Article

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Mediterranean plant germination reports – 6

Abstract

Salmeri, C., Bacchetta, G., Blandino, C., Boi, M. E., Cristaudo, A., Crocenzi, G., Di Cecco, V., Di Martino, L., Di Paola, A. I., Escribá, M. C., Estrelles, E., Fabrini, G., Güemes, J., Nebot, A., Panero, I., Porceddu, M., Prieto-Mossi, J., Tantalo, F. & Magrini, S.: Mediterranean plant germination reports – 6. — Fl. Medit. 34: 159-194. 2024. — ISSN: 1120-4052 printed, 2240-4538 online.

This is the sixth issue of the series of germination reports from Mediterranean areas (sensu Med-Checklist). It comprises germination protocols for 29 taxa, 19 of which are endemic, preserved in six seedbanks from the Ribes and/or GENMEDA networks. The investigated taxa and populations are *Leucanthemum tridactylites*, *Achillea barrelieri* subsp. *barrelieri*, *Erysimum majellense*, *Digitalis micrantha* and *Saxifraga porophylla* subsp. *porophylla* from Abruzzo (Italy) by Di Cecco & al. (Nos. 121-125), *Armeria sulcitana* and *Iberis integerrima* from Sardinia (Italy) by Boi & al. (Nos. 126-127), *Eokochia saxicola* and *Primula palinuri* from Campania and *Lythrum tribracteatum* from Latium (Italy) by Crocenzi & al. (Nos. 128-130), *Hyoseris lucida* subsp. *taurina*, *Lotus cytisoides*, *Senecio leucanthemifolius*, *Silene neglecta* from Lipari (Aeolian Islands) and *Linaria pseudolaxiflora* from Gozo (Maltese archipelago) by Di Paola & al. (Nos. 131-135), *Gadoria falukei* from Almería (Spain) by Nebot & Güemes (No. 136), *Coris monspeliensis*, *Limonium dufourii*, *L. furfuraceum*, *L. lobatum*, *L. perplexum*, *L. supinum*, *Nigella nigellastrum*, *Parentucellia viscosa*, *Silene mellifera* and *S. tridentata* from Valencian Community (Spain) by Escribá & al. (Nos. 137-146), *Erysimum metlesicsii*, *Jacobaea lycopifolia* and *Matthiola incana* subsp. *rupestris* from Sicily (Italy) by Scafidi & al. (Nos. 147-149).

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

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Introduction

This sixth issue of the series of germination reports from Mediterranean areas (sensu Med-Checklist) examines the germination protocols of 29 taxa belonging to twelve dicot

plant families, namely *Plumbaginaceae* (6), *Asteraceae* (5), *Brassicaceae* (4), *Caryophyllaceae* (3), *Plantaginaceae* (3), *Primulaceae* (2), *Amaranthaceae* (1), *Fabaceae* (1), *Lythraceae* (1), *Orobanchaceae* (1), *Ranunculaceae* (1) and *Saxifragaceae* (1).

Twelve of the 29 taxa are endemic to Italy, of which 2 are strictly endemic to Sardinia and 1 to Sicily, other 6 taxa are endemic to Spain, of which 3 are strictly endemic to the Valencian flora, 1 species is restricted to the Maltese archipelago (Malta) and the island of Linosa (Sicily), while the remaining 10 taxa have a wider distribution in the Mediterranean. 62% of the taxa studied are considered threatened to varying degrees and are included in an IUCN Red List category at the national or global (3 species) level.

As is known, seed germination is a key event in the plant life cycle which influences the survival of most plant species. Knowing the germination behaviour, especially of endemic and rare taxa, is pivotal to both *in situ* and *ex situ* conservation actions, providing useful information about the ecological requirements for seedling establishment and plant growth in the current and future environmental conditions. These reports contribute to the improvement of the knowledge of the best germination protocols for Mediterranean plants and implement to 149 records the checklist of Mediterranean germination reports available in the MPGR folder, a valid tool for researchers and technicians involved in plant conservation and propagation.

121. *Leucanthemum tridactylites* (A.Kern. & Huter ex Porta & Rigo) Huter, Porta & Rigo (*Asteraceae*)

Accession data:

It: Abruzzo. Pennapiedimonte (Chieti), loc. Fontanino Acquaviva (WGS84: 42.120981° N, 14.115225° E), pseudo-alpine meadows, rocky slopes, 2,170 m a.s.l., 12 Aug 2023, *V. Di Cecco & F. Tantalo* (MSB_N_20230812_111_VDC).

Germination data

Pre-treatments: Soaking in water for 2h, sterilization with a solution of 1% sodium hypochlorite plus Tween 20 for 4 minutes, followed by 3 rinses in sterile distilled water.
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]
92.5%	constant 20°C	12/12h	2.0	5.1	15.5	5.8

Observations

Leucanthemum tridactylites is endemic to Italy and is found only in Abruzzo, Molise, Lazio, and Calabria. This species is a scapose hemicryptophyte and lives in pseudo-alpine meadows, rocky slopes, and cracks in rocks at an elevation ranging from 1500 to 2200 m a.s.l., where it blooms from July to August.

Fig. 1. Germinated seeds of *Leucanthemum tridactylites.*

It is a species included in the Italian Red List of Threatened Plants under the IUCN "Least Concern" (LC) category (Orsenigo & al. 2018; Rossi & al. 2020).

Germination tests were carried out 7 months after seed harvesting, using constant temperatures of 15°C and 20°C with a light-dark photoperiod of 12/12 hours, and constant temperatures of 20°C and 5°C in continuous darkness. The seeds of *L. tridactylites* showed no dormancy and had the highest germination rate (92.5%) at a temperature of 20°C with a light-dark photoperiod of 12/12 hours.

The Petri dishes incubated in the dark at a temperature of 20°C were opened after 50 days and the germination percentage was 55%. In contrast, the Petri dishes incubated in the dark at 5°C and opened after 50 days revealed no germinated seeds. Eighty seeds were incubated in the dark at 5°C for 3 months (vernalization); they were subsequently subjected to a constant temperature of 15°C with a light-dark photoperiod of 12/12 hours, reaching 52.5% of germination. The viability of the non-germinated seeds at the end of the tests was estimated through the cutting test.

These results suggest that *L. tridactylites* seeds prefer constant high or medium temperatures for germination. We report the first germination data for this taxon here.

V. Di Cecco, F. Tantalo & L. Di Martino

122. ***Achillea barrelieri*** (Ten.) Sch.Bip. subsp. ***barrelieri*** (*Asteraceae*)

Accession data:

It: Abruzzo. Pennapiedimonte (Chieti), loc. Fontanino Acquaviva (WGS84: 42.120536° N, 14.115330° E), consolidated gravels and pioneer sod, 2,184 m a.s.l., 12 Aug 2023, *V. Di Cecco & F. Tantalo* (MSB_N_20230812_112_VDC).

Germination data

Pre-treatments: Soaking in water for 2h, sterilization with a solution of 1% sodium hypochlorite plus Tween 20 for 4 minutes, followed by 3 rinses in sterile distilled water. 80 seeds were incubated in the dark at 5°C for 3 months (vernalization); they were subsequently subjected to a constant temperature of 15°C with a light-dark photoperiod of 12/12h[(1)].

Germination medium: 1% agar, pH 5.75.
Sample size: 80 seeds (20 × 4 replicates) for each condition.

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max}[d]	MTG [d]
100%	constant 20°C	12/12h	2.0	2.5	6.0	3.5
97.5%[(1)]	constant 15°C	12/12h	1.0	1.6	10.5	6.4
97.5%	constant 20°C	0/24h	-	-	-	-
90.0%	constant 15°C	12/12h	2.5	4.0	7.3	4.5

Observations

Achillea barrelieri subsp. *barrelieri* is endemic to Italy and is found only in Abruzzo, Molise, Lazio, Marche, and Umbria. This species is a cespitose hemicryptophyte and lives on consolidated gravels and pioneer sod at altitudes from 2000 to 2600 m a.s.l., where it blooms in July and August. The species is included in the Italian Red List of Threatened Plants under the IUCN "Least Concern" (LC) category (Orsenigo & al. 2018; Rossi & al. 2020).

Germination tests were carried out 6 months after seed harvesting, using constant temperatures of 15°C and 20°C with a light-dark photoperiod of 12/12 hours, and constant temperatures of 20°C and 5°C in continuous darkness. Seeds showed no dormancy and had the highest germination rate (100%) at a temperature of 20°C with a 12/12 h light-dark photoperiod. The Petri dishes incubated in the dark at a temperature of 5°C were opened after 50 days revealing any germinated seeds. The seeds subjected to vernalization for 3 months reached 97.5% of germination. The viability of the non-germinated seeds at the end of the tests was estimated through the cutting test.

These results suggest that *Achillea barrelieri* subsp. *barrelieri* seeds prefer constant high or medium temperatures for germination. Vernalization slightly improved the germination rate. We report here the first germination data for this taxon.

V. Di Cecco, F. Tantalo & L. Di Martino

123. *Erysimum majellense* Polatschek (*Brassicaceae*)

Accession data:

It: Abruzzo. Fara San Martino (Chieti), loc. Val Cannella (WGS84: 42.083469 N, 14.115810 E), steppe and rock slopes, and arid calcareous meadows, 2,154 m a.s.l., 06 Oct 2023, *V. Di Cecco* (MSB_N_20231006_114_VDC).

