

C. Salmeri, A. E. Cristaudo, L. Di Martino, M. Di Stefano, E. Estrelles-Perpiñá, E. García-Martínez, G. Mazzara Curcurù, G. Pipitone, F. Scafidi, F. Tantalo & S. Magrini†

Mediterranean plant germination reports – 7

Abstract

Salmeri, C., Cristaudo, A.E., Di Martino, L., Di Stefano, M., Estrelles-Perpiñá, E., García-Martínez, E., Mazzara Curcurù, G., Pipitone, G., Scafidi, F., Tantalo, F. & Magrini, S.: Mediterranean plant germination reports – 7. — Fl. Medit. 35: 271-291. 2025. — ISSN: 1120-4052 printed, 2240-4538 online.

This seventh issue of the germination report series from Mediterranean areas includes germination protocols for 17 taxa, all conserved within four seed banks belonging to the RIBES and/or GENMEDA networks. Eight of the investigated species are endemic: five restricted to the Iberian Peninsula, and three endemic to Central–Southern Italy and Sicily. Seven of the germination reports focus on *Sideritis* species from Spain, while four protocols address species typical of the highly specialised habitats of Mediterranean temporary ponds. The taxa and populations investigated in this issue are: *Glacium flavum* Crantz from Alicante (Spain) by García-Martínez (No. 159), *Sideritis chamaedryfolia* Cav., *S. glauca* Cav., *S. hirsuta* L., *S. incana* L., *S. pungens* Benth., *S. spinulosa* Barnadez ex Asso, *S. tragoriganum* Lag. from Valencian Community (Spain) by Estrelles-Perpiñá (Nos. 151-157), *Verbascum niveum* subsp. *garganicum* (Ten.) Murb. from Abruzzo (Italy) by Tantalo & Di Martino (No. 158), *Antinoria insularis* Parl., *Lythrum hyssopifolia* L., *Middendorfia borysthénica* (Schränk) Trautv., *Myosotis sicula* Guss. from Sicily (Italy) by Di Stefano & Cristaudo (Nos. 159-162), *Centaurea virescens* (Guss.) Domina & Raimondo, *Dianthus graminifolius* C. Presl, *Iberis semperflorens* L. and *Rhaponticum coniferum* (L.) Greuter subsp. *coniferum* from Sicily (Italy) by Scafidi, Mazzara Curcurù & Pipitone (Nos. 163-166).

Key words: endemic species, *ex-situ* conservation, protocols, Spain, Italy, Sicily, seeds.

Article history: Received 6 November 2025; received in revised form 10 December 2025; accepted 15 December 2025; published 31 December 2025.

Introduction

Seed germination is a pivotal phase in the plant life cycle, shaping the long-term survival, recruitment, and population dynamics of most species. Understanding germination behaviour—especially for endemic, rare, or threatened taxa—is essential for both in situ and ex situ conservation strategies, as it provides fundamental insights into the ecological

requirements for seedling establishment under current and future environmental conditions. Germination studies therefore represent a cornerstone in conservation biology, guiding seed banking, habitat restoration, and propagation programmes across biodiversity-rich but vulnerable regions such as the Mediterranean Basin.

Within this framework, the present issue of the germination report series from Mediterranean areas (*sensu* Greuter 2008) offers germination protocols for 17 taxa, all conserved within four seed banks belonging to the RIBES and/or GENMEDA networks. With this contribution, the series now reaches a total of 166 published protocols, further consolidating its role as a reference resource for Mediterranean plant conservation, seed ecology, and *ex situ* research.

Importantly, the long-term continuity and scientific robustness of this initiative are made possible by the collaborative effort of the RIBES and GENMEDA networks, which coordinate germplasm conservation across multiple institutions, harmonise methodologies, and promote shared standards for data collection, seed handling, and protocol testing. Such networks are essential to address the conservation challenges of the Mediterranean region, enabling comparability of results, enhancing data reliability, and fostering the exchange of expertise and plant material among seed banks.

Eight of the species investigated here are endemic—five restricted to the Iberian Peninsula and three to Central–Southern Italy and Sicily—while the remaining nine taxa exhibit a broader Mediterranean distribution. Seven of the germination reports in this issue focus on *Sideritis* species from Spain (Nos. 152–157), providing new comparative insights into germination requirements within this taxonomically complex and ecologically diverse genus. Additionally, four protocols examine species characteristic of Mediterranean temporary ponds (Nos. 159–162), a priority habitat under the EU Habitats Directive and one that remains critically underrepresented in germination studies despite its high conservation value.

Overall, these contributions enrich the Mediterranean germination checklist available in the MPGR folder, now expanded to 166 records, and offer researchers and conservation practitioners an increasingly robust and practical tool to support plant conservation, seed banking, ecological restoration, and propagation activities throughout the region. By leveraging the coordinated efforts of the RIBES and GENMEDA networks, this growing dataset not only advances scientific knowledge but also strengthens the collective capacity to safeguard Mediterranean plant diversity.

