *C. crispus*, a species included int he 'steno' group. Differences specific for each salt. The resulting germination responses are related to the salt concentration in each species' natural habitat. For this reason, and with a particular salt, species can be classified as saline-tolerant, saline-inhibited or saline- stimulated.

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