Germination data

Pre-treatments: Soaking in water for 2h, sterilization with a solution of 1% sodium hypochlorite plus Tween 20 for 3 minutes followed by 3 rinses in sterile distilled water.
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]
81.2%	constant 15°C	12/12h	3.2	4.5	7.0	5.0

Observations

Erysimum majellense is endemic to Italy, circumscribed to Abruzzo, Molise, and Lazio. This species is a scapose hemicryptophyte and lives on steppe and rock slopes, and arid calcareous meadows from 1100 to 2400 m above sea level, where it blooms from June to August. The species is included in the Italian Red List of Threatened Plants in the IUCN "Least Concern" (LC) category (Orsenigo & al. 2018; Rossi & al. 2020).

Germination tests were carried out 1 month after seed harvesting, using constant temperatures of 10°C, 15°C, 20°C, 25°C, and the alternating temperature of 10/20°C, with a light-dark photoperiod of 12/12 hours, and constant temperatures of 20°C and 5°C in continuous darkness. The seeds of *E. majellense* showed no dormancy and had the highest germination rate (81.25%) at a temperature of 15°C with a light-dark photoperiod of 12/12 hours. Seeds germinated at a rate of 75% at the constant temperatures of 10°C and 20°C with a light-dark photoperiod of 12/12 hours. The germination percentage was slightly lower (70%) for seeds incubated at the 20/10°C alternating thermoperiod, with 12/12h light-dark condition, while it dropped to 32.5% at 25°C and 12/12 h light-dark photoperiod. The Petri dishes incubated in the dark were opened after 34 days, revealing a germination percentage of 43.75% at 20°C and of only 7.5% at 5°C. Eighty seeds were incubated in the dark at 5°C for 3 months (vernalization); then they were maintained under a constant temperature of 20°C with a 12/12h light-dark photoperiod, reaching 67.5% of germination.

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

These results suggest that seeds of *Erysimum majellense* mostly germinate between 10° and 20°C and show a positive photoblastic response. Vernalization does not improve seed germination in this species.

V. Di Cecco, F. Tantalo & L. Di Martino

124. *Digitalis micrantha* Roth ex Schweigg. (*Plantaginaceae*)

Accession data:

It: Abruzzo. Taranta Peligna (Chieti), loc. Valle di Taranta (WGS84: 42.038494 N, 14.152415 E), forest clearings, 1,370 m a.s.l., 13 Sept 2023, *A. Di Renzo* & *F. Tantalo* (MSB_N_20230913_113_ADR).

Germination data

Pre-treatments: Priming with 500 ppm gibberellic acid (GA_3) aqueous solution for 24 hours. Afterwards, sterilization with a solution of 1% sodium hypochlorite plus Tween 20 for 3 minutes, followed by 3 rinses in sterile distilled water.

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%	constant 20°C	12/12h	4.3	6.3	16.0	7.3

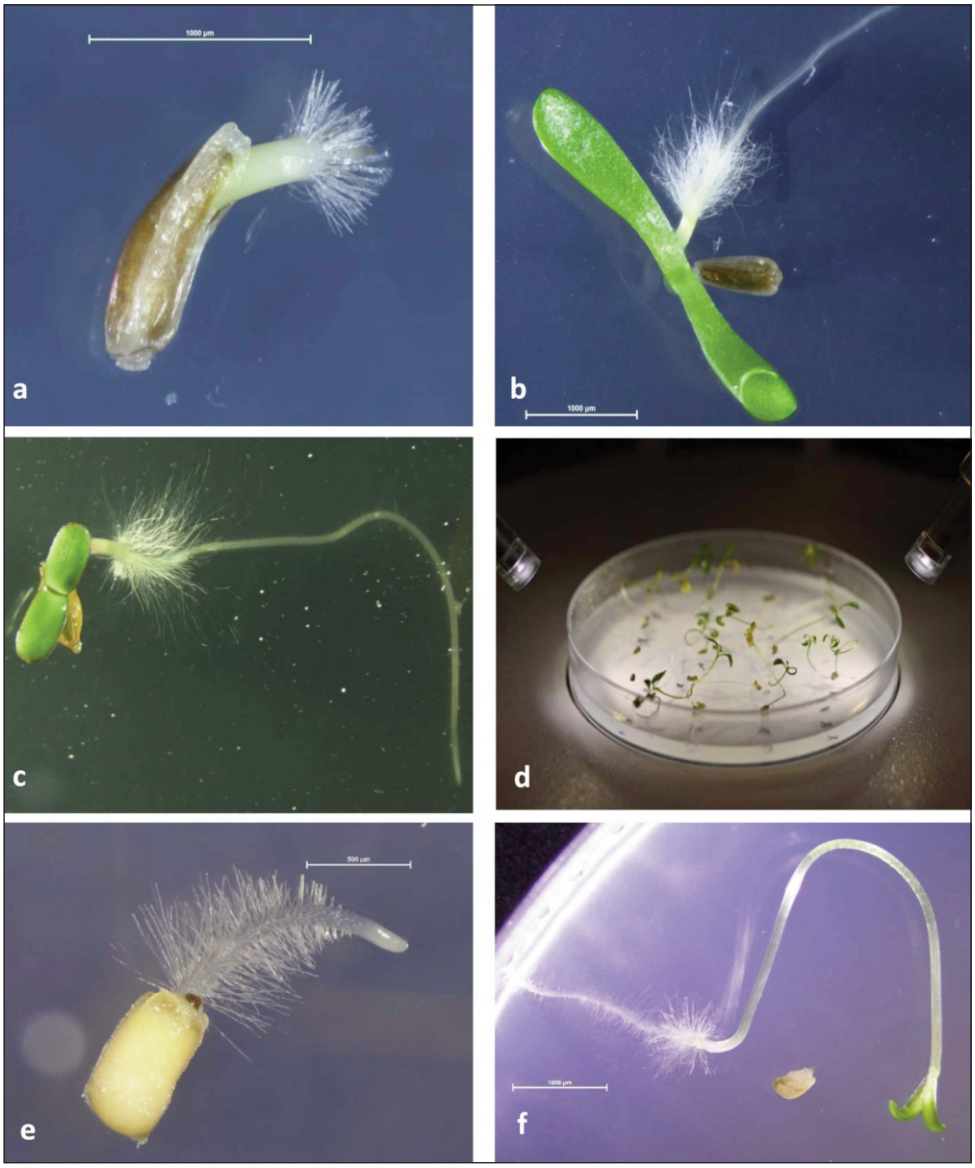

Fig. 2. Germinated seeds of *Achillea barrelieri* subsp. *barrelieri* (a, b), *Erysimum majellense* (c, d), *Digitalis micrantha* (e, f),

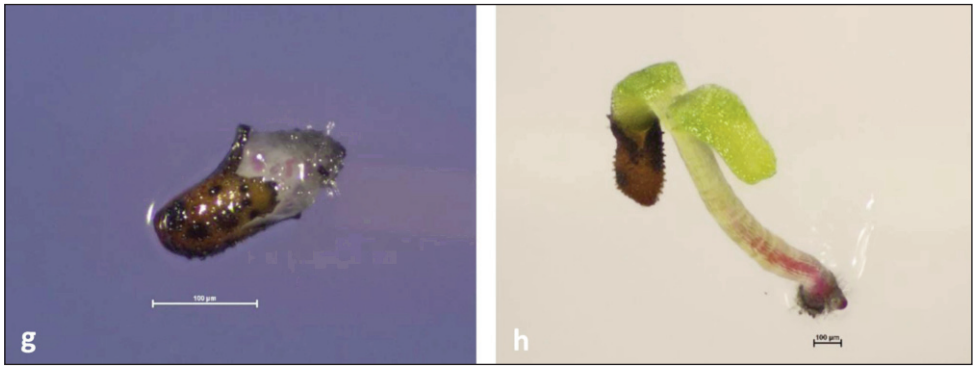

Fig. 2. Germinated seeds of *Saxifraga porophylla* subsp. *porophylla* (g, h),

Observations

Digitalis micrantha is endemic to Italy and is found only in the Apennines. This species is a scapose hemicryptophyte that lives in forest clearings starting from 300 m above sea level; flowering occurs from May to July. The species is included in the Italian Red List of Threatened Plants in the IUCN "Least Concern" (LC) category (Orsenigo & al. 2018; Rossi & al. 2020).

Germination tests were carried out 7 months after seed collection at different temperatures (5°C, 10°C, 15°C, 20°C, 25°C, 10°/20°C) and different photoperiods (12/12 hours light-dark and continuous darkness). A significant germination percentage (71.25%) was recorded only at a constant temperature of 10°C with a 12/12h light-dark photoperiod, after over 100 days of incubation. Seed germination was significantly improved by hormonal priming pre-treatment (24 h in 500 ppm GA_3), which provided 100% of germination at the constant temperature of 20°C and a 12/12h light-dark photoperiod. These results suggest that *D. micrantha* seeds have some physiological dormancy and the treatment with gibberellins accelerates their cell development.

V. Di Cecco, F. Tantalo & L. Di Martino

125. *Saxifraga porophylla* Bertol. subsp. ***porophylla*** (*Saxifragaceae*)

Accession data:

It: Abruzzo. Fara San Martino (Chieti), loc. Cima Murelle (WGS84: 42.111121 N, 14.132902 E), compact or crumbling limestone cliffs, 2,571 m a.s.l., 12 Aug 2023, *V. Di Cecco* & *F. Tantalo* (MSB_N_20230812_115_VDC).