The taxa and populations investigated in this issue are: *Glacium flavum* Cratz from Alicante (Spain) by García-Martínez (No. 159), *Sideritis chamaedryfolia* Cav., *S. glauca* Cav., *S. hirsuta* L., *S. incana* L., *S. pungens* Benth., *S. spinulosa* Barnadez ex Asso, *S. tragoriganum* Lag. from Valencian Community (Spain) by Estrelles-Perpiñá (Nos. 151–157), *Verbascum niveum* subsp. *garganicum* (Ten.) Murb. from Abruzzo (Italy) by Tantalo & Di Martino (No. 158), *Antinoria insularis* Parl., *Lythrum hyssopifolia* L., *Middendorfia borysthénica* (Schrank) Trautv., *Myosotis sicula* Guss. from Sicily (Italy) by Di Stefano & Cristaudo (Nos. 159–162), *Centaurea virescens* (Guss.) Domina & Raimondo, *Dianthus graminifolius* C. Presl, *Iberis semperflorens* L. and *Rhaponticum coniferum* (L.) Greuter subsp. *coniferum* from Sicily (Italy) by Scafidi, Mazzara Curcurù & Pipitone (Nos. 163–166).

150. *Glaucium flavum* Crantz (*Papaveraceae*)

Accession data:

HS: Valencia, Moncofar, Playa de Moncofar, Torre Caiguda (WGS84: 39.4659°N, - 0.0838°W), 1.8 m a.s.l., 20 Oct 2023, *E. García-Martínez* (UVEG-JBVAL-BG 91B2023).

Germination data

Pre-treatments: no treatment.
Germination medium: Agar 0.6%
Sample size: 75 seeds (25 × 3 replicates)

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	MGT [d]
86.2%	alternating 25/10°C	0/24h	8.0	12.0	24.0	12.7

Observations

Glaucium flavum is an herbaceous species, generally biennial, with a wide distribution, mainly occurring in coastal regions of western and southern Europe, northwestern Africa, and southwestern Asia. It inhabits coastal environments, such as sandy or gravel beaches, where it tolerates adverse conditions, including salinity.

Germination tests were conducted at the Germplasm Bank of the Botanical Garden of the University of Valencia. Seed germination was evaluated under light (12/12 h) and dark (0/24 h) conditions, as well as under both alternating (25/10°C) and constant (15°C) temperatures. The highest germination percentage was observed in darkness under alternating temperatures (86.2%), and rather high (77.0%) value was reached at 15°C. In contrast, germination under light conditions was markedly reduced, reaching only 33% at 25/10 °C and 9.6% at 15 °C. This light-induced inhibition is interpreted as a mechanism to prevent seedlings from emerging on the soil surface (Thanos & al. 1989).

E. García-Martínez

151. *Sideritis chamaedryfolia* Cav. (*Lamiaceae*)

Accession data:

HS: Alicante, Villena, Collado de la Peñarrubia (WGS84: 38.599339°N, -0.800554°W), 750 m a.s.l., 25 june 1997, *F Marco, J. Riera* (UVEG-JBVAL-BG 35B1997).

Germination data

Pre-treatments: no treatment.
Germination medium: Agar 0.6%.
Sample size: 100 seeds (25 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	TMG [d]
94.7%	alternating 20/10 °C	0/24h	3.5	5.6	11.8	6.9

Observations

This perennial herb reaches approximately 25–45 cm in height and is woody at the base. The stems are covered with whitish hairs, and the leaves are elliptic to obovate, with prominent venation, bearing 2–3 teeth per margin, and sparsely distributed short hairs. It produces dense terminal whorls of flowers. It is endemic to southeastern Spain and typically grows on sandy, dry, calcareous soils under a Mediterranean climate. Local botanists regard the populations in this area as belonging to subsp. *chamaedryfolia*, a taxon listed in the Valencian Catalogue of Threatened Flora Species. It is assigned the conservation category “Monitored,” which informs regional conservation planning and management actions (Generalitat Valenciana 2022).

Experimental results indicate that *S. chamaedryfolia* exhibits enhanced germination under dark conditions. When exposed to a 12-hour light / 12-hour dark photoperiod, a significantly lower germination rate was recorded, with a maximum value of 62.3%. This germination pattern is consistent with the species’ ecological traits, suggesting an adaptation to sandy substrates, which impose greater water stress on the soil surface due to their low water-holding capacity (Thanos & al. 1991).

E. Estrelles-Perpiñá

152. *Sideritis glauca* Cav. (Lamiaceae)

Accession data:

Hs: Alicante, Redován, Sierra de Callosa (WGS84: 38.116084°N, -0.903742°W), 85 m a.s.l., 07 june 1996, *E. Estrelles, J. Riera, F Marco* (UEG-JBVAL-BG 98B1996).

Hs: Alicante, Cox, Peñón de la Lobera (WGS84: 38.131849°N, -0.918632°W), 165 m a.s.l., 09 june 2016, *E. Estrelles, J. Prieto, C. Valbuena* (UEG-JBVAL-BG 45B2016).

Hs: Alicante, Cox, Cresta del Palacio (WGS84: 38.134280°N, -0.885503°W), 90 m a.s.l., 09 june 2016, *E. Estrelles, J. Prieto, C. Valbuena* (UEG-JBVAL-BG 57B2016).

Germination data

Pre-treatments: no treatment.

Germination medium: Agar 0.6%.

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

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	TMG [d]	Accession code
93.3%	constant 15 °C	12/12h	5.3	6.8	13.0	8.0	45B2016
90.8%	alternating 25/15 °C	12/12h	4.0	6.1	13.3	7.5	45B2016

88.8%	alternating 20/10 °C	12/12h	4.0	6.4	11.5	7.4	45B2016
82.5%	constant 20 °C	12/12h	4.0	5.3	11.5	6.1	45B2016
81.7%	constant 25 °C	12/12h	2.5	4.6	12.0	5.5	45B2016
92.9%	alternating 20/10 °C	12/12h	4.8	8.2	20.0	10.0	57B2016
84.1%	alternating 25/15 °C	12/12h	4.0	5.6	16.5	7.2	57B2016
82.6%	constant 20 °C	12/12h	4.0	5.4	12.8	6.5	57B2016
80.1%	constant 15 °C	12/12h	6.3	8.0	14.0	9.1	57B2016
81.8%	alternating 20/10 °C	12/12h	6.5	13.4	23.8	81.8	98B1996



Fig. 1. From left to right: *Sideritis glauca* habit in its natural habitat, the collection of mature seeds, detail of the inflorescence, detail of the seeds, cut test showing a properly developed embryo, and seedlings after seed germination.

