

## Investigating and modeling the combined effects of pH and osmotic pressure on seed germination for use in phytoactivity and allelopathic research

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### Abstract

Phytoactivity and allelopathic studies are heavily dependent on germination bioassays of water solutions of allelochemical(s), which necessarily imply that pH and osmotic pressure vary among treatments and between treatments and controls and are therefore a confounding factor in the assessment of seed germination responses to allelochemical(s). When the contribution of pH and osmotic pressure to seed germination responses is considered in experimental designs their effects are almost without exceptions examined separately being assumed, without any evidences, that pH and osmotic pressure act independently on seed germination responses. The objectives of this work were to examine experimentally such assumption using wheat, lettuce, and subterranean clover cultivars to evaluate and model the combined effects on germination of pH and osmotic pressure in the range between 3.0–6.0 and 0–100 mOsmol kg<sup>-1</sup>, respectively. Empirical equations are fitted, discussed, and the need to consider the simultaneous effects of pH and osmotic pressure firmly established. Finally, the use of the equations fitted and its impact on conclusions is exemplified in a dose-response bioassay of water extracts of *Cistus ladanifer* on seed germination using subterranean clover as target species where hormesis was found before allelochemical effects were corrected for pH and osmotic pressure values of control and extracts.

**Keywords:** Allelopathy, germination, hormesis, pH, osmotic pressure

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