Germination data

Pre-treatments: Priming with 10^{-3} M gibberellic acid (GA_3) aqueous solution for 24 hours. Afterwards sterilization with a solution of 1% sodium hypochlorite plus Tween 20 for 2 minutes followed by 3 rinses in sterile distilled water.

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]
81.4%	constant 20°C	12/12h	8.0	6.2	36.8	9.9

Observations

Saxifraga porophylla subsp. *porophylla* is endemic to Italy, only occurring in the central-southern Apennines (Abruzzo, Molise, Lazio, Marche, Umbria, Campania, Basilicata, and Calabria). This species is a pulvinate chamaephyte and lives on compact and crumbling limestone cliffs from 1200 m a.s.l. upwards; flowering occurs in June. It is a species included in the Italian Red List of Threatened Plants under the IUCN "Least Concern" (LC) category (Orsenigo & al. 2018; Rossi & al. 2020).

Germination tests were carried out 8 months after seed collection, using a constant temperature of 20°C with a light-dark photoperiod of 12/12 hours, which provided a germination percentage of 81.39%. Further germination tests at different temperatures (5°C, 15°C, 20°C) and different photoperiods (12/12 hours light-dark and continuous darkness) were carried out on seeds not treated with gibberellins without any germination, thus suggesting the presence of a physiological seed dormancy in this taxon.

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

V. Di Cecco, F. Tantalo & L. Di Martino

126. *Armeria sulcitana* Arrigoni (*Plumbaginaceae*)

Accession data:

Sa: Gonnosfanadiga (South - West Sardinia), Genn'e Spina (WGS84: 39.4454360°N, 8.6571890°E), granitic cliffs and rocky walls, 840 m a.s.l., 5 Jul 2021*, M. Porceddu & M. Sarigu* (BG-SAR PRIN 01/21, Sardinian Germplasm Bank).

Germination data

Pre-treatments: No treatment.
Germination medium: 1% agar.
Sample size: 60 seeds for each test (20 × 3 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
86.1%	constant 10°C	12/12h	5.0	12.0	40.0	11.9
85.8%	constant 15°C	12/12h	5.0	8.0	26.0	9.7

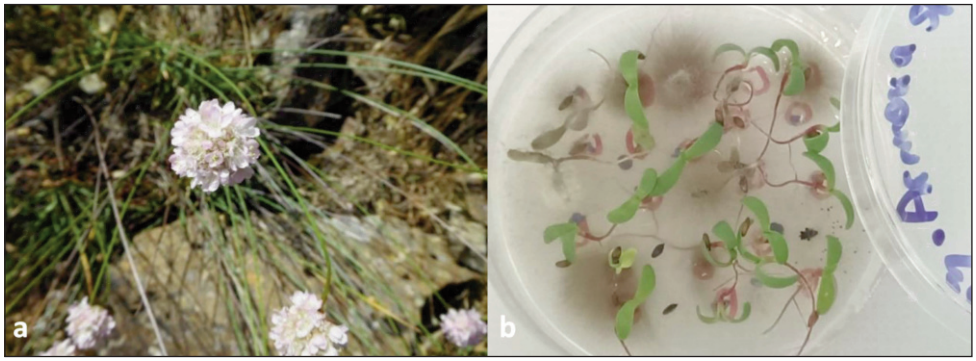

Fig. 3. a) Flowering specimen of *Armeria sulcitana*; b) Germinated seeds and seedlings of *A. sulcitana.*

Observations

Armeria sulcitana is endemic to Sardinia, and its distribution range is restricted to the Sulcis-Iglesiente biogeographic sector (Bacchetta & Pontecorvo, 2005). It is considered Least Concern (LC) both in Sardinia and in the Italian flora's red list (Rossi & al. 2020). This is the first complete germination report for this taxon. Seeds of *A. sulcitana* germinated with high percentages (>85%) at 10°C and 15°C, and reached 76.8% of germination at 20°C. The germination tests were carried out at the Sardinian Germplasm Bank (BG-SAR; Porceddu & al. 2017). The result reported in the SER's Seed Information Database indicates high germination capability at 20°C obtained in 33 days by testing 52 seeds with no replicates (SER, INSR, RBGK, Seed Information Database -SID-, 2023).

M. E. Boi, M. Porceddu & G. Bacchetta

127. *Iberis integerrima* Moris (*Brassicaceae*)

Accession data:

Sa: Iglesias (South - West Sardinia), Bacino San Giorgio (WGS84: 39.289583°N, 8.520027°E), garrigue, 134 m a.s.l., 5 Jul 2023, *M.E. Boi, L. Dessì & A. Lallai* (BG-SAR 11/23, Sardinian Germplasm Bank).

Germination data

Pre-treatments: No treatment.
Germination medium: 1% agar.
Sample size: 100 seeds for each test (25 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
100%	constant 20°C	12/12h	3.0	3.1	7.0	4.4
99.0%	constant 15°C	12/12h	3.0	3.1	7.0	4.3

97.0%	alternating 20/10°C	12/12h	3.5	4.0	7.8	5.0
95.0%	constant 25°C	12/12h	3.0	6.3	26.5	10.0
93.0%	constant 10°C	12/12h	5.0	5.5	11.5	7.2

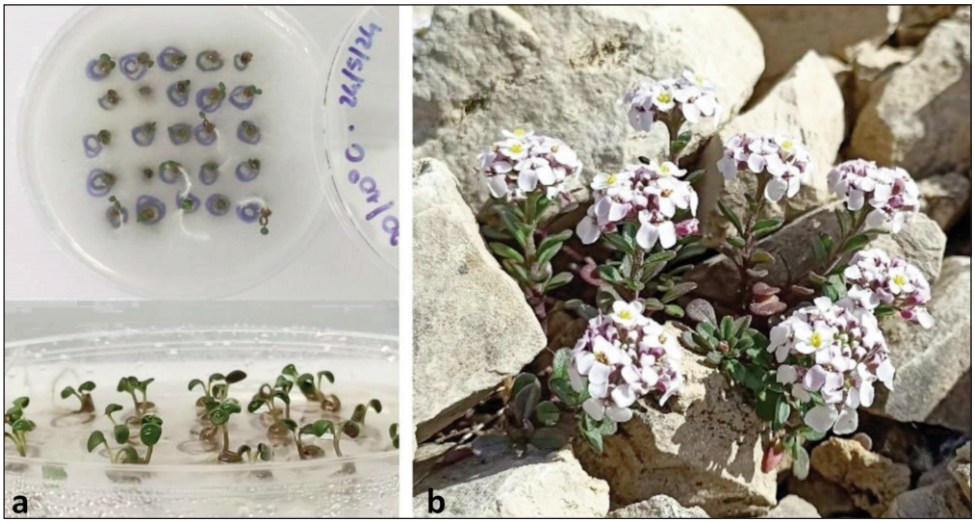

Fig. 4. a) Details of germination tests of *Iberis integerrima*; b) Flowering specimen of *I. integerrima.*

Observations

Iberis integerrima is an endemic calcicolous chamaephyte of Sardinia that occurs on carbonatic substrates also naturally enriched by metal(loid)s and on polluted mine wastes of abandoned mine sites (Angiolini & al. 2005; Fig. 1b). It is considered Near Threatened (NT) in the Italian flora's red list (Rossi & al. 2020) and of medium/high conservation priority at the regional scale (Bacchetta & al. 2012).

Results from germination tests showed that seeds of *I. integerrima* germinated with a high percentage close to 100% at all tested temperatures (10, 15, 20, 25 and 20/10°C). However, the germination capacity is reduced at 5°C and 30°C (17% and 71%, respectively). Radicle emergence started in the first three days from sowing, reaching the T_{50} in less than a week and finished approximately within 26 days. The germination tests were carried out at the Sardinian Germplasm Bank (BG-SAR; Porceddu & al. 2017). Previous studies carried out at 20°C on different seed lots stored under seed banks at - 25°C and 5°C for 12, 11, 9, 8 and 3 years showed germination percentages ranging from 64% to 92 % (Porceddu & al. 2022), results which are comparable to those obtained with fresh seeds tested for this report. Although germination data about other *Iberis* species are scarcely available, *I. violacea* W.T.Aiton (Carruggio & al. 2020) and *I. linifolia* L. (Pérez-García & al. 2006) show similar germination percentages.

M. E. Boi, M. Porceddu & G. Bacchetta

128. *Eokochia saxicola* (Guss.) Freitag & G. Kadereit (*Amaranthaceae*)

Accession data

It: Campania. Anacapri (NA) (WGS84: 40.56083° N, 14.21722° E), vertical sea cliffs, mainly on shady sites, within approx. 8-10 m a.s.l., 20 Oct 2022, *G. Fabrini* (2227 063s 1022 1222, Germplasm Bank, Sapienza University of Rome).

It: Campania. Anacapri (NA) (WGS84: 40.56083° N, 14.21722° E), vertical sea cliffs, mainly on shady sites, within approx. 8-10 m a.s.l., 14 Nov 2023, *G. Fabrini* (2260 063s 1022 0123, Germplasm Bank, Sapienza University of Rome).