Observations

It is a perennial herbaceous plant with woody, glabrous stems and densely hairy, greyish-green leaves. The inflorescences (2–7 cm) consist of clusters of white to cream-colored tubular flowers, occasionally pinkish, arranged in open, spike-like inflorescences with 2–9 whorls.

This species is endemic to the southeastern region of Spain and commonly inhabits fissures in calcareous rocky cliffs. It thrives in sunny, well-drained habitats, usually at low to mid elevations.

This species is included in several plant conservation lists, including the List of Wild Species under Special Protection and the Spanish Catalogue of Threatened Species (LESRPE-CEEA; Royal Decree 139/2011). In the Spanish Red List it was considered within the IUCN category of VU (vulnerable) until 2017, and since then NT (near threatened), according to the criteria B1ab(iv,v)+2ab(iv,v) (SEBiCoP 2025).

Germination percentages were generally high across the temperatures tested, both constant and alternating. An exception was observed in sample 57B2016, which, at 25 °C under a 12-hour light / 12-hour dark photoperiod, exhibited a significantly lower germination percentage, specifically 50.7% (T_1 : 3.8; T_{50} : 5.0; T_{max} : 9.5; TMG: 6.0). It should also be noted that, a high proportion of empty seeds—exceeding 30%—was recorded in sam-

ples 98B1996 and 57B2016. Germination percentages were always calculated based on potentially viable seeds, after performing the cut test at the end of the experiment.

E. Estrelles-Perpiñá

153. *Sideritis hirsuta* L. (*Lamiaceae*)

Accession data:

Hs: Castellón, Barracas, prope el Mazorral (WGS84: 40.007882°N, -0.705113°W), 1020 m a.s.l., 16 june 1998, *J. Riera, F Marco, E. Estrelles* (UVEG-JBVAL-BG 102B1998).

Germination data

Pre-treatments: no treatment.

Germination medium: Agar 0.6%.

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

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	TMG [d]
86.2%	alternating 20/10 °C	12/12h	3.3	6.8	17.0	7.6

Observations

Perennial plant with a woody base and variable height (10–69 cm). Stems and leaves are densely pubescent. The inflorescence is elongated, consisting of 3–13 verticillasters, with an average of six flowers each, generally well-spaced.

The species grows on dry, stony, or calcareous soils, in scrublands, grasslands, and clearings of Mediterranean woodlands. It is occasionally ruderal or found in arable areas. Its distribution covers the Iberian Peninsula, southern France, northern Italy, and Morocco, with almost the entire Iberian Peninsula occupied, except for the Cantabrian coast and the western third.

As in the other studied species, no seed dormancy was observed. Germination begins almost immediately after the hydration phase.

E. Estrelles-Perpiñá

154. *Sideritis incana* L. (*Lamiaceae*)

Accession data:

Hs: Valencia, Carcaixent, Barranco de la Falzia (WGS84: 39.094674°N, -0.374940°W), 150 m a.s.l., 11 june 1998, *J. Riera, E. Estrelles* (UVEG-JBVAL-BG 41B1998).

Germination data

Pre-treatments: no treatment.

Germination medium: Agar 0.6%.

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

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	TMG [d]
82.5%	alternating 20/10 °C	12/12h	5.8	7.6	11.3	8.3

Observations

Perennial plant of variable size, ranging from 8 to 72 cm in height, with pubescent stems and linear or lanceolate leaves, usually entire and lanuginous when young. The inflorescence is 3–15 cm long, composed of verticillasters bearing four or more flowers, well-spaced from each other; bracts with distinctly marked and sometimes pungent teeth. This is a highly variable species, particularly with respect to the size and density of the indumentum. The studied population consists of tall plants with large flowers, calyx approximately 7 mm long. Such specimens have been identified by some authors as belonging to *Sideritis incana* subsp. *edetana* (Pau ex Font Quer) Mateo & M.B. Crespo.

Natural habitats include shrublands, esparto grasslands, clearings of Mediterranean forests, and cultivated fields, typically on basic, marly, or dolomitic substrates of stony or sandy nature. The species is distributed mainly in the western Mediterranean, including central, eastern, and southern Spain, as well as northern Africa.

The germination response observed is consistent with that reported for the studied *Sideritis* group.

E. Estrelles-Perpiñá

155. *Sideritis pungens* Benth. (*Lamiaceae*)

Accession data:

Hs: Castellón, Vistabella del Maestrat, cim del Penyagolosa (WGS84: 40.222809°N, - 0.349791°W), 1810 m a.s.l., 10 september 1997, *J. Riera* (UVEG-JBVAL-BG 76B1997).

Germination data

Pre-treatments: no treatment.

Germination medium: Agar 0.6%.

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

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	TMG [d]
82.8%	alternating 20/10 °C	12/12h	3.8	5.3	12.5	7.8

Observations

Perennial, erect herb with stems usually 15–53 cm tall, sparsely covered with rigid hairs, and narrow, elongated leaves, some mucronate and spiny. The inflorescence is spike-like,

up to 7 cm long, composed of 3–12 verticillasters with six flowers each, densely arranged and exhibiting a prickly aspect.

