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Seed germination data of three *Hieracium* and one *Pilosella* (*Asteraceae*) from Sicily and southern Italy

Abstract

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This work reports the first seed germination data of three *Hieracium* and one *Pilosella* (*Asteraceae*) taxa from Sicily and southern Italy. The studied taxa are: *Hieracium hypochoeroides* subsp. *cilentanum*, endemic to Campania, *H. schmidtii* subsp. *nebrodense*, endemic to Sicily, *H. terraccianoi*, endemic to Calabria and *Pilosella hoppeana* subsp. *sicula*, endemic to Sicily. The obtained results showed that the investigated taxa produce non-dormant seeds, with a high percentage of germination at all tested thermoperiods (15°C to 25°C and the alternating temperature of 25/15°C). Germination tests carried out in gibberellic acid (GA_3) provided similar germination percentages. The data presented in this paper provides useful information for the conservation of these endemic taxa.

Key words: apomixis, conservation, endemics, sexuality, taxonomy.

Introduction

Hieracium L. s. str. and *Pilosella* Vaill. (*Asteraceae*) are two of the largest angiosperm genera notorious for their taxonomic complexity caused by widespread interspecific hybridization, polyploidy, apomixis and sexuality (see, e.g., Krahulcová & al. 2000; Mráz & al. 2019). Many *Hieracium* and *Pilosella* taxa have a very restricted distribution and are punctual endemics. In southern Europe there are only local populations and most of them seem to be relict (Mráz & al. 2019). Therefore, their biological, phytogeographical and taxonomical relevance requires specific actions of *ex situ* and *in situ* protection. To this regard, the knowledge of the seed germination behaviour is an important contribution to the conservation of these taxa.

The taxonomy and distribution of *Hieracium* and *Pilosella* in southern Italy are currently under review. Recent studies resulted in the description of new endemic taxa with very local distributions (Brullo & al. 2001; Raimondo & Di Gristina 2004, 2007; Caldarella & al. 2014; Gottschlich & al. 2013, 2015; Di Gristina & al. 2013a, 2014, 2015a, 2015b, 2016a, 2016b, 2018, 2019). Also, little-known taxa were rediscovered (Di Gristina & al. 2016c; Gottschlich & al. 2017b) or reported as new to the Italian flora (Gottschlich & al. 2017a).

In this study, we present the seed germination data of four endemic hawkweed from Sicily and southern Italy: *Hieracium hypochoeroides* subsp. *cilentanum* Di Grist., Gottschl. & Raimondo, *H. schmidtii* subsp. *nebrodense* (Tineo ex Lojac.) Di Grist., Gottschl. & Raimondo, *H. terraccianoi* Di Grist., Gottschl. & Raimondo, and *Pilosella hoppeana* subsp. *sicula* Di Grist., Gottschl. & Raimondo

42. *Hieracium hypochoeroides* subsp. ***cilentanum*** Di Grist., Gottschl. & Raimondo (*Asteraceae*)

Accession data

It: Campania. Sanza (Salerno), Mt Cervati (Parco Nazionale del Cilento e Vallo di Diano) (WGS84: 40.290336°N, 15.477447°E), carbonate rocks, 1.860 m a.s.l., 09 Jul 2015, *E. Di Gristina* (PAL 102652).

Germination data

Pre-treatments: No treatment. Only manual removal of pappus.

Germination medium: Petri dishes with 2 sheets of sterilized Whatman 40 filter papers, imbibed in sterilized distilled water or in 10^{-3} M gibberellic acid (GA_3) water solution(1).

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]
94%	constant 20°C	0/24h	6.0	12.4	21.0	12.8
95%(1)	constant 20°C	0/24h	5.0	11.8	22.0	12.8

Observations

Hieracium hypochoeroides subsp. *cilentanum* is a chasmophytic hawkweed endemic to Mt Cervati (Campania, S Italy) (Di Gristina & al. 2016a). The collective species *H. hypochoeroides* s. l. is a young aggregate of many apomictic microtaxa which have evolved probably during the post-glacial period (Di Gristina & al. 2015a). Many of the taxa so far described have a very restricted distribution and are punctual endemics (Di Gristina & al. 2013a, 2015b). In southern Europe there are only local populations, and most of them seem to be relict (Di Gristina & al. 2015b). *H. hypochoeroides* subsp. *cilentanum* matures and disperses seeds in July (Di Gristina & al. 2016a).