Germination data

Pre-treatments: no treatments.
Germination medium: 3 sheets of sterilized filter paper (Whatmann No. 1), imbibed with 6 ml of sterilized distilled water.
Sample size: 80 seeds for each test (20 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]	N. accession
96.7%	alternating 20/10°C	12/12h	4.2	11.6	23.7	13.2	2260 063s 1022 0123
83.0%	alternating 15/6°C	12/12h	14.0	14.0	36.2	20.2	2227 063s 1022 1222

Observations

Eokochia saxicola is a perennial, suffruticose chamaephyte endemic to southern Italy, where it only grows on calcareous or volcanic sea cliffs between 5 to 90 m a.s.l. The species has an extremely fragmented range with stations in Campania (two on Capri and two in Cilento) and one in Sicily, on the rock of Strombolicchio in the Aeolian archipelago (Santangelo & al. 2012; Strumia & al. 2015). It blooms in the summer months between July and September and fruits in autumn. The species is reported as Endangered (EN) in the IUCN Red List of Threatened Species (Domina & Santangelo 2023). It is also listed as a priority species in the Annexes II and IV of the Habitat Directive 92/43 CEE, and in Annex I of the Bern Convention. It is protected under regional laws and partially included in Natura 2000 sites and is one of the target species of the LIFE SEEDFORCE project. The highest and fastest germination rate was observed at an alternating temperature of 20/10°C, with 96.7% of the seeds germinating under 12/12h photoperiod conditions. These results are based on germination tests conducted with seeds collected in November 2023. When a lower alternating temperature of 15/6°C was applied to seeds sampled in 2022, the germination rate decreased but remained relatively high, reaching 83%. Additionally, other tests were conducted with seeds collected in 2022 under various conditions: temperatures of 20/10°C, 15/6°C and 25/15°C in complete darkness (0/24h). However, none of these tests

achieved an 80% germination rate. The same was true for seeds tested at 20/10°C and 25/15°C with a 12/12h light/dark photoperiod.

G. Crocenzi, I. Panero & G. Fabrini

129. *Primula palinuri* Petagna (*Primulaceae*)

Accession data:

It: Campania. Centola (SA), Palinuro (WGS84: 40.0320833N, 15.2726389E), Jurassic limestones and dolostones, 20 m a.s.l., 15 July 2023, *Ilaria Panero* (2224 061s 0522 0722, Germplasm Bank, Sapienza University of Rome).

Germination data

Pre/treatments: No treatment.

Germination medium: Petri dishes with 3 sheets of sterilized filter paper (Whatmann No. 1), imbibed with 6 ml of sterilized distilled water.

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

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
99%	alternating 15/6°C	12/12h	10	12.24	16	12.8
94%	alternating 20/10°C	12/12h	9.75	15.09	30.5	16.48
93%	constant 10°C	12/12h	12	15.21	18	15.9
81%	constant 15°C	12/12h	9	9.98	13.25	11.0

Observations

Primula palinuri Petagna is an endemic plant species that is listed as Endangered (EN) in the IUCN Red List of Threatened Species (Gangale & al. 2011). It is a suffruticose, perennial, summer deciduous, hexaploid plant, endowed with a sturdy rhizome topped by a dense rosette of fleshy, leathery but not rigid leaves, with a cartilaginous toothed margin, closely adhering to the rocks (Barbi 2008). It is unique for its Mediterranean ecology, only found on north-facing sea cliffs along the southern Tyrrhenian coasts of Italy (Aronne & al. 2018). *P. palinuri* matures its capsules from the end of June to the end of July. By August, some of these capsules show initial cracks at the apex and begin to dehisce and disperse seeds in October (Silvestro & al. 2020). Germination tests were carried out 1 month after seed harvesting, using constant temperatures of 10°C and 15°C, and alternate temperatures of 15/6°C and 20/10°C with a 12/12 h light/dark photoperiod.

The results obtained indicate that *P. palinuri* seeds germinate more effectively at lower temperatures, with reduced germination rates (>80%) observed at higher temperatures

(25°C and 25/15°C). The optimal temperature for germination was found to be 15/6°C, achieving a germination rate of 99%.

I. Panero, G. Crocenzi & G. Fabrini

130. *Lythrum tribracteatum* Salzm. ex Spreng (*Lythraceae*)

Accession data

It: Lazio. Ladispoli (RM), Palo Laziale (WGS84: 41.93755N, 12.09591E), small Mediterranean temporary ponds which are present only in winter or late spring, 3 m a.s.l, Jul 2021, *D. La Montagna* (2212 062s 0721 010 21, Germplasm Bank, Sapienza University of Rome).

Germination data

Pre-treatments: no treatments.
Germination medium: 3 sheets of sterilized filter paper (Whatmann No. 1), imbibed with 6 ml of sterilized distilled water.
Sample size: 100 seeds for each test (25 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
81%	alternating 25/15°C	12/12h	4.0	5.7	12.5	7.2

Observations

Lythrum tribracteatum is an erect, branching, annual herb, which habitually prefers mudlees, ditches or temporary ephemeral ponds. It grows 6–30 cm high and it has an erect or prostrate, branched, opposite, quadrangular stem, usually reddish and papillose. The leaves are alternate and range from linear to oblong-elliptical. The flowers are homostylous, solitary, and axillary while the fruits are cylindrical capsules and usually match the length of the floral tube when mature. The seeds are about 0.5-1.0 mm long, obovoid to rhomboid (Tavilla & al. 2023). According to Valdés (2012), *L. tribracteatum* occurs in the Mediterranean basin and east to central Asia. It is one of the species characterizing the *Lythrion tribracteati* alliance which belongs to the plant communities of the *Isoëto–Nanojuncetea* class in the western Mediterranean regions (Brullo & al. 2022). The *Lythrion tribracteati* is included in the priority habitat of Mediterranean temporary ponds (3170*) as per the Annex I of the Habitat Directive 92/43 CEE. The species is also listed in the Italian Red List of threatened plants (Rossi & al. 2020) under the Least Concern (LC) IUCN category.

Seeds tested at a temperature of 25/15 °C with a 12/12h light/dark photoperiod showed the highest germination percentage (81%), while the number of germinated seeds decreased below 80% with temperatures of 20/10 °C and 15/6 °C under 12/12h light/dark photoperiod. At the same temperatures under continuous darkness no germination was recorded, thus revealing a positive photoblastic response of *L. tribracteatum* seeds.

G. Crocenzi, G. Fabrini, D. La Montagna & I. Panero

131. *Hyoseris lucida* L. subsp. ***taurina*** (Pamp.) Peruzzi & Vangelisti (*Asteraceae*)

Accession data

Si: Lipari (Messina), Lisca Bianca – Panarea (WGS84: 38.639058° N, 15.114147° E), coastal scrub on sandy soil and rocky outcrops, 7 m a.s.l., 12 May 2023, *A. Cristaudo & A.I. Di Paola* (SiMaSeedPLUS/CT/23/05, BGS-CT).

Germination data

Pre-treatments: five months of dry after-ripening at 22 ± 2°C and 50% RH.
Germination medium: 1% agar on 9 cm Petri dishes.
Sample size: 100 seeds (25 × 4 replicates) for "intermediate" cypselas, 60 seeds (15 × 4 replicates) for both the "central" and "peripheral" cypselas.

CENTRAL CYPSELAS:

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
100%	constant 25°C	12/12 h	2.0	1.6	7.0	2.2
100%	alternating 20/10°C	12/12 h	3.0	3.4	5.0	3.9
100%	alternating 25/15°C	12/12 h	2.0	1.9	7.0	2.4
100%	alternating 35/25°C	12/12 h	2.0	1.7	7.0	2.4
100%	alternating 35/25°C	0/24 h	-	-	-	-
98%	constant 30°C	12/12 h	2.0	1.6	7.0	2.2
98%	constant 35°C	12/12 h	2.0	3.8	10.0	4.8
98%	alternating 15/5°C	12/12 h	7.0	6.5	7.0	7.0
98%	alternating 30/20°C	12/12 h	2.0	1.5	7.0	2.1
98%	alternating 20/10°C	0/24 h	-	-	-	-
98%	alternating 25/15°C	0/24 h	-	-	-	-
98%	alternating 30/20°C	0/24 h	-	-	-	-
97%	constant 5°C	12/12 h	10.0	13.3	18.0	13.2
97%	constant 15°C	12/12 h	3.0	4.3	5.0	4.6
96%	constant 20°C	12/12 h	2.0	1.9	5.0	2.5
96%	constant 15°C	0/24 h	-	-	-	-
96%	constant 20°C	0/24 h	-	-	-	-
95%	constant 10°C	12/12 h	5.0	4.7	6.0	5.2

95%	constant 25°C	0/24 h	-	-	-	-
95%	alternating 15/5°C	0/24 h	-	-	-	-
93%	constant 10°C	0/24 h	-	-	-	-
93%	constant 30°C	0/24 h	-	-	-	-

Intermediate Cypselas:

