



Article

Classification of Seed Dormancy in *Pedicularis hallaisanensis* Hurusawa: An Endemic and Endangered Species Native to Korea

Hyeong-Bin Park ^{1,2}, Jung Eun-Hwang ^{1,*}, Dae Young-Jeon ¹, Chang Woo-Lee ¹, Hwan-Joon Park ¹, Seongjun Kim ¹, Young-Joong Kim ¹ and Young Jun Yoon ¹

¹ Research Center for Endangered Species, National Institute of Ecology, Yeongyang 36531, Republic of Korea; phb1274@nie.re.kr (H.-B.P.); uagin@nie.re.kr (D.Y.-J.); jacky903@nie.re.kr (C.W.-L.); rhg9281@nie.re.kr (H.-J.P.); dao1229@nie.re.kr (S.K.); yjkim@nie.re.kr (Y.-J.K.); yjyoon@nie.re.kr (Y.J.Y.)

² Department of Environmental Horticulture, University of Seoul, Seoul 02504, Republic of Korea

* Correspondence: hwangje@nie.re.kr; Tel.: +82-054-680-7283; Fax: +82-054-680-7299

Abstract: *Pedicularis hallaisanensis* Hurusawa, native to Mt. Halla and Gaya, is an endangered endemic species. To support conservation efforts, this study investigated its germination characteristics and kind of seed dormancy. The seeds of *P. hallaisanensis* had fully developed linear embryos at dispersal, with no additional embryo growth observed. Water imbibition was observed prior to germination. The seeds were water-permeable. The seeds did not germinate at four temperature treatments (4 °C/1 °C, 15 °C/6 °C, 20 °C/10 °C, and 25 °C/15 °C). However, cold stratification and gibberellic acid treatments broke seed dormancy. Total germination was 15%, 15%, and 45% at 12, 16, and 20 weeks of cold stratification, respectively. Total germination at 25 °C /15 °C for GA treatments were 0%, 25%, 25%, and 80% at 500, 1000, 1500, and 2000 mg/L, respectively. This study showed that the seeds of *P. hallaisanensis* have intermediate physiological dormancy, requiring 20 weeks of cold stratification or more than 2000 mg/L GA concentration to maximize total germination. These results are useful for understanding ecophysiological mechanisms related to the species' habitat and for mass propagation to conserve this endangered species.

Keywords: ecophysiological; final germination rate; mass propagation; cold stratification; seed morphology



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1. Introduction

The *Pedicularis* genus (originally of Scrophulariaceae, currently placed in Orobanchaceae under the APG IV classification system) comprises more than 677 species of semiparasitic plants distributed worldwide, native to the polar regions of the northern hemisphere and temperate alpine regions [1,2]. In South Korea, five semiparasitic species, *P. resupinata*, *P. mandshurica*, *P. hallaisanensis*, *P. spicata*, and *P. ishidoyana*, are distributed [1]. Among them, *Pedicularis hallaisanensis* Hurusawa is an endemic species, rarely found only on Mt. Halla and Mt. Gaya in Korea. Although some global databases treat this taxon as a synonym of *Pedicularis verticillata* subsp. *verticillata*, it is recognized as a distinct endemic species in the authoritative regional botanical literature of Korea [3,4]. This species, restricted to alpine regions, has been designated as a Grade II Endangered Wild Species by the Ministry of Environment of the Republic of Korea, following criteria analogous to those of the IUCN Red List, due to the rapid decline in its natural habitats and populations. Although *P. hallaisanensis* has decreased biodiversity, previous research is insufficient in addressing both external factors, such as habitat destruction, exploitation, and pollution, and internal factors, such as propagation for ex situ conservation.