Germination tests were carried out 3 months after seed harvesting, using the constant temperatures of 15°C, 20°C, 25°C, and the alternating temperature of 25/15°C (16h/8h), in continuous darkness. The obtained results showed that *H. hypochoeroides* subsp. *cilentanum* produces non-dormant seeds, with a high percentage of germination at all tested thermoperiods. This can be due to a strategy aimed at allowing populations living in unfavourable ecological conditions, such as chasmophytic environments, to increase the probability of dispersal and affirmation of the progeny. The optimal ger-

mination temperature was 20°C (94%). Germination tests carried out in 10^{-3} M gibberellic acid (GA_3) provided similar germination percentages. No germination data are present in literature for this taxon nor for the *H. hypochoeroides* aggregate.

43. *Hieracium schmidtii* subsp. ***nebrodense*** (Tineo ex Lojac.) Di Grist., Gottschl. & Raimondo

Accession data

Si: Polizzi Generosa (Palermo), Monte Cavallo (Monti Madonie) (WGS84: 37.831973°N, 14.037852 E), quartzarenitic rocks, 1.400 m a.s.l., 28 Jun 2015, *E. Di Gristina* (PAL 102631).

Germination data

Pre-treatments: No treatment. Only manual removal of pappus.

Germination medium: Petri dishes with 2 sheets of sterilized Whatman 40 filter papers, imbibed in sterilized distilled water or in 10^{-3} M gibberellic acid (GA_3) water solution(1).

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]
90%	constant 20°C	0/24h	6.0	11.5	21.0	13.1
95%(1)	constant 20°C	0/24h	5.0	12.5	20.0	11.7

Observations

Hieracium schmidtii subsp. *nebrodense* is a chasmophytic hawkweed endemic to the Madonie Mountains (Sicily, Italy) (Di Gristina & al. 2016c). This taxon has been recently rediscovered after almost two centuries since its first and single collection made in 1830 and reclassified as a subspecies of the collective species *H. schmidtii* (Di Gristina & al. 2016c). This aggregate in Sicily is also represented by another taxon endemic to the Madonie Mountains, *H. schmidtii* subsp. *madoniense* (Raimondo & Di Grist.) Greuter (syn. *H. madoniense*, see Raimondo & Di Gristina 2007). *H. schmidtii* subsp. *nebrodense* matures and disperses seeds in June and July (Di Gristina & al. 2016c).

Germination tests were carried out 3 months after seed harvesting, using the constant temperatures of 15°C, 20°C, 25°C and the alternating temperature of 25/15°C (16h/8h), in continuous dark. In water, high percentage of germination was obtained at all tested thermoperiods, the highest (90%) and with high germination speed (T_{50}: 11.5, MTG: 13.1) at the constant temperature of 20°C. Germination tests carried out in 10^{-3} M gibberellic acid (GA_3) provided a bit higher germination percentage (95%). Here we report the first germination data for this taxon and for the *H. schmidtii* aggregate.

44. *Hieracium terraccianoi* Di Grist., Gottschl. & Raimondo (*Asteraceae*)

Accession data

It: Calabria, Morano Calabro (CS), Scala di Gaudolino (Parco Nazionale del Pollino) (WGS84: 39.900303° N, 16.169194°E), carbonate rocky slopes, 1.350 m a.s.l., 12 Jul 2014, *E. Di Gristina* (PAL 101239).

Germination data

Pre-treatments: No treatment. Only manual removal of pappus.

Germination medium: Petri dishes with 2 sheets of sterilized Whatman 40 filter papers, imbibed in sterilized distilled water or in 10^{-3} M gibberellic acid (GA_3) water solution(1).