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
100%	alternating 30/20°C	0/24 h	-	-	-	-
98%	alternating 30/20°C	12/12 h	1.0	1.7	5.0	2.5
98%	constant 20°C	0/24 h	-	-	-	-
98%	constant 25°C	0/24 h	-	-	-	-
97%	alternating 15/5°C	12/12 h	5.0	5.5	15.0	6.2
96%	constant 25°C	12/12 h	1.0	1.6	5.0	2.3
96%	constant 30°C	12/12 h	1.0	1.7	7.0	2.5
96%	alternating 20/10°C	12/12 h	3.0	3.9	5.0	4.4
96%	alternating 20/10°C	0/24 h	-	-	-	-
95%	alternating 25/15°C	12/12 h	2.0	3.2	14.0	3.6
95%	alternating 35/25°C	12/12 h	2.0	2.0	4.0	2.6
95%	constant 15°C	0/24 h	-	-	-	-
94%	constant 10°C	12/12 h	5.0	5.0	12.0	5.6
94%	constant 35°C	12/12 h	3.0	5.7	16.0	6.2
94%	constant 10°C	0/24 h	-	-	-	-
94%	alternating 15/5°C	0/24 h	-	-	-	-
94%	alternating 25/15°C	0/24 h	-	-	-	-
93%	constant 20°C	12/12 h	2.0	2.4	5.0	3.0
91%	constant 15°C	12/12 h	4.0	4.4	7.0	4.8
89%	constant 30°C	0/24 h	-	-	-	-
88%	constant 5°C	12/12 h	12.0	12.0	26.0	12.8
86%	alternating 35/25°C	0/24 h	--	-	-	-

PERIPHERAL CYPSELAS:

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
98%	constant 15°C	12/12 h	3.0	4.3	12.0	5.2
97%	alternating 20/10°C	12/12 h	3.0	4.6	13.0	5.4
91%	constant 10°C	12/12 h	5.0	7.1	13.0	8.1
91%	alternating 25/15°C	12/12 h	2.0	3.8	6.0	4.2
90%	constant 25°C	12/12 h	2.0	2.9	10.0	4.2
83%	constant 20°C	12/12 h	3.0	3.8	9.0	4.5
82%	alternating 30/20°C	12/12 h	3.0	3.3	14.0	4.6
80%	constant 15°C	0/24 h	-	-	-	-

Observations

Hyoseris lucida subsp. *taurina* is a perennial herb characterized by a woody stock, robust roots and fleshy, glabrous, leaves. It flowers from March to November and has a W Mediterranean-S Tyrrhenian distribution. It grows on rocky, siliceous cliffs, subject to marine spray and with a prevalent northern exposure (Brullo & al. 1997).

The seed accession was collected on Lisca Bianca, an islet off the coasts of Panarea (Aeolian Islands, Italy) which is part of a regional integral nature reserve (RNI "Isola di Panarea e Scogli Viciniori") and of the ZSC ITA030025 "Isola di Panarea e scogli Viciniori".

As common among the *Asteraceae* (Fenesi & al. 2019) and already reported for this taxon by Brullo & al. (1997), *H. lucida* subsp. *taurina* brings heteromorphic diaspores which differ in their shape, position, function and germination capacity. In particular, three kinds of diaspores have been identified in the capitula: narrow, unwinged cypselas, positioned at the centre (referred to as "central cypselas"); winged cypselas in an intermediate position (referred to as "intermediate cypselas"); winged cypselas positioned at the border and equipped with a less developed pappus than the first two categories (referred to as "peripheral cypselas").

Seeds were tested at seven constant (5, 10, 15, 20, 25, 30, 35 °C) and five alternating temperature conditions (15/5, 20/10, 25/15, 30/20, and 35/25°C), both in light/dark (12/12 h photoperiod) and full darkness (0/24 h), after five months of drying after ripening.

Central and intermediate cypselas reached high germination percentages at almost all the temperatures tested, both in light and in darkness. Peripheral cypselas have a greater proportion of empty or not fully developed seeds. High germination percentages were obtained, in the presence of light, at 10, 15, 20, 25, 20/10, 25/15 and 30/20 °C but not at the lower and higher temperatures tested (5, 30, 35, 15/5 and 35/25 °C), indicating a narrower thermal range if compared with the other two categories. Peripheral cypselas in dark condition germinated only at 15°C. Here we present the first germination data for this taxon.

A.I. Di Paola, C. Blandino, G. Emma, M. Di Stefano & A. Cristaudo

132. *Lotus cytisoides* L. (*Fabaceae*)

Accession data:

Si: Lipari (Messina), Lisca Bianca – Panarea (WGS84: 38.639058° N, 15.114147° E), coastal scrub on sandy soil and rocky outcrops, 7 m a.s.l., 27 Jun 2023, *A. Cristaudo & A.I. Di Paola* (SiMaSeedPLUS/CT/23/12, BGS-CT).

Germination data

Pre-treatments: four months of drying after ripening at 22 ± 2°C and 50% RH; scarification with a scalpel.

Germination medium 1% agar in 9 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 30°C	12/12 h	1.0	2.5	10.0	3.1
100%	alternating 25/15°C	12/12 h	3.0	2.5	4.0	3.0
100%	alternating 25/15°C	0/24 h	-	-	-	-
100%	alternating 30/20°C	0/24 h	-	-	-	-
99%	constant 25°C	12/12 h	1.0	2.5	4.0	2.8
99%	alternating 15/5°C	12/12 h	3.0	2.8	8.0	3.6
99%	alternating 20/10°C	12/12 h	3.0	2.6	8.0	3.4
99%	alternating 30/20°C	12/12 h	3.0	2.5	4.0	3.0
99%	constant 20°C	0/24 h	-	-	-	-
99%	alternating 15/5°C	0/24 h	-	-	-	-
98%	constant 5°C	12/12 h	8.0	8.0	29.0	9.9
98%	constant 10°C	12/12 h	3.0	3.4	15.0	4.7
98%	constant 15°C	12/12 h	2.0	2.5	5.0	3.1
98%	constant 20°C	12/12 h	1.0	1.5	3.0	2.0
98%	constant 15°C	0/24 h	-	-	-	-
98%	constant 30°C	0/24 h	-	-	-	-
98%	alternating 20/10°C	0/24 h	-	-	-	-

Observations

Lotus cytisoides L. is an herbaceous perennial plant. The centre of its distribution area is the Mediterranean Basin, where it occurs in the Balearic Islands, Corse, Crete, France, Greece, Spain, Italy, ex-Yugoslavia, Sardinia, Sicily and Malta. It grows on coastal environments, on sandy dunes or rocky cliffs, preferring undeveloped soils, sandy or rocky and poor in nutrients, at altitudes between 0 and 100 m a.s.l. Its yellow flowers appear from April to June. The tested seed accession was collected on Lisca Bianca, an islet off the coasts of Panarea (Aeolian Islands, Italy).

The seeds have an impermeable seed coat, which imposes a physical dormancy. Therefore, it was necessary to scarify the seeds with a scalpel, making a small incision in the distal portion of the seed, away from the hilum to avoid damaging the radicle. Scarified seeds were immediately transferred to the germination substrate to prevent the drying of the exposed embryo. Seeds were tested at six constant (5, 10, 15, 20, 25, 30 °C) and four alternating temperature conditions (15/5, 20/10, 25/15 and 30/20°C), both in light/dark (12/12 h) photoperiod and continuous darkness (0/24 h), after four months of drying after ripening. High germination percentages (>95%) were obtained at all the tested conditions, without significant differences between constant and alternating temperatures and the light presence or absence.

A.I. Di Paola, C. Blandino, G. Emma, M. Di Stefano & A. Cristaudo

133. *Senecio leucanthemifolius* Poir**.** (*Asteraceae*)

Accession data:

Si: Lipari (Messina), Lisca Bianca – Panarea (WGS84: 38.639058° N, 15.114147° E), coastal scrub on sandy soil, 7 m a.s.l., 12 May 2023, *A. Cristaudo & A.I. Di Paola* (SiMaSeedPLUS/CT/23/02, BGS-CT).

Germination data

Pre-treatments: six months of drying after-ripening at 22 ± 2°C and 50% 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]
97%	constant 15°C	12/12 h	2.0	4.6	14.0	5.5
95%	alternating 25/15°C	12/12 h	4.0	4.6	19.0	5.5
88%	alternating 30/20°C	12/12 h	4.0	4.5	27.0	5.5
86%	constant 10°C	12/12 h	5.0	6.6	23.0	7.9

Observations

Senecio leucanthemifolius Poir. is an annual species of the *Asteraceae* family. It is native to the Mediterranean Basin, where it grows on poorly developed soils, flowering from December to April. The seeds were collected on Lisca Bianca, an islet off the coasts of Panarea (Aeolian Islands, Italy). Seeds were tested at six constant (5, 10, 15, 20, 25, 30 °C) and four alternating temperature conditions (15/5, 20/10, 25/15 and 30/20°C), both in light/dark (12/12 h) photoperiod and full darkness (0/24 h), after six months of drying after ripening. The highest germination rates (≥85%) were observed at constant temperatures ranging from 10 to 20 °C and at alternating temperatures ranging from 20/10 to 30/20 °C, only under light exposure. Some germination occurred also in continuous darkness, but the final percentage never reached 80%. This is the first germination protocol developed for this species.

A.I. Di Paola, C. Blandino, G. Emma, M. Di Stefano & A. Cristaudo

134. *Silene neglecta* Ten**.** (*Caryophyllaceaee*)

Accession data:

Si: Lipari (Messina), Lisca Bianca – Panarea (WGS84: 38.639058° N, 15.114147° E), coastal scrub on sandy soil, 7 m a.s.l., 12 May 2023, *A. Cristaudo & A.I. Di Paola* (SiMaSeedPLUS/CT/23/21, BGS-CT).