Propagation through seed germination allows for mass propagation by producing a large number of plant individuals simultaneously. However, due to varying germination characteristics and seed dormancy among species, detailed research is necessary. This is particularly true for seeds requiring specific conditions to break dormancy, such as cold

temperatures or hormone treatments. Seed dormancy blocks germination until favorable conditions arise, serving as a survival strategy in unfavorable environments [5]. From an ecophysiological perspective, seed dormancy offers insights into conservation biology by revealing how specific species control germination timing and adapt to natural habitats. The authors of [6] classified five kinds of seed dormancy based on seed morphology and germination characteristics: (1) physical dormancy, (2) physiological dormancy, (3) morphological dormancy, (4) morphophysiological dormancy, and (5) combinational dormancy (physical + physiological dormancy). These dormancy types are further subdivided by depth and characteristics. Among them, physiological dormancy is the most common in seeds of gymnosperms and major angiosperm clades, and it is frequently found in plants in all parts of the world [7].

Generally, seeds with physiological dormancy (PD) do not germinate within 4 weeks under favorable conditions. This dormancy can be subdivided by depth: deep, intermediate, or nondeep [7,8]. Seeds germinate after temperature treatments (warm and cold stratification) and artificial hormone treatments (gibberellic acid). Thus, classifying PD provides a method for mass propagation through dormancy breaking. However, dormancy and germination characteristics vary even among species in the same genus. In [9], seeds of eight *Pedicularis* species had PD and exhibited different germination characteristics. Cold stratification promoted the germination of *P. pseudomelampyryflora* seeds but did not promote the germination of *P. longiflora* or *P. siphonantha*. In five species, GA3 did not promote or decrease germination. In four species, gibberellic acid (GA3) promoted germination to varying extents. India-endemic *P. olympica* seeds required a combination of scarification and cold stratification, or GA3, for germination [10]. Thus, classifying seed dormancy and investigating germination characteristics provides insight into how each species adapts to different natural habitats [11].

Although previous studies have investigated the germination of *P. hallaisanensis* seeds using host plants [12], there are no studies on the class of seed dormancy. In this study, we examined germination characteristics under four temperature regimes (4 °C/1 °C, 15 °C/6 °C, 20 °C/10 °C, and 25 °C/15 °C), cold stratification treatments (4 °C/1 °C for 0, 8, 12, 16, and 20 weeks), and gibberellic acid treatments (0, 500, 1000, 1500, and 2000 mg/L), as well as seed morphology. We then classified the seed dormancy of *P. hallaisanensis*. The results of this study will provide an understanding of seed dormancy and ecophysiological mechanisms in natural habitats and aid in the mass propagation for the conservation of *P. hallaisanensis*.

2. Materials and Methods

2.1. Plant Materials

This study was conducted at the Endangered Resources Center in Yeong-yang, Korea. The mature seeds of *P. hallaisanensis* were collected on 11 September 2020 from plants growing on Mt. Gaya, Gyeongsangnam-do (Figure 1). The seeds were dehisced and dried at room temperature (~25 °C) for 2 weeks, then stored at 4 °C for a week before the germination study.

2.2. Seed Morphology

To investigate morphological characteristics, seed morphology measurements were conducted on *P. hallaisanensis* seeds incubated at 25 °C/15 °C. The seeds were halved using a surgical blade (stainless blade; Feather Safety Razor Co., Ltd., Osaka, Japan). External characteristics (length and width) and internal characteristics (embryo length at dispersal and just before germination) were measured using a USB microscope (AD7013MZT Dino-Lite; AnMo Electronics Co., New Taipei City, Taiwan). The embryo–seed ratio (E:S ratio) was then calculated and compared.

2.3. Water Imbibition Test

To investigate the physical dormancy of *P. hallaisanensis*, a water imbibition test was performed. The dry weight of the seeds was measured, and three replicates of 10 seeds were placed in Petri dishes on two sheets of filter paper filled with distilled water. The seeds were incubated at a constant temperature, and their fresh weight was measured after 2, 4, 6, 8, or 12 h. Water absorption by the seeds was calculated using the water uptake formula [6]:

$$\text{Water absorption (\%)} = [(M2 - M1)/M1] \times 100 \quad (1)$$

where M2 is the mass of the seeds after imbibition for a given interval and M1 is the initial seed mass.



Figure 1. *Pedicularis hallaisanensis* Hurusawa. In habitat. (A) germinated individual; (B) second-year individual; (C) flowering individuals.

