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Seed germination reports of high mountain species native to Mount Etna (Sicily)

Abstract

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The germination ability of five endemic species from the high mountain belt of Mt. Etna were studied; they are *Astragalus siculus*, *Erysimum etnense*, *Senecio squalidus* subsp. *aethnensis*, *Silene italica* subsp. *sicula*, and *Tanacetum vulgare* subsp. *siculum.* Mature seeds were collected in the field, within an elevation range of 1700–2000 m a.s.l. Different experimental conditions were tested and the best methods with optimal germination results are provided and compared for each species. First germination records are given for 4 out of 5 of the investigated taxa.

Key words: *Astragalus siculus*, *Erysimum etnense*, high-mountain endemics, Mt. Etna, *Senecio aethnensis*, *Silene sicula*, *Tanacetum siculum.*

Introduction

Mt. Etna has a rich and diversified flora with a big contingent of endemic taxa. The high mountain zone of Mt. Etna is characterized by the presence of xerophytic thorny cushion communities dominated by the endemic *Astragalus siculus* Biv., which grows on old lava flows and pyroclastic deposits in association with several other typical endemic species of this plain. It represents the most important species for both number of plants and cover abundance, giving the landscape a peculiar physiognomy.

Evidence of temperature increases linked to global climate change has been predicted and reported for the Mediterranean mountain ranges (Giménez-Benavides & al. 2005, 2007). As a consequence, seed germination in some species may be anticipated, thus affecting seedling emergence, growth, and development. Specific germination requirements constitute valuable information for predicting plant survival and ensure a successful plant propagation. Surprisingly, there is almost no published basic information on germination features of most of these key species. In this study, the best protocols for seed germination of five interesting endemic species growing in the high mountain zone of Mt. Etna were assessed and discussed. Names and taxonomic status of investigated taxa follow Bartolucci & al. (2018).

32. *Astragalus siculus* Biv. (*Fabaceae*)

Accession data

Si: Mt. Etna, Milo (Catania), Mt. Concazza (WGS84: 37.766930°N 15.056690°E), orophilous cushion-like shrublands, 1720 m a.s.l., 26 Aug 2004, *A. Restuccia & N. Visalli* (BGS-CT 11AR/NV, Catania Germplasm Bank).

Germination data

Pre-treatments: disinfection with a 4% sodium hypochlorite water solution for 5 minutes followed by 3-4 rinses in sterile distilled water; scarification with **1)** sterile abrasive paper for 5 minutes followed by imbibition in sterile distilled water overnight, **2**) 98% sulfuric acid for 30 minutes.

Germination medium: 3 sheets of sterilized filter paper (Whatman 40).

Sample size: 100 seeds (25 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
88% [1]	constant 21°C	0/24h	7.0	9.3	35.0	16.1
87% [2]	constant 20°C	12/12h	3.0	8.7	40.0	13.6

Observations

These are the first germination reports for this taxon. Similarly, to other *Astragalus* species, *A. siculus* has hard seed coats and a resultant physical dormancy. Mechanical scarification provided the best germination percentage; similar values were also reached by chemical scarification not exceeding 30 minutes, above which germination decreased to 53-47% (at 60 and 90 min, respectively), while no germination and embryo death resulted from longer treatments. Other types of scarification, such as warm water (40, 50, 60°C) or boiling water (3, 5, 10 min), allowed no more than 20% of seed germination. Seeds did not result photoblastic since different photoperiod did not significatively affect the final germination percentage.

33. *Erysimum etnense* Jord. (*Brassicaceae*)

Accession data

Si: Mt. Etna, Ragalna (Catania), loc. Piano Vetore, (WGS84: 37.693338°N 14.980555°E), old lava flows, 1740 m a.s.l., 19 Sept 2012, *C. Brullo, S. Brullo & G. Giusso* (UNICT_069, Catania Germplasm Bank).

Germination data

Pre-treatments: disinfection with a 4% sodium hypochlorite water solution for 5 minutes followed by 3-4 rinses in sterile distilled water; imbibition in sterile distilled water for 24 h.

Germination medium: 1% agar.

Sample size: 100 seeds (25 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
98%	constant 10°C	0/24h	2.0	2.7	7.0	3.7
94%	constant 15°C	0/24h	1.0	1.5	4.0	2.2

Observations

These are the first germination reports for this taxon. Germination tests carried out on fresh seeds provided successful germination results (> 80%) under different constant temperatures (10, 15, 20 and 25°C) either in full darkness or 12h light/dark photoperiod, with better results at the lower temperatures. Higher temperatures enhanced the germination speed (T_{50} < 1.5, MGT ≤ 2). Seeds showed a negative light sensitivity at lower temperatures, with less germination in 12h light/dark photoperiod (85% at 10°C, 81% at 15°C), while light had positive effects at higher temperatures increasing the germination percentages compared to full darkness (92% *vs* 89% at 20°C, 87% *vs* 84% at 25°C).