Germination data

Pre-treatments: five months of drying after-ripening at 22 ± 2°C and 50% RH.
Germination medium: 3 sheets of filter paper (Whatmann No. 1), imbibed with 6 ml of distilled water in 9 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%	alternating 15/5°C	12/12 h	5.0	5.5	10.0	6.2
91%	alternating 20/10°C	12/12 h	2.0	2.6	12.0	3.4
93%	alternating 25/15°C	12/12 h	2.0	2.6	14.0	3.8
86%	alternating 30/20°C	12/12 h	2.0	2.6	22.0	4.4

Observations

Silene neglecta Ten. is an herbaceous annual species. Its distribution area extends from north-eastern Spain to the Mediterranean, with records for central and southern Italy, southwestern Sardinia, Sicily, northern Algeria and Tunisia (Sáez & al. 2022). It grows on siliceous rocky substrates or coastal sands, at altitudes from 0 to 600 m a.s.l., flowering from March to May. *S. neglecta* has been often confused with *S. nocturna*, until its status as a valid species has been recently clarified by Sáez & al. (2022).

The seed accession was collected on volcanic sands and poorly developed soils on the islet of Lisca Bianca (Aeolian Islands, Italy). Seeds were tested at six constant (5, 10, 15, 20, 25, 30 °C) and four alternating temperature conditions (15/5, 20/10, 25/15 and 30/20°C), both in light/dark (12/12h) photoperiod and darkness (0/24h), after five months of drying after ripening. The highest final germination percentage was scored at the four alternating temperature regimes with 12/12h photoperiod, suggesting a response to those environmental cues indicating seed proximity to the soil surface.

A.I. Di Paola, C. Blandino, G. Emma, M. Di Stefano & A. Cristaudo

135. *Linaria pseudolaxiflora* Lojac. (*Plantaginaceae*)

Accession data:

Ma: Gozo (Malta), Ras il-Wardija promontory (WGS84: 36.0366° N; 14.186747° E), limestone lithosoil, 129 m a.s.l., 28 Apr 2023, *S. Cambria* (SEEDFORCE/CT/23/05, BGS-CT).

Germination data

Pre-treatments: five months of dry after-ripening at 22 ± 2°C and 50% RH.
Germination medium: 1% agar in 6 cm Petri dishes, with the addition of 0, 100, 250 and 500 mg/L GA_3.
Sample size: 100 seeds (25 × 4 replicates).

Germination	Thermoperiod	GA_3 [mg/L]	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
100%	alternating 20/10°C	0	12/12 h	9.0	9.5	10.0	10.0
100%	alternating 25/15°C	0	12/12 h	3.0	3.4	10.0	4.1
100%	alternating 25/15°C	500	12/12 h	6.0	6.1	17.0	7.1
99%	constant 20°C	500	12/12 h	6.0	9.2	32.0	9.2
99%	alternating 25/15°C	100	12/12 h	6.0	6.1	10.0	6.9
99%	alternating 25/15°C	250	12/12 h	6.0	6.3	12.0	7.0
97%	constant 20°C	100	12/12 h	6.0	9.5	49.0	10.7
97%	constant 20°C	250	12/12 h	6.0	8.0	32.0	8.8
90%	alternating 30/20°C	0	12/12 h	6.0	6.6	27.0	8.5

Observations

Linaria pseudolaxiflora Lojac. is an annual species, endemic to the Maltese Islands and to the island of Linosa (Italy). It grows on shallow and well-drained lithosols or

rocky outcrops, on both volcanic (Linosa) and limestone (Maltese Islands) substrates. *L. pseudolaxiflora* is a species listed in Annex II of the 92/43/CEE Directive "Habitat" and its global IUCN status is Vulnerable (Mifsud & al. 2019). It flowers from the end of February to the beginning of April, setting fruits in March-April. The seeds were tested, after five months of drying after-ripening, at three constant temperatures (15, 20 and 25 °C) and at the corresponding three alternating ones (20/10, 25/15, 30/20 °C). The effect of gibberellic acid was tested only at 20 and 25/15 °C, adding 100, 250 and 500 mg/L of GA_3 to the growing media. Each temperature was tested with a 12/12 h light/dark photoperiod. In the alternating temperature, the exposure to light coincided with the warmer phase. Without GA_3, high final germination percentages were obtained only at the alternating temperatures, reaching 100% at 20/10°C and 25/15 °C. In the gibberellic acid treatments, all the tested conditions reached a final germination percentage >80%, demonstrating that GA_3, at 20°C, equalized the requirement of alternating temperatures.

A.I. Di Paola, C. Blandino, G. Emma, M. Di Stefano & A. Cristaudo

136. *Gadoria falukei* Güemes & Mota (*Plantaginaceae*)

Accession data

Hs: Botanical Garden of the University of Valencia, environmental conditions, 20 Aug 2018, J. Pons-López (UVEG-JBVAL-BG-264B2018). *Ex-situ* collection from Almería. Dalías, Sierra de Gádor, barranco Bernal (WGS84: 36.826103ºN, 2.723992ºW), limestone walls with marine fossils (bivalves), orientation S, cattle refuge area, 580 m a.s.l., 12 Jun 2012, *J. Güemes & J. Mota* (UVEG-JBVAL-BG-141B2012, Germplasm Bank of the University of Valencia).

Germination data

Pre-treatments: no pre-treatment.

Germination medium: sterile 0.6% agar, following the protocols of the Germplasm Bank of the University of Valencia.

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

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MTG [d]
96%	Constant 15ºC	12/12h	12.8	13.3	30	15.0
95%	Constant 20ºC	12/12h	8.0	8.6	17	10.0
89%	Constant 10ºC	12/12h	22.5	24.4	32	25.5
88%	Constant 25ºC	12/12h	14.3	16.0	32	17.4
83%	Constant 20ºC	0/24h	14.3	15.4	32	18.6

Observations

Gadoria falukei Güemes & Mota is a Critically Endangered narrow endemic species of a monotypic genus discovered in 2012, which occurs with a single population in Sierra de Gador, Almería (Spain). It is a perennial suffrutescent species growing on south-facing almost vertical and overhanging limestone walls with marine fossils (bivalves), in a cattle refuge area at 580 m a.s.l. (Güemes & Mota 2017). The population, with less than 80 individuals, is divided into three subpopulations and most of the plants are unreachable. This study was conducted on seeds collected from the *ex-situ* collection at the Botanical Garden of the University of Valencia during summer 2018. This is the first seed germination report for the species.

Seed germination under eight different conditions (10ºC, 15ºC, 20ºC and 25ºC with 12/12h and 0/24h light/dark photoperiod) was tested, resulting in highly influenced by the photoperiod regime. All the temperatures tested provided germination percentages above 88% when seeds were incubated at 12/12h light/dark photoperiod. Those incubated at 15ºC presented the highest germination percentage (96%) and those incubated at 25ºC presented the lowest results (88%). Even if the germination percentages at 15 ºC and 20ºC under light conditions were basically the same, the germination at 15ºC was delayed by at least 5 days at all tested parameters. The photoperiod had a strong effect on seeds incubated at 10ºC and 25ºC, as when full darkness was applied seed germination significantly decreased by up to 7% and 20%, respectively. Seeds incubated at 15ºC obtained 71% of germination.

The high autogamy of the species and the high fruit and seed production, combined with the high germination percentages observed in the 12/12h photoperiod, increase the probability of plant establishment in its rupicolous habitat. These characteristics raise the chances of species survivorship, especially in crevices fairly exposed to sunlight, which represent the best sites for future reinforcements.

A. Nebot & J. Güemes

137. *Coris monspeliensis* L. (*Primulaceae*)

Accession data:

Hs: Valencia, Vilamarxant, La Pea (WGS84: 39.595964ºN, -0.682458ºW), 200 m a.s.l., 20 Sept 2007, *F. Marco* (UVEG-JBVAL-BG 189B2007, Germplasm Bank of the University of Valencia).

Germination data

Pre-treatments: 1000 ppm Gibberellic acid (GA_3) for 24h.
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]	MGT [d]
99.0%	constant 20°C	12/12h	4.0	4.8	9.8	5.6

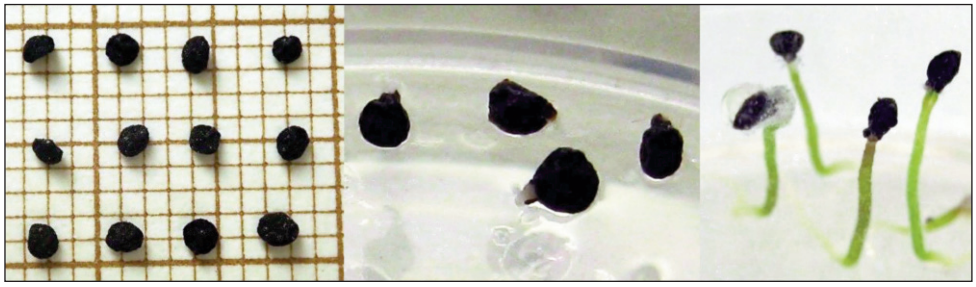

Fig. 5. Seeds and seedlings of *Coris monspeliensis*.

Observations

This perennial plant has small but attractive violet flowers all grouped in a terminal cluster. It is part of the heliophile chamaephyte communities and shrublands characteristic of the Mediterranean region and is distributed throughout South Europe, North Africa and the Balearic Islands. In the Valencian Community, it can be found dispersed throughout almost the entire territory. It is a plant with great ornamental potential.

The seeds of this species exhibit physiological dormancy; therefore, a prior imbibition in gibberellic acid (GA_3) for 24 hours is required to achieve high germination percentages. Only 11% germination has been observed in the control group.