2.4. Temperature Treatments

The seeds were placed in 10-cm-diameter Petri dishes on top of two layers of filter paper moistened with distilled water. All Petri dishes were sealed with Parafilm to prevent water loss during the experiment. Temperature- and light-controlled multiroom chambers were used in this study. The chambers were set at 4 °C/1 °C, 15 °C/6 °C, 20 °C/10 °C, and 25 °C/15 °C, respectively. Cool white fluorescent lamps provided an alternating 12 h light/dark photoperiod.

Germination was investigated weekly, and germinated seeds were removed from the Petri dishes. Distilled water was frequently added to prevent water loss. Rotten seeds were excluded from the germination rate calculation. Measured traits included the total germination (TG).

$$TG = (N/S) \times 100 \quad (2)$$

where (N) is the total number of germinated seeds and (S) is the total number of seeds sown.

2.5. Cold Stratification

Cold stratification treatment was conducted to investigate its effect on seed germination and break seed dormancy. The seeds were placed in 10-cm-diameter Petri dishes on two layers of filter paper moistened with distilled water. The seeds were stored in a chamber set to 4 °C/1 °C with a 12/12 h light/dark cycle for 8, 12, 16, or 20 weeks. After each cold stratification treatment, they were moved to a chamber at 25 °C/15 °C. Germinated seeds were counted weekly and removed from the Petri dishes. Distilled water was frequently added to the Petri dishes to prevent water loss. Rotten seeds were excluded from the germination rate calculation.

2.6. Gibberellic Acid Treatments

To examine the impact of GA₃ treatments on breaking seed dormancy and germination, three sets of 10 fresh seeds were used. The seeds were soaked in four GA₃ concentrations (500, 1000, 1500, and 2000 mg/L) for 24 h at room temperature. After treatment, the seeds were rinsed with distilled water and placed in a chamber at 25 °C/15 °C. Germinated seeds were counted and removed from the Petri dishes weekly. Distilled water was regularly added to the Petri dishes to prevent dehydration. Rotten seeds were excluded from the germination rate calculation.

2.7. Statistical Analyses

Statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). Tukey's honestly significant difference tests were used to assess differences between the mean TG of seeds under the four cold stratification treatments. Paired *t*-tests evaluated differences between the E:S ratio of seeds at dispersal and just before germination. Results with *p*-values < 0.05 were considered statistically significant.

3. Results and Discussion

3.1. Seed Morphology

The mature seeds of *P. hallaisanensis* are dark and oval-shaped. The length and width of the seeds were 108.06 ± 1.4 mm and 52.11 ± 1.9 mm, respectively (Table 1). The seeds had fully developed linear embryos at dispersal, a type common in gymnosperms, monocots, and dicots [13] (Figure 2). The E:S ratio of the seeds was 0.62 ± 0.01 at dispersal and 0.70 ± 0.01 just before germination (Figure 3). There was no significant difference in the E:S ratio between these stages. Generally, seeds with underdeveloped embryos exhibit morphological or morphophysiological dormancy. Such seeds disperse with underdeveloped embryos, which grow until just before germination within 30 days under optimal conditions. In this study, the seeds of *P. hallaisanensis* showed no morphological dormancy and, if lacking other dormancy types, will germinate without additional embryo growth within 30 days.

