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Short communication

# Seed germination of five *Helianthemum* species: Effect of temperature and presowing treatments

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**Abstract**

The germination behaviour of five *Helianthemum* species (*H. almeriense*, *H. appeninum*, *H. cinereum*, *H. hirtum*, *H. squamatum*) has been studied under controlled conditions. Constant 15, 20 or 25 °C and alternating 25/15 °C temperature regimes and 16/8 h light/dark photoperiod conditions were used. Presowing treatments applied were manual scarification, boiling water, hot water, dry heat and sulphuric acid. Germination values recorded were final germination percentage and germination rate expressed as days to reach 50% of the final germination percentage ($T_{50}$). Incubation temperature had no significant effect on final germination percentage for untreated seeds of the five *Helianthemum* species. However, variation due to temperature was significant for scarified seeds, with the lowest germination percentage attained at 25 °C. In all *Helianthemum* species studied, the highest germination percentages were obtained by manual scarification of seeds. Germination rate of scarified seeds decreased as germination temperature increased. The different presowing treatments investigated allowed some germination in some species, but none were any better than manual scarification. The high germination among most species studied, following mechanical rupture of the seed coat, shows that the mechanism of dormancy lies in the seed coat. The physical dormancy caused by impermeable seed-coat appears to be the main reason of poor germination of untreated seeds of *Helianthemum* species studied.


*Keywords:* *Helianthemum*; Seed dormancy; Seed germination; Seed scarification; Temperature

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Almost half of the *Helianthemum* species (Cistaceae) are found mainly in the Mediterranean rim. Many of these species grow in regions with arid or semi-arid climates. In the present work, five *Helianthemum* species [*H. almeriense* Pau, *H. appeninum* (L.) Mill., *H. cinereum* (Cav.) Pers., *H. hirtum* (L.) Mill., and *H. squamatum* (L.) Dum. Cours.] of the Iberian Peninsula were tested for germination. Two of them are Iberian endemic shrubs: *H. squamatum* is an endemic shrub widely distributed on gypsum soils of semi-arid Iberian Peninsula and *H. almeriense* is an endemic shrub of arid SE Spain.

Seed coat hardness and impermeability to water might be the most important causes of the dormancy present in several species of Cistaceae (Thanos et al., 1992). Heat and scarification release these seeds from dormancy by breaking the impermeable seed coat allowing imbibition and germination to proceed (Thanos et al., 1992; Valbuena et al., 1992). Relatively few studies exist on the reproductive biology of *Helianthemum* species (Escudero et al., 1997, 1999, 2000; Gutterman and Agami, 1987; Pérez-García et al., 1995; Thanos et al., 1992). The aims of the study were (1) to evaluate the effect of constant or alternating temperatures on germination of these species; and (2) to determine the most appropriate presowing treatments for enhancing germination.

Ripe fruits (capsules) containing mature seeds were collected in the field in July 2002 in several provinces of Spain: *H. almeriense* in Sorbas (Almería, SE Spain); *H. appeninum* in Entrepeñas (Guadalajara, central Spain); *H. cinereum* in Albacete (Albacete, SE Spain); *H. hirtum* in Pinilla del Valle (Madrid, central Spain); *H. squamatum* in Rivas (Madrid, central Spain). In all trials, four replicates of 25 seeds each were tested for germination on top of two sheets of filter paper (previously moistened with 3.5 ml distilled water, which was periodically added) in 7-cm diameter glass Petri dishes. Incubation took place at 16-h light/8-h dark photoperiod (the light was provided by cool white fluorescent tubes with an irradiance of 35 $\mu mol\, m^{-2}\, s^{-1}$) under constant temperature regimes (15 °C, 20 °C, 25 °C) or alternating temperature of 25 °C (light)/15 °C (darkness). Germinating seeds were counted and removed every 2 days over a 60-day incubation period. The criterion of germination was emergence of the radical through the seed coat. The time necessary (in days) to reach 50% of the final germination percentage ($T_{50}$) was calculated by linear interpolation from the two germination values closest to median germination.

Five different pretreatments were applied in order to enhance seed germination: (1) mechanical scarification by abrasion of seeds between two sheets of fine-grained sandpaper; (2) seeds immersed in distilled water boiled at 100 °C and then left to cool in the water to room temperature (ca. 23 °C) for 24 h; (3) seeds immersed in distilled water at 80 °C for 5 min; (4) seeds placed in an oven at 100 °C for 5, 10 or 30 min; (5) seeds soaked in concentrated sulphuric acid ($H_2SO_4$, 96%) for 0.5, 1 or 5 min. After these presowing treatments, seeds were set to germinate at 15 °C under a 16-h light photoperiod. Control seeds were sown in the same incubation conditions without pretreatment.

For each trial, the final germination percentages were calculated and arc-sine transformed values were subjected to analysis of variance using the computing package SPSS. One-way factorial ANOVA was performed with pretreatment or temperature as the main factors and the replicates as the error term. A comparison of means among results from the different incubation temperatures was carried out through the least significant difference test (LSD) at the 5% level of probability.

Final germination percentage of the seeds, which were germinated without any pretreatment (control), ranged considerably (from 11% to 44%), depending on the species (Table 1). For each species, no significant differences in germination percentages of intact