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138. *Limonium dufourii* (Girard) Kuntze (*Plumbaginaceae*)

Accession data:

Hs: Valencia, València, el Saler, la Devesa (WGS84: 39.342777ºN, -0.318834ºW), 0.5 m a.s.l., 22 Aug 2009, *A. Navarro* (UVEG-JBVAL-BG 86B2009, Germplasm Bank of the University of Valencia).

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]	MGT [d]
98.0%	constant 20°C	12/12h	2.0	1.7	4.5	2.4

Observations

This perennial species is a narrow endemism from the Valencian Community (Castellón and Valencia provinces), with small and disjointed populations considered endangered. All

populations grow in littoral areas, mainly in salt marshes or on cliffs exposed to the sea spray. The main threat is the intensive urban growth and the over-tourism in coastal territories. Moreover, it hybridizes with other *Limonium* species cohabiting in the same plant communities. To support plant production for conservation programs, it is essential to collect seeds from individuals as pure as possible to preserve the target species. The dense pubescence and the compact arranged spikelets are its main differential characters.

The seeds of this species are non-dormant and, therefore, do not require any pre-treatment. They achieve high germination percentages and exhibit a rapid response under the single condition tested. Another study observed the germination response of this species at a temperature regime of 30/20°C and a photoperiod of 18/6 hours (González-Orenga & al. 2019). The germination percentage was also high, though the germination rate was slower (MGT = 5.3 days).

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139. *Limonium furfuraceum* (Lag.) Kuntze (*Plumbaginaceae*)

Accession data:

Hs: Alicante, Elx, Clot de Galvany (WGS84: 38.250157ºN, -0.531724ºW), 4 m a.s.l., 24 Oct 2011, *P. Soriano, M. Boscaiu & E. Estrelles* (UVEG-JBVAL-BG 95B2011, Germplasm Bank of the University of Valencia).

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]	MGT [d]
100.0%	constant 30°C	12/12h	1.3	1.6	2.7	2.0
97.6%	constant 22.5°C	12/12h	1.7	2.1	6.7	3.1
81.0%	constant 15°C	12/12h	2.0	3.5	8.3	4.6

Observations

This perennial *Limonium* is a dense hairy plant with a very characteristic and apparent inflorescence, which provides it with high ornamental potential. It is a narrow endemic species distributed only in the Alicante province (Valencian Community), that grows in thermo-Mediterranean semi-arid environments on saline or gypsum soils. Its populations have a high number of individuals and, therefore, it is not on the current list of threatened plants. However, conservation protocols are being developed due to its local nature. As in the other *Limonium* species studied, high germination percent-

ages are achieved under the investigated conditions. Seeds of this species are non-dormant, therefore, no pretreatment is required. In this study, the response across a range of temperatures was examined, revealing that both germination percentage and rate decrease at lower temperatures.

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140. *Limonium lobatum* (L. fil.) Chaz. (*Plumbaginaceae*)

Accession data:

Hs: Alicante, Santa Pola, Ermita del: 38.227325ºN, -0.510777ºW), 2 m a.s.l., 08 May 2009, *C. Obón* (UVEG-JBVAL-BG 10B2009, Germplasm Bank of the University of Valencia).

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]	MGT [d]
96.9%	constant 20°C	12/12h	1.0	0.7	7.0	2.0

Observations

This species is characterized by markedly lobed leaves, bluish-white flowers and its annual nature. It is a plant that grows on dry and stony soils, mostly in coastal communities, but there are some populations in inland areas. Its populations are distributed in the Mediterranean basin, mainly in the southern regions; from the southeast of the Iberian Peninsula and northern Africa to the Irano-Turanian region. In the Valencian Community, it is a very rare plant located in semi-arid areas, with a single nucleus in the south of the Alicante province, that shows a great interannual fluctuation in the number of individuals. It is a plant considered endangered in this region.

Its annual character implies that its survival depends on the germination capacity of its seeds. Thus, it is essential to increase the knowledge of the seed behaviour requirements, as well as the longevity of these seeds in the soil. The limiting factor is the low availability of seeds to develop such studies reliably.

As in the other *Limonium* species studied, high germination percentages were achieved under the tested conditions. The seeds of this species are non-dormant, so no pretreatment is required.

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141. *Limonium perplexum* L. Sáez & Rosselló (*Plumbaginaceae*)

Accession data:

Hs: Castellón, Peñíscola, microrreserva Torre Badum (WGS84: 40.316134ºN, 0.358344ºE), 8 m a.s.l., 9 Nov 2015, *E. Estrelles, A.M. Ibars & P. Pérez-Rovira* (UVEG-JBVAL-BG 61B2015, Germplasm Bank of the University of Valencia).

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]	MGT [d]
96.3%	constant 30°C	12/12h	1.0	0.7	4.3	1.5
94.7%	constant 22.5°C	12/12h	1.0	0.9	4.3	1.7
87.7%	constant 15°C	12/12h	1.7	1.6	3.3	2.2

Observations

This is a plant that can be annual or perennial depending on the environment where it grows. It is a small plant, with branchy inflorescences, which attract attention. It is endemic to the Valencian coast, included in the catalogue of threatened plants within the endangered category. Its populations normally grow on ledges of coastal cliffs in scarce locations of the province of Castellón, and consist of few individuals, although strong interannual fluctuations are observed in the censuses. Relevant conservation work has been carried out on its natural populations (Laguna & al. 2016).

No dormancy was observed in the seeds of this species, similarly to the other *Limonium* species studied in this work. Germination was both high and rapid, improving with increasing temperature.

M.C. Escribá, E. Estrelles & J. Prieto-Mossi

142. *Limonium supinum* (Girard) Pignatti (*Plumbaginaceae*)

Accession data:

Hs: Alicante, Villena, Microrreserva de Flora “Cabecicos de Villena” (WGS84: 38.643980ºN, -0.892783ºW), 540 m a.s.l., 16 Nov 2016, *A.M. Ibars, E. Estrelles, J. Prieto & P. Soriano* (UVEG-JBVAL-BG 147B2016, Germplasm Bank of the University of Valencia).

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]	MGT [d]
100.0%	constant 30°C	12/12h	1.0	0.5	1.3	1.0
100.0%	constant 22.5°C	12/12h	1.0	0.5	1.3	1.0
94.7%	constant 15°C	12/12h	1.0	1.5	3.0	2.0

Fig. 6. Seeds and seedlings of *Limonium supinum*.

Observations

This perennial plant, practically glabrous with violaceous flowers, is endemic to the centre and southeast of the Iberian Peninsula. Principal populations are found in inland halophilic environments. In the Valencian Community, it is a very rare plant, and thus it is included in the collecting objectives for its *ex-situ* conservation in the germplasm bank.

The observed germination response is consistent with the data obtained for other species of the genus studied. The seeds are non-dormant and exhibit a similar response to that observed for the *Limonium* group, with faster germination percentages and rates as the temperature increases

M.C. Escribá, E. Estrelles & J. Prieto-Mossi

143. *Nigella nigellastrum* (L.) Willk. (*Ranunculaceae*)

Accession data:

Hs: Valencia, Pedralba, prope Barranco Seco (WGS84: 39.590953ºN, -0.736854ºW), 180 m a.s.l., 22 Jun 2009, *A. Navarro* (UVEG-JBVAL-BG 124B2009, Germplasm Bank of the University of Valencia).

Germination data
Pre-treatments: disinfection with a 10% sodium hypochlorite water solution for 10 minutes followed by 3-4 rinses in sterile distilled water and imbibition in sterile distilled water for 24 h.
Germination medium: FP. Whatman Filter Papers N.2 (Filter Lab 516/G), soaked to saturation in distilled water.
Sample size: 100 seeds (25 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T_1 [d]	T_{50} [d]	T_{max} [d]	MGT [d]
94.0%	constant 4°C	0/24h	20	8.0	25.0	9.5

Observations
This annual herb has small bluish-white stellate flowers, with bifid petals showing a characteristic nectary structure. It grows in dryland tree crops, wastelands, dry grasslands and margins of crop-fields at low altitudes. It is distributed in the western and eastern regions of the Mediterranean basin, especially in the northern territories, as well as in the west of the Irano-Turanian region. In the Valencian Community, it is a rare plant, found only in a few localities of the Valencia province. Therefore, it is included in the regional list of protected species.

We have selected the used germination conditions based on the findings of Torra & al. (2015) on closely related species within the *Ranunculaceae* family, including *Delphinium*, *Consolida*, and *Nigella*. Their research identified darkness and low temperatures as optimal conditions for the seed germination of the studied taxa. Given the ecological similarity of *N. nigellastrum* to these species, we hypothesized that its germinative response would follow a similar pattern. The germination tests conducted under light conditions (12/12 h) yielded significantly low results (>12%), strongly suggesting that the seeds exhibit photoinhibition. However, further studies are required to definitively confirm the negative photoblastic seed behaviour of this plant, particularly under different temperature regimes.

M.C. Escribá, E. Estrelles & J. Prieto-Mossi

144. *Parentucellia viscosa* (L.) Caruel (*Orobanchaceae*)

Accession data:
Hs: Alicante, Xàbia, Els Planets (WGS84: 38.782277º N 0.138994º E), 30 m a.s.l., 11 June 2009, *A. Navarro* (UVEG-JBVAL-BG 93B2009, Germplasm Bank of the University of Valencia).