This species is endemic to the northern and eastern regions of the Iberian Peninsula, occurring in shrublands on calcareous, marly, clayey, gypsiferous, or conglomerate substrates, and occasionally on fluvial gravels, sometimes along roadsides and in cultivated fields.

The germination pattern observed in this species aligns with that reported for the studied taxa of the same genus.

E. Estrelles-Perpiñá

156. *Sideritis spinulosa* Barnadez ex Asso (*Lamiaceae*)

Accession data:

Hs: Castellón, Vilafranca, La Palomita (WGS84: 40.435624°N, -0.311291°W), 1320 m a.s.l., 21 august 2006, *E. Estrelles* (UVEG-JBVAL-BG 86B2006).

Germination data

Pre-treatments: no treatment.

Germination medium: Agar 0.6%.

Sample size: 100 seeds (10 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T1 [d]	T50 [d]	Tmax [d]	TMG [d]
81.2%	constant 20 °C	12/12h	4.8	6.2	11.3	7.1

Observations

Perennial plant, woody at the base and very leafy, with internodes largely covered by the leaves; stems lanate leaves 9–25 mm long, lanceolate, dentate, and more or less spiny, exhibiting variable indumentum. The inflorescence is compact, usually composed of 2–6 verticillasters, each bearing 6–10 flowers, with glabrous bracts.

The species grows in scrublands, thyme-dominated communities, and sage-dominated habitats on limestone, clay, marl, or gypsiferous marl, occasionally on skeletal soils or rocky outcrops. It is endemic to central and eastern Spain.

The germination behaviour observed in this species is comparable to that reported for the studied *Sideritis* group.

E. Estrelles-Perpiñá

157. *Sideritis tragoriganum* Lag. (*Lamiaceae*)

Accession data:

Hs: Valencia, Ayora, Casas de Madrona (WGS84: 38.978692°N, -1.081764°W), 690 m a.s.l., 19 june 1993, *J. Güemes*, *J. Riera* (UVEG-JBVAL-BG 74B1995).

Hs: Castellón, Ares del Maestrat, carretera a Catí Km. 1 (WGS84: 40.380284°N, - 0.062425°W), 630 m a.s.l., 19 july 2006, *E. Estrelles* (UVEG-JBVAL-BG 35B2006).

Germination data

Pre-treatments: no treatment.
Germination medium: Agar 0.6%.
Sample size: 100 seeds (25 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	TMG [d]	Accession code
83.1%	alternating 20/10 °C	12/12h	5.8	10.1	20.0	10.8	74B1995
91.0%	constant 20 °C	12/12h	4.3	5.5	12.5	6.5	35B2006

Observations

This taxon is a small perennial subshrub, reaching up to 48 cm in height, woody at the base and covered with whitish hairs. Its leaves are entire, narrow, mucronate to spiny, and tomentose. The inflorescence is clearly whorled, with 5–17 whorls of six flowers each, variably spaced.

It is endemic to the southern and eastern Iberian Peninsula, inhabiting sunny clearings in dry, calcareous scrublands.

The two populations studied, one from the northern part of Castellón Province and the other further south in Valencia Province, are locally assigned to different subspecies. The first population (74B1995), characterized by its smaller corolla (up to 8 mm in length) and a corolla tube exceeding the calyx in length, is identified as *S. tragoriganum* subsp. *mugro-nensis* (Borja) Obón & D. Rivera. In contrast, the second population (35B2006) exhibits larger flowers (up to 10 mm in length) and a corolla with a shorter tube, not visible between the calyx teeth, corresponding to *S. tragoriganum* subsp. *juryi* (Peris, Stübing & Figuerola) M.B.Crespo & Mateo. These differing taxonomic assignments, however, remain doubtful and under discussion among various authors.

This species exhibits a germination response similar to that observed in the studied *Sideritis* taxa.

E. Estrelles-Perpiñá

158. *Verbascum niveum* subsp. *garganicum* (Ten.) Murb. (*Scrophulariaceae*)

Accession data

It: Abruzzo, Pineto (Teramo), Torre del Cerrano Marine Protected Area (WGS84: 42.587186° N, 14.087285° E); sandy dune, 0 m a.s.l.; 22 July 2024; F. Tantalo (MSB_N_20240722_286_FT).

Germination data

Pre-treatments: soaked in water for 2 h, sterilization with a solution of 3% sodium hypochlorite plus Tween 20 for 4 min, followed by 3 rinses in sterile distilled water. Before performing germination test ⁽¹⁾, 80 seeds were incubated at 5 °C for 3 months (vernalization) under dark condition.

Germination medium: 1% agar, pH 5.75.

Sample size: 80 seeds (20 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	MTG [d]
100%	alternating 25/15°C	16/8h	2.0	2.4	11.0	6.9
91.7%	constant 20°C	12/12h	2.0	2.7	14.0	5.0
⁽¹⁾ 82.3%	constant 20°C	12/12h	1.0	2.5	10.0	6.5

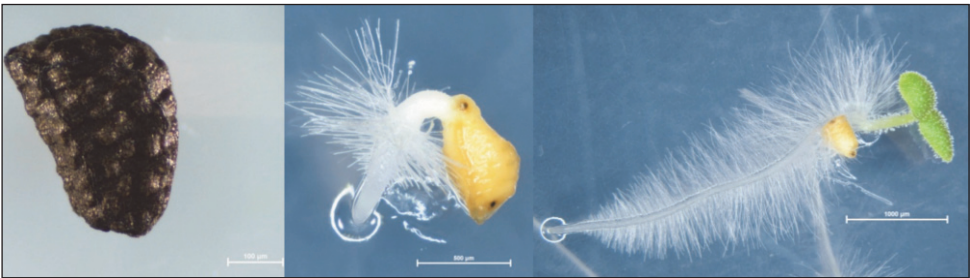


Fig. 2. Germinated seeds of *Verbascum niveum* subsp. *garganicum*.