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]
90%	constant 15°C	0/24h	7.0	14.9	19.0	15.0
90%(1)	constant 15°C	0/24h	6.0	13.4	19.0	14.0

Observations

Hieracium terraccianoi is a pseudorosulate hemicryptophytic hawkweed endemic to the Pollino National Park (S Italy) (Di Gristina & al. 2014). This species belongs to a complex of similar morphotypes which have been grouped together in *H.* sect. *Grovesiana* (Gottschlich & al. 2013). *H. terraccianoi* matures and disperses the seeds in June and July (Di Gristina & al. 2014).

Germination tests were carried out 3 months after seed harvesting, using the constant temperatures of 15°C, 20°C, 25°C and the alternating temperature of 25/15°C (16h/8h), in continuous dark. The seeds of *H. terraccianoi* showed no dormancy and the highest germination (90%) at the temperature of 15°C. High germination was also obtained at 20°C reaching a value of 84%, while the alternating temperature of 25/15°C only reached a maximum of 65%. These results suggest that the seeds of *H. terraccianoi* prefer constant, cool or medium temperatures, for germination. Tests carried out in 10^{-3} M gibberellic acid (GA_3) provided similar germination percentages. Our germination tests are the first for this species and for the *H.* sect. *Grovesiana*.

45. *Pilosella hoppeana* subsp. ***sicula*** Di Grist., Gottschl. & Raimondo (*Asteraceae*)

Accession data

Si: Polizzi Generosa (Palermo), Monte Scalone (Monti Madonie) (WGS84: 37.841030°N 14.018628°E), quartzarenitic rocky slopes, 1.510 m a.s.l., 15 Jun 2011, *E. Di Gristina* (PAL 101238).

Si: Nicosia (Enna), Monte Sambughetti, (Monti Nebrodi) (WGS84: 37.820000°N 14.385000°E), quartzarenitic rocky slopes, 1.420 m a.s.l., 20 Jun 2011, *E. Di Gristina* (PAL 100473).

Germination data

Pre-treatments: No treatment. Only manual removal of pappus.

Germination medium: Petri dishes with 2 sheets of sterilized Whatman 40 filter papers, imbibed in sterilized distilled water or in 10^{-3} M gibberellic acid (GA_3) water solution(1).

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]	Herbarium Id no.
85%	constant 20°C	0/24h	5.0	9.2	18.0	10.0	PAL101238
87%(1)	constant 20°C	0/24h	5.0	9.1	17.0	9.9	PAL101238

Observations

Pilosella hoppeana subsp. *sicula* is a rosulate hemicryptophytic hawkweed endemic to the Madonie and Nebrodi Mountains (Sicily, Italy) (Di Gristina & al. 2016b). The *P. hoppeana* (Schult.) F.W. Schultz & Sch. Bip. aggregate includes widespread taxa and also very localized ones (Di Gristina & al. 2013b). In Sicily the group is represented by the widely spread *P. hoppeana* subsp. *macrantha* (Ten.) S. Bräut. & Greuter and *P. hoppeana* subsp. *sicula*, recently described on the basis of an integrated morphological, karyological and isoenzymatic study (Di Gristina & al. 2013b). The two populations of *P. hoppeana* subsp. *sicula* from the Madonie and Nebrodi Mountains were investigated. This taxon matures and disperses seeds in June and July (Di Gristina & al. 2016b).

Germination tests were carried out 3 months after seed harvesting, using the constant temperatures of 15°C, 20°C, 25°C and the alternating temperature of 25/15°C (16h/8h), in continuous dark. The examined populations of *P. hoppeana* subsp. *sicula* showed no seeds dormancy and 20°C as optimal germination temperature. However, the germination rates were different between the two populations: the Madonie one showed the highest percentage (85%) with a high germination speed (T_{50}: 9.25, MTG: 10), while the seed germination value of the Nebrodi population only reached 75%, with lower speed (T_{50}: 14.5, MTG: 15.4). Tests carried out in 10^{-3} M gibberellic acid (GA_3) provided similar or slightly higher germination percentages. These are the first germination data for this taxon and for the *P. hoppeana* aggregate.

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