Germination data
Pre-treatments: disinfection with commercial H_2O_2 solution for 10 minutes followed by 3-4 rinses in sterile distilled water and imbibition in sterile distilled water for 24 h.
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]	MGT [d]
98.2%	20/10°C	12/12h	9.8	14.2	23.3	14.9

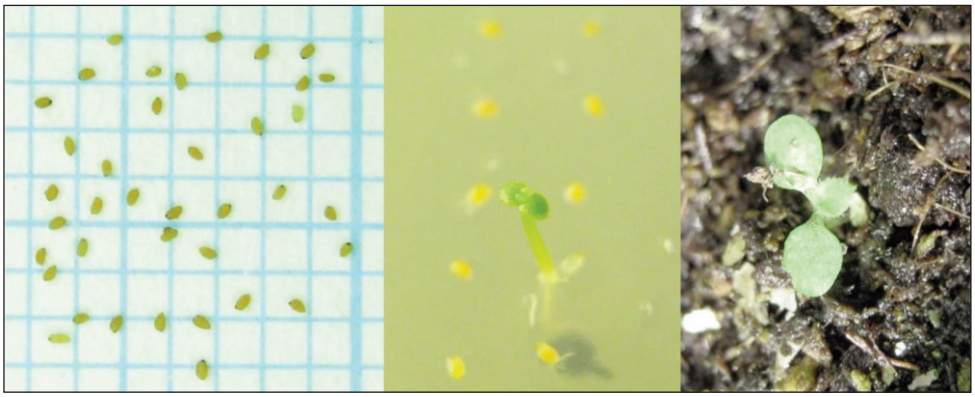

Fig. 7. Seeds and seedlings of *Parentucellia viscosa*.

Observations

This hemiparasitic annual plant, with tiny seeds, grows in grasslands and roadside ditches, preferably on nitrified and humid soils. It is distributed throughout West and South Europe, North Africa, southwest Asia and Macaronesia. In the Valencian Community it is occasionally present in the provinces of Alicante and Castellón, so it is included in the regional list of protected species.

The seeds appear to exhibit a preference for an alternating temperature regime, as results below 25% were observed under constant temperature regimes at 20ºC. Future studies are recommended to verify this requirement.

M.C. Escribá, E. Estrelles & J. Prieto-Mossi

145. *Silene mellifera* Boiss. & Reut. (*Caryophyllaceae*)

Accession data:

Hs: Alicante, Villena, Cueva del Lagrimal (WGS84: 38.5133570ºN, -1.019064ºW), 980 m a.s.l., 07 Aug 2008, *J. Prieto & F. Marco* (UVEG-JBVAL-BG 165B2008, Germplasm Bank of the University of Valencia).

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]	MGT [d]
87.5%	constant 20°C	12/12h	3.0	2.6	3.0	3.0

Observations

This perennial plant has a slimy stem, and the leaf blade of the petals is bifid, greenish or white in colour. Present in scrublands, rocky perennial and shady grasslands, always in mountainous areas with humid environments. This species is an endemism of the East and South Iberian Peninsula. In the Valencian Community, it is located in mountainous areas in the three provinces.

This seed accession does not exhibit dormancy, and its germination response is highly synchronized and relatively rapid.

M.C. Escribá, E. Estrelles & J. Prieto-Mossi

146. *Silene tridentata* Desf. (*Caryophyllaceae*)

Accession data:

Hs: Valencia, L'Olleria, Pla de la Tramussera (WGS84: 38.949273ºN, -0.532279ºW), 460 m a.s.l., 30 May 2007, *E. Estrelles, F. Marco & A.M. Ibars* (UVEG-JBVAL-BG 13B2007, Germplasm Bank of the University of Valencia).

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]	MGT [d]
100.0%	constant 20°C	12/12h	1.0	1.8	3.0	2.3

Observations

This small annual herb shows pinkish petals deeply bifid. It is present in dry therophytic crop fields and wastelands, on somewhat carbonated soils. It is distributed in the Iberian Peninsula (centre, south and east), Canary Islands, north Africa and southwest Asia. In the Valencian Community, dispersed populations have been located in the three provinces.

Similar to the previous taxon, germination is both rapid and highly synchronized. These two *Silene* species may potentially belong to the category of generalist germinators identified by Zani and Müller (2017). However, this hypothesis requires further validation through testing across a broader range of temperatures.

M.C. Escribá, E. Estrelles & J. Prieto-Mossi

147. *Erysimum metlesicsii* Polatscheki (*Brassicaceae*)

Accession data:

Si: Palermo, Belmonte Mezzagno, Monte Grifone (WGS84: 38.066667°N, 13.392778°E), 800 m a.s.l., limestone slopes, 11 Jul 2023, *F. Scafidi 085-SF* (SPGR/PA 1949/23; Sicilian Plant Germplasm Repository, University of Palermo)

Germination data

Pre-treatments: disinfection with a 1% sodium hypochlorite solution for 3 minutes followed by 2 rinses in sterile distilled water.

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]	MGT [d]
100.0%	constant 15°C	0/24h	3.0	3.5	6.0	4.0
98.7%	constant 15°C	12/12h	2.0	5.3	14.0	6.7
98.7%	constant 20°C	0/24h	3.0	2.2	5.0	3.1
96.0%	constant 20°C	12/12 h	3.0	2.7	8.0	3.5

Observations

Erysimum metlesicsii is a suffruticose chasmophyte endemic to western (Palermo Mts., Sicani Mts.) and central Sicily (Caltanissetta, Sutera, Campofranco, Agrigento and Aragona). The species is reported as Least Concern (LC) in the Red List of the Italian flora (Rossi & al. 2020). The germination tests were carried out at the Germplasm Bank of University of Palermo. This is the first germination report for the species. Seeds did not reveal any dormancy. Best germination results (100%) were achieved at the constant temperature of 15°C under full darkness, but high germination rates also occurred with 12/12h photoperiod (ca. 99%), and at higher temperature (20°C). As under 12/12h photoperiod both the germination rate and speed were a little lower at all tested temperatures, seeds seem to be somewhat negatively affected by light.

F. Scafidi, G. Pipitone & C. Salmeri

148. *Jacobea lycopifolia* (Desf. ex Poir.) Greuter & B.Nord. (*Asteraceae*)

Accession data:

Si: Messina**,** Motta d'Affermo, C.da Pattina (WGS84: 37.992778°N, 14.285833°E), 28 Sept 2023, uncultivated land, *F. Scafidi 131-SF* (SPGR/PA 1997/23; Sicilian Plant Germplasm Repository, University of Palermo).

Germination data
Pre-treatments: disinfection with a 1% sodium hypochlorite solution for 3 minutes followed by 2 rinses in sterile distilled water.
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]	MGT [d]
93.3%	constant 20°C	12/12h	2.0	2.7	17.0	3.7
90.7%	constant 15°C	0/24h	3.0	3.9	13.0	4.8
82.7%	constant 20°C	0/24h	2.0	3.0	18.0	4.4

Observations
Jacobea lycopifolia is a rare suffruticose chamaephyte endemic to South Italy (Sicilia, Puglia and Basilicata), which is reported as Least Concern (LC) in the Red List of the Italian flora (Rossi & al. 2020). The germination tests were carried out at the Germplasm Bank of University of Palermo. This is the first germination report for the species, which showed its best germination rate (93.3%) at 20 °C with 12/12h photoperiod, while under full darkness the germination rate was lower (82.7%). At 15°C, 90.7% of seeds germinated under full dark condition, but the germination dropped to 77.3% with a 12/12h light/dark photoperiod. The germination results, however, were influenced by mould contamination in all tested conditions.

F. Scafidi, G. Pipitone & C. Salmeri

149. ***Matthiola incana*** (L.) W.T. Aiton subsp. ***rupestris*** (Raf.) Nyman (*Brassicaeae*)

Accession data:
Si: Palermo, Santa Flavia, Capo Zafferano (WGS84: 38.111389°N, 13.537778°E), 32 m a.s.l., coastal limestone cliffs, 21 Aug 2023. *F. Scafidi 121-SF* (SPGR/PA 1988/23; Sicilian Plant Germplasm Repository, University of Palermo).

Germination data
Pre-treatments: disinfection with a 1% sodium hypochlorite solution for 3 minutes followed by 2 rinses in sterile distilled water.
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]	MGT [d]
90.7%	constant 15°C	12/12h	3.0	3.1	23.0	4.2

Observations

It is a suffruticose chamaephyte native to Sicily (Ustica, Egadi and Aeolian islands included) and Calabria, where sporadically grows on coastal calcareous cliffs and old rock walls. This is the first germination report for this taxon, which is considered as Near Threatened (NT) in the Red List of the Italian flora (Rossi & al. 2020). The germination tests were carried out at the Germplasm Bank of University of Palermo. Seed germination was tested at the constant temperatures of 15°C and 20°C, with a mean germination percentage of 90.7% reached at 15°C under 12/12h photoperiod; seeds incubated in total darkness got only 49.3% of germination. At 20°C the germination percentage dropped at 74.7% under light condition (12/12h) and to 70.6% under full darkness, while the germination speed (MTG) slightly quickened to 3.7-3.9 days. These results seem to indicate that seeds are positively influenced by light but negatively affected by high temperature. Previous tests conducted at 25°C on some populations from Taormina (ME), in fact, gave only 10% of seed germination with marked mould contamination.

F. Scafidi, G. Pipitone & C. Salmeri

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