Observations

Verbascum niveum subsp. *garganicum* is endemic to Italy and occurs only in Abruzzo, Marche, Molise, Lazio and Puglia. It is a biennial hemicryptophyte growing in dry grasslands at an elevation ranging between 0 and 1000 m a.s.l. Plants flower from June to August.

It is a species included in the Italian Red List of Threatened Plants under the IUCN “Data Deficient” (DD) category (Orsenigo & al. 2018; Rossi & al. 2021).

Germination tests were performed 12 months after seed collection, using constant temperatures of 15 °C and 20 °C with a 12/12 h light-dark photoperiod, alternating temperatures of 25 °C/15 °C with a 16/8 hours light-dark photoperiod and at 5 °C in continuous darkness.

The seeds of *V. niveum* subsp. *garganicum* showed no dormancy and achieved the highest germination rate (100%) under alternating temperatures of 25 °C/15 °C with a 16/8 h light-dark photoperiod. Germination percentage was just 50% under a constant temperature of 15 °C with a 12/12h light-dark photoperiod. Seeds subjected to vernalization (5 °C for

3 months in the dark) reached 82.3% of germination at constant temperature of 20 °C with a 12/12h light-dark photoperiod. The viability of ungerminated seeds at the end of the tests was estimated through the cutting test.

These results suggest that seeds of *V. niveum* subsp. *garganicum* germinate preferential-ly under non-constant but relatively high temperatures sustained for several hours per day. Cold stratification does not enhance seed germination in this species.

F. Tantalo & L. Di Martino

159. *Antinoria insularis* Parl. (*Poaceae*)

Accession data:

Si: Buccheri (Siracusa), Contessa di Sopra (WGS84: 37.106078° N, 14.856931° E), Mediterranean temporary ponds on volcanic soils, 905 m a.s.l., 15 July 2023, *M. Di Stefano, A. Alecci, P. Frazzetto & D. Vitale* (BGS-CT/CT/23/02).

Germination data

Pre-treatments: four months of dry after-ripening at 20 °C and 40% RH.

Germination medium: 1% agar in 6 cm Petri dishes.

Sample size: 100 seeds (25 × 4 replicates)

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	MTG [d]
81.8%	alternating 20/10 °C	12/12h	3	5.63	27	6.65
81.8%	alternating 25/15 °C	12/12h	2	6.57	27	8.72

Observations

Antinoria insularis is a steno-mediterranean species that in Italy is reported only for Apulia, Latium, Molise, Sardinia, and Sicily (Bartolucci & al. 2018). In Sicily, this species characterizes several communities of the small-sized ephemeral vegetation typical of Mediterranean temporary ponds (Brullo & al. 2022). In particular, it is a therophyte that colonises the intermediate belt of the ponds, where flooding can last but water depth is not excessive (Nimis & al. 2014). It is included in the Italian Red List of Threatened Plants under the IUCN “Near Threatened” (NT) category (Orsenigo & al. 2021).

Germination tests were carried out four months after seed harvesting. The seeds were incubated under 12/12 h photoperiod (with the warmer temperature provided simultaneously with the light phase) and in complete darkness, using constant temperatures of 15°C and 20°C, and alternating temperatures of 20/10 °C and 25/15°C (thermoperiod 12/12 hours).

Germination percentages of *A. insularis* were low at both 15 °C (56%) and 20 °C (25%) under light-dark conditions. The highest Final Germination Percentage (FGP) was

achieved at the alternating temperatures of both 20/10 °C and 25/15 °C (82%). Seeds incubated in complete darkness achieved 64% of final germination at 20/10 °C. The viability of the non-germinated seeds at the end of the tests was estimated through the cutting test.

These results suggest that *A. insularis* after-ripened seeds prefer alternating temperatures and light for germination, but they can also germinate, with lower rates, in darkness under alternating temperature regimes. We report the first germination data for this taxon here.

M. Di Stefano & A. Cristaudo

160. *Lythrum hyssopifolia* L. (Lythraceae)

Accession data:

Si: Buccheri (Siracusa), Contessa di Sopra (WGS84: 37.106078° N, 14.856931° E), Mediterranean temporary ponds on volcanic soils, 905 m a.s.l., 15 July 2023, *M. Di Stefano, A. Alecci, P. Frazzetto & D. Vitale* (BGS-CT/CT/23/03).

Germination data

Pre-treatments: four months of dry after-ripening at 20 °C and 40% RH.

Germination medium: 1% agar in 6 cm Petri dishes.

Sample size: 100 seeds (25 × 4 replicates)

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	MTG [d]
100.0%	constant 15 °C	12/12h	4	5.53	18	6.27
98.0%	alternating 20/10 °C	12/12h	3	6.06	25	8.00
90.8%	constant 20 °C	12/12h	2	4.02	23	5.97
87.6%	alternating 25/15 °C	12/12h	2	5.90	23	7.40

Observations

Lythrum hyssopifolia is a small therophyte with a wide ecological and biogeographic range that colonizes waterlogged or briefly inundated soils (Gazaix & al. 2021). It is typically found in the intermediate and outer belt of Mediterranean temporary ponds (Nimis & al. 2014).

Germination tests were carried out four months after seed harvesting. The seeds were incubated using constant temperatures of 15 °C and 20° C, and alternating temperatures of 20/10 °C and 25/15 °C (thermoperiod 12/12 hours), under both a light-dark photoperiod of 12/12 h (with warmer temperature provided simultaneously with light) and in complete darkness.

In light/dark conditions, germination was high (>87%) at every temperature tested. However, darkness completely inhibited germination under any temperature regime.

The viability of the non-germinated seeds at the end of the tests was estimated through the cutting test.

These results suggest that a strict light requirement, but not a preference for constant or alternating temperature, regulates the germination of *L. hyssopifolia*. We report the first germination data for this taxon here.

M. Di Stefano & A. Cristaudo

161. *Middendorfia borysthenica* (Schrank) Trautv. (*Lythraceae*)

Accession data:

Si: Buccheri (Siracusa), Contessa di Sopra (WGS84: 37.106078° N, 14.856931° E), Mediterranean temporary ponds on volcanic soils, 905 m a.s.l., 06 Jun 2022, *M. Di Stefano, D. Vitale & A. Cristaudo* (BGS-CT/CT/22/01).

Germination data

Pre-treatments: five months of dry after-ripening at 20 °C and 40% RH.
Germination medium: 1% agar in 6 cm Petri dishes.
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 15 °C	12/12h	4	5.97	9	6.48
99.8%	alternating 20/10 °C	12/12h	5	7.79	30	9.37
99.7%	alternating 25/15 °C	12/12h	3	7.38	30	9.56
99.5%	constant 20 °C	12/12h	3	4.32	19	5.44

Observations

Middendorfia borysthenica is an ephemeral Pontic-Mediterranean species that in Italy is reported only for Apulia, Latium, Piedmont, Sardinia, and Sicily (Bartolucci & al. 2018). It is typical of the areas of Mediterranean temporary ponds with shallow waters, where it usually develops dense and monospecific patches (Nimis & al. 2014; Brullo & al. 2022). In Sicily, the species is reported as rare (Giardina & al. 2007).

Germination tests were carried out five months after seed harvesting. The seeds were incubated at constant temperatures of 15 °C and 20 °C, and alternating temperatures of 20/10 °C and 25/15 °C (thermoperiod 12/12 hours), under both a light-dark photoperiod of 12/12 h (with warmer temperature provided simultaneously with light) and in complete darkness.

Under a 12/12 h photoperiod, seeds fully germinated at every tested temperature regime. Darkness completely inhibited germination under any temperature condition. The viability

of the non-germinated seeds at the end of the tests was estimated through the cutting test.

M. borysthenica showed a germination behaviour similar to the phylogenetically close *L. hyssopifolia* (Gazaix & al. 2021). In particular, the germination of the species is characterized by a strict light requirement and by the absence of a thermoperiod preference (constant or alternating). We report the first germination data for this taxon here.

M. Di Stefano & A. Cristaudo

162. *Myosotis sicula* Guss. (*Boraginaceae*)

Accession data:

Si: Buccheri (Siracusa), Contessa di Sopra (WGS84: 37.106078° N, 14.856931° E), Mediterranean temporary ponds on volcanic soils, 905 m a.s.l., 06 Jun 2022, *M. Di Stefano, D. Vitale & A. Cristaudo* (BGS-CT/CT/22/02).

Germination data

Pre-treatments: five months of dry after-ripening at 20°C and 40% RH.

Germination medium: 1% agar on 6 cm Petri dishes.

Sample size: 100 seeds (25 × 4 replicates)

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	MTG [d]
99.8%	constant 15°C	12/12h	4	4.71	8	5.27
98.8%	alternating 20/10°C	12/12h	4	4.63	8	5.21
98.1%	alternating 25/15°C	12/12h	4	6.32	18	7.12
96.3%	constant 20°C	12/12h	2	3.89	8	4.38

Observations

Myosotis sicula is a small Mediterranean therophyte reported in Italy only for Latium, Tuscany, Sardinia, and Sicily (Bartolucci & al. 2018). It grows in the intermediate belt of Mediterranean temporary ponds, but it can also colonize wet meadows (Nimis & al. 2014; Brullo & al. 2022).

In Sicily, the species is reported as very rare, being found only in a few wetlands of western Sicily and in the Nebrodi and Hyblean mountains (Giardina & al. 2007; Brullo & al. 2022).

Germination tests were carried out five months after seed harvesting. The seeds were incubated using constant temperatures of 15°C and 20°C, and alternating temperatures of 20/10°C and 25/15°C (thermoperiod 12/12 hours) under both a light-dark photoperiod of 12/12 hours (with warmer temperature provided simultaneously with light) and in complete darkness.

Under light-dark conditions, seeds fully germinated at every tested temperature regime. Seeds also germinated in darkness under alternating temperatures, with a peak of 73.7% at 20/10°C in darkness. The viability of the non-germinated seeds at the end of the tests was estimated through the cutting test.

Seeds of *M. sicula* showed no thermoperiod preference to germinate. Full germinability can be achieved at medium temperatures after five months of after-ripening. We report the first germination data for this taxon here.

M. Di Stefano & A. Cristaudo

163. *Centaurea virescens* (Guss.) Domina & Raimondo (*Asteraceae*)

Accession data

Si: Palermo, Torretta, Piano dell'Occhio, (WGS84: 38. 38.096666°N, 13.225833°E), rocky pastures, ca. 640 m a.s.l., 09 Jul 2024, *F. Scafidi* (233_SF/24; SPGR/PA Sicilian Plant Germplasm Repository, University of Palermo, Italy)

Germination data

Pre-treatments: sterilization with commercial bleach (4% NaOCl) for 3 min, followed by 2 rinses in sterile distilled water, and imbibition in sterile distilled water for 12 h.

Germination medium: 2 sheets of sterilized filter paper (Whatmann No. 1), imbibed with 6 ml of sterilized distilled water in 9 cm Petri dishes.

Sample size: 75 seeds (25 × 3 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	MTG [d]
82.7%	alternating 20/15 °C	0/12h	3	7.50	30	10.29

Observations

Centaurea virescens is an heliophilous calcicolous species endemic to Palermo Mounts belonging to the *C. parlatoris* complex (Domina & al. 2021). The species is reported as Near Threatened (NT) in the in the Red List of the Italian flora sub. *C. parlatoris* Heldr. subsp. *virescens* (Guss.) Raimondo & Bancheva (Rossi & al. 2020). This is the first germination report for this taxon. The best germination percentage (82.7%) was achieved at alternating temperature regime 20/15 °C in full darkness condition, while under 12/12 h photoperiod germination dropped to a mean value of 68% ± 13.66. At the constant temperature of 15° C germination reached 73.3% in the dark and just 62.7% applying 12 hours of light exposure. Based on these results seeds of this species show a somewhat negative photoblastic behaviour and require high temperature to germinate.

F. Scafidi, G. Mazzara Curcurù & G. Pipitone

164. *Dianthus graminifolius* C. Presl (Caryophyllaceae)**Accession data**

Si: Palermo, Torretta, Portella Torretta, (WGS84: 38.1358333°N, 13.245277°E), carbonate lithosol, ca. 561 m a.s.l., 17 Jul 2024, *F. Scafidi* (245_SF/24; SPGR/PA Sicilian Plant Germplasm Repository, University of Palermo, Italy)

Germination data

Pre-treatments: sterilization with commercial bleach (4% NaOCl) for 3 min, followed by 2 rinses in sterile distilled water, and imbibition in sterile distilled water for 12 h.

Germination medium: 2 sheets of sterilized filter paper (Whatmann No. 1), imbibed with 6 ml of sterilized distilled water in 9 cm Petri dishes.

Sample size: 75 seeds (25 × 3 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	MTG [d]
98.7%	constant 15 °C	12/12h	2	3.44	13	4.59
97.3%	constant 15 °C	0/24h	3	3.13	13	4.30
97.3%	alternating 20/15 °C	12/12h	3	2.92	16	4.45
88.0%	alternating 20/15 °C	0/12h	2	2.76	15	3.82

Observations

Dianthus graminifolius, which belongs to the *D. virgineus complex*, is native to Sicily and Tunisia (Domina & al. 2025). The species is classified as Least Concern (LC) in the Red List of the Italian flora (Rossi & al. 2020). It is rather common in Sicily, especially in the north-western part, growing from the sea level up to 1000 m a.s.l. The species appears adapted to different soil types and is usually found in dry grasslands dominated by *Ampelodesmos mauritanicus* (Bacchetta & al. 2010). The chromosome number of this species ($2n=2x=30$) was recently reported for the first time by (Franzoni & al. 2024). This is the first germination report for this species. Likewise other Sicilian populations of *Dianthus* species (Lantieri & al. 2012; Salmeri & al. 2023), seed are non-dormant and the highest and faster germination rate occurred at the constant temperature of 15°C. High values were also observed under the alternating regime of 20/15 °C. Seeds are not photosensitive, though germination resulted slightly improved under 12/12h photoperiod.

F. Scafidi, G. Mazzara Curcurù & G. Pipitone

165. *Iberis semperflorens* L. (*Brassicaceae*)

Accession data

Si: Palermo, Santa Flavia, Capo Zafferano, (WGS84: 38.110555°N, 13.538611°E), sea cliffs, ca. 34 m a.s.l., 29 May 2024, *F. Scafidi* (348_SF/24; SPGR/PA Sicilian Plant Germplasm Repository, University of Palermo, Italy)

Germination data

Pre-treatments: sterilization with commercial bleach (4% NaOCl) for 3 min, followed by 2 rinses in sterile distilled water, and imbibition in sterile distilled water for 12 h.

Germination medium: 2 sheets of sterilized filter paper (Whatmann No. 1), imbibed with 6 ml of sterilized distilled water in 9 cm Petri dishes.

Sample size: 50 seeds (25 × 2 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T ₁ [d]	T ₅₀ [d]	T _{max} [d]	MTG [d]
84.0%	constant 20 °C	12/12h	1	1.92	10	3.12
82.0%	constant 20 °C	0/24h	1	3.25	15	5.07
82.0%	constant 15 °C	12/12h	2	2.96	11	4.20
82.0%	constant 15 °C	0/24h	2	2.94	6	3.63

Observations

Iberis semperflorens L. is a subendemic perennial shrub to southern Italy, Sicily and Zembra (Tunisia) (Pignatti & al. 2017-2019). In Sicily, the species grows along the coastal areas of Sicily in dry calcareous soils and in partially shaded calcareous rock crevices (Iapichino & Bertolino 2009a). Germination tests on this taxon were previously carried out by Iapichino & Bertolino (2009b) on a selected cultivated clone, providing optimal germination (91%) at 20°C under 12/12h photoperiod, while germination decreased under full dark conditions and at both lower and higher temperatures, with 38% and 27% at 14°C with light and total darkness conditions respectively. We carried out our germination experiments on seeds collected from a wild population close to the locus classicus, near Palermo. Differently from literature data, tests at constant temperature of 20 °C and 15 °C provided a final mean germination of 84 and 82% respectively, without any substantial difference between 12/12h and 0/24 h photoperiod, except for higher speed rates under light conditions at 20°C, while on the contrary at 15°C.

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166. *Rhaponticum coniferum* (L.) Greuter subsp. *coniferum* (Asteraceae)

Accession data

Si: Palermo, Monreale, Cozzo di Fratantoni, (WGS84: 38.001388°N, 13.25166°E), garrigue, ca. 970 m a.s.l., 21 Jul 2023, *F. Scafidi* (104_SF/23; SPGR/PA Sicilian Plant Germplasm Repository, University of Palermo, Italy)

Germination data

Pre-treatments: sterilization with commercial bleach (4% NaOCl) for 3 min, followed by 2 rinses in sterile distilled water, and imbibition in sterile distilled water for 12 h.

Germination medium: 2 sheets of sterilized filter paper (Whatmann No. 1), imbibed with 6 ml of sterilized distilled water in 9 cm Petri dishes.

Sample size: 75 seeds (25 × 3 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T _i [d]	T ₅₀ [d]	T _{max} [d]	MTG [d]
97.3%	constant 15 °C	0/24h	9	12.63	26	13.73
96.0%	constant 15 °C	12/12h	7	12.96	23	13.18
93.3%	alternating 20/15 °C	0/12h	8	14.60	32	16.04
82.7%	alternating 20/15 °C	12/12h	8	15.50	33	18.68

Observations

Rhaponticum coniferum subsp. *coniferum* is a perennial herbaceous species growing in the W Mediterranean area (Lekouaghet & al. 2020). In Italy, its presence was reported in Piedmont, Liguria, Tuscany, Sardinia and Sicily, but as uncertain in Apulia (Bartolucci & al. 2024). In Sicily, *R. coniferum* subsp. *coniferum* is a very rare taxon, only occurring in the Mounts of Palermo and Madonie Mountains (Cambria & Di Gregorio 2024). No germination data from Italian populations of this taxon were previously available. Seeds from Spain provided 95% of germination at constant temperature of 21 °C at 12/12 h photoperiod (Society for Ecological Restoration 2025). Our experiments showed best germination results at the constant temperature of 15°C, both under light and full darkness conditions. Application of alternating thermoperiod (20/15 °C) lowered the germination rate to 93.3% under complete darkness, dropping to 82.7% with the presence of light. In general, seed germination was rather slow, with the radicles emerging after 7-9 days light seems under-stimulate seed germination

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Fig. 3 Germinated seeds of *Centaurea virescens* (A), *Dianthus graminifolius* (B) and *Rhaponticum coniferum* subsp. *coniferum* (C) from Sicily. Green background is due to inactinic light (510 nm) for checking germination tests under full dark conditions.

Acknowledgements

This article is dedicated to the memory of our esteemed colleague and friend, Dr. Sara Magrini, co-editor of this series and a botanist with outstanding expertise in biodiversity conservation, who served as curator of the Tuscia Germplasm Bank and passed away prematurely last August.

The research of E.E. has been partially funded by the Generalitat Valenciana (Nos. 151-157). C.S. and G.P. gratefully acknowledge the financial support of NBFC to University of Palermo, funded by the Italian Ministry of University and Research, PNRR, Mission 4 Component 2, “*Dalla ricerca all’impresa*” Investment 1.4, Project CN00000033 (Nos. 163-166).

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Addresses of the authors:

Cristina Salmeri^{1,2,3*},

¹Department of Biological, Chemical and Pharmaceutical Sciences and Technologies (STEBICEF) & Mediterranean Plant Germplasm Repository, University of Palermo, Via Archirafi 38, I 90123 Palermo, Italy. E-mail: cristinamaria.salmeri@unipa.it

²National Biodiversity Future Center (NBFC), Piazza Marina, 61, 90133, Palermo, Italy.

³RIBES, Rete Italiana Banche del germoplasma per la conservazione Ex Situ della flora italiana ETS, www.reteribes.it

Eva García-Martínez^{4*}, Elena Estrelles-Perpiñá^{4*},

⁴Jardí Botànic de la Universitat de València, Quart 80, 46008 Valencia, Spain.

Emails: eva2.Garcia@uv.es; elena.estrelles@uv.es

Francesca Tantalo⁵ & Luciano Di Martino^{5*},

⁵MaiellaSeed Bank, Maiella National Park, via Fonte Cannella 46, 66010 Lama dei Peligni (CH), Italy. E-mails: francesca.tantalo@gmail.com; luciano.dimartino@parcomaiella.it

Mario Di Stefano⁶ & Antonia Cristaudo^{3,6*},

⁶Catania Germplasm Bank, Department of Biological, Geological and Environmental Sciences, Catania University, Catania, Italy. E-mail: acristau@unict.it

Filippo Scafidi^{1*}, Giulia Mazzara Curcurù¹ & Gessica Pipitone^{1, 2},

Sara Magrini^{3, 7 †},

⁷Department of Ecological and Biological Sciences & Tuscia Germplasm Bank, Tuscia University, Largo dell'Università, 01100 Viterbo, Italy.

*Corresponding authors