34. *Senecio squalidus* subsp. ***aethnensis*** (DC.) Greuter (*Asteraceae*)

Accession data

Si: Mt. Etna, Nicolosi (Catania), loc. Monti Silvestri (WGS84: 37.699166°N 14.999722°E), volcanic sands, 1896 m a.s.l., 26 Jul 2012, *S. Bogdanovič, C. Brullo, S. Brullo & G. Giusso* (UNICT_051, Catania Germplasm Bank)

Germination data

Pre-treatments: disinfection with a 4% sodium hypochlorite water solution for 5 minutes followed by 3-4 rinses in sterile distilled water; imbibition in sterile distilled water for 24 h.

Germination medium: 1% agar.

Sample size: 100 cypselae (25 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
95%	constant 10°C	12/12h	3.0	3.9	15.0	5.6
90%	constant 20°C	12/12h	2.0	2.3	6.0	2.8

Observations

These are the first germination reports for this taxon. Germination tests carried out on fresh cypselae provided successful germination results, ranging from 81% to 95% under different constant temperatures (10, 15, 20 and 25°C) either in 12h dark/light

photoperiod or full darkness, with enhanced performance at the lowest temperature. Conversely, higher temperatures increased germination speed (T_{50} and MTG < 3). Seeds of *Senecio squalidus* subsp. *aetnensis* resulted somewhat positively photoblastic having higher germination percentages under 12h dark/light photoperiod (95% *vs* 90% at 10°C, 89% *vs* 81% at 15°C, 90% *vs* 83% at 20°C). Light sensitivity reversed at the highest temperature (81% *vs* 86% at 25°C). Similar results of germination (95%, 16°C 12h light/dark) were reported for *Senecio squalidus* by Royal Botanic Gardens Kew (2019).

35. *Silene italica* subsp. ***sicula*** (Ucria) Jeanm. (*Caryophyllaceae*)

Accession data

Si: Mt. Etna, Nicolosi (Catania), loc. Rifugio Sapienza (WGS84: 37.697774°N 14.986665°E), lava flows and basalt outcrops, 1860 m a.s.l., 26 Jul 2012, *S. Bogdanovič, C. Brullo, S. Brullo & G. Giusso* (UNICT_067, Catania Germplasm Bank).

Germination data

Pre-treatments: disinfection with a 4% sodium hypochlorite water solution for 5 minutes followed by 3-4 rinses in sterile distilled water; imbibition in sterile distilled water for 24 h.

Germination medium: 1% agar.

Sample size: 100 seeds (25 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
100%	constant 10°C	12/12h	2.0	2.8	8.0	3.8
100%	constant 15°C	12/12h	1.0	1.6	8.0	2.5
100%	constant 20°C	0/24h	1.0	1.5	7.0	2.1
98%	constant 25°C	0/24h	1.0	1.5	14.0	2.7

Observations

Germination tests carried out on fresh seeds provided optimal germination results (98-100%) under different constant temperatures (10, 15, 20 and 25°C), either in 12h dark/light photoperiod or full darkness, revealing the ability of *Silene sicula* seeds to germinate very fast in a wide range of temperature. Best results, with the finest values of both germination percentage and velocity, were achieved at 15-20°C. These data agree with the only existing record for this taxon (100% at 15°C 12h light/dark on 1% agar; Royal Botanic Gardens Kew 2020). Lastly, seed exposure to light condition had an extremely low influence on seed germination, since germination rates in full darkness were almost equivalent.

36. *Tanacetum vulgare* subsp. ***siculum*** (Guss.) Raimondo & Spadaro (*Asteraceae*)

Accession data

Si: Mt. Etna, Sant'Alfio (Catania), loc. Rifugio Citelli (WGS84: 37.765277°N 15.058888°E), orophilous cushion-like shrublands, 1740 m asl, 19 Sept 2012, *C. Brullo, S. Brullo & G. Giusso* (UNICT_065, Catania Germplasm Bank).

Germination data

Pre-treatments: disinfection with a 4% sodium hypochlorite water solution for 5 minutes followed by 3-4 rinses in sterile distilled water; imbibition in sterile distilled water for 24 h.

Germination medium: 1% agar.

Sample size: 100 cypselae (25 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
87%	constant 20°C	0/24h	1.0	2.5	8.0	4.0
86%	constant 25°C	12/12h	2.0	11.7	38.0	13.6

Observations

These are the first germination reports for this taxon. Germination tests carried out on fresh cypselae, under different constant temperatures (10, 15, 20 and 25°C) either in 12h dark/light photoperiod or full darkness, provided very variable germination percentages (ranging from 1% to 87%). Best results were achieved at higher temperatures, while a drastic fall in germination occurred at the lowest temperature (1% and 6% at 10°C and 12h light/12h dark and 24h dark, respectively).

In general, the absence of light represented a more favourable incubation condition for germination at the different temperatures tested, except for 25°C, when 12h light photoperiod improved the final germination (86% *vs* 65% at 24h dark) while reducing the germination speed (T_{50}: 11.7 *vs* 3.3, MTG: 13.6 *vs* 7).

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