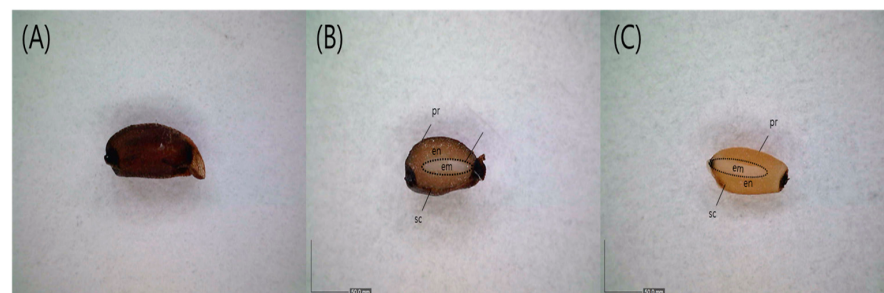
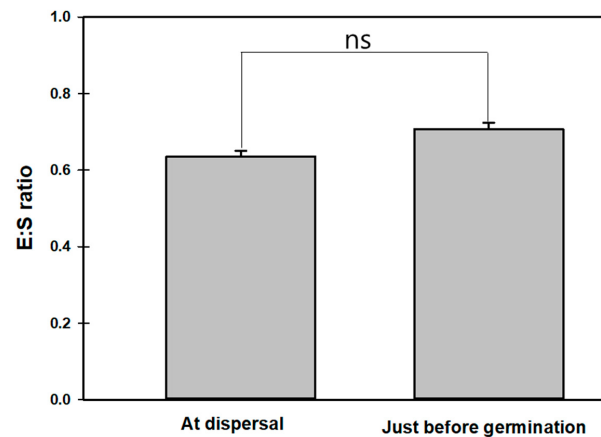


Figure 2. External and internal seed morphology of *P. hallaisanensis*. Intact seed (A) and fully developed embryos at seed dispersal (B) and just before germination (C) are shown. pr, pericarp; sc, seed coat; en, endosperm; em, embryo. Scale bars are 50 mm.

Table 1. *Pedicularis hallaisanensis* seed characteristics in this study.

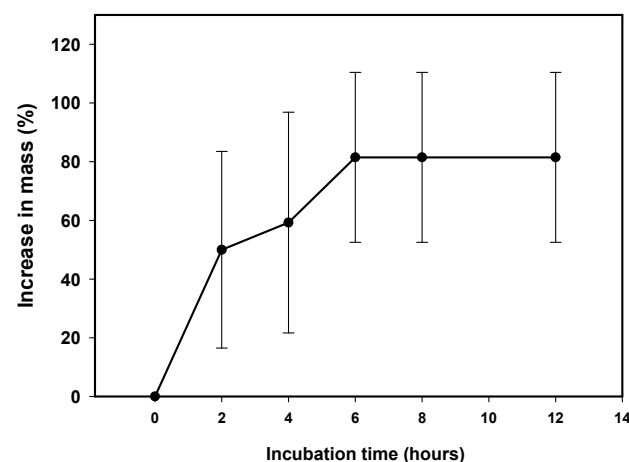
Length	Width	E:S Ratio
108.06 ± 1.41 *	52.11 ± 1.95	0.62 ± 0.01

* Mean ± standard error ($n = 10$).**Figure 3.** Embryo/seed ratio (E:S ratio) in the seeds of *P. hallaisanensis* at seed dispersal and just before germination. The vertical error bars represent SE ($n = 6$). Each E:S ratio at dispersal and just before germination was compared using Tukey's HSD tests. ns = not significant.

From an evolutionary perspective, the primitive dormancy classes are morphological dormancy and morphophysiological dormancy. Morphophysiological dormancy seeds evolved into PD by increasing embryo size, eventually becoming nondormant seeds that have lost PD [7,8,14].

3.2. Water Imbibition Test

Physical dormancy results from the impermeability of palisade cells in the seed or fruit coat, which inhibits water imbibition [8,15]. Eighteen families of angiosperms, including Fabaceae, exhibit physical dormancy [16]. This dormancy can be broken by treatments such as physical (dry or wet heat, alternate wet-dry heat, etc.) and chemical (H_2SO_4 , HCl) scarification. Generally, if the water absorption rate is under 20%, the seeds are considered PY dormancy type. In this study, mass mature seeds of *P. hallaisanensis* increased by 50% in 2 h and by 81% (fully imbibed) in 12 h (Figure 4). Thus, the seeds of *P. hallaisanensis* imbibe water and do not have PY or combination dormancy. In conclusion, the seeds of *P. hallaisanensis* do not require scarification treatments for germination in their habitat or artificial propagation.

**Figure 4.** Water uptake intact seeds of *Pedicularis hallaisanensis*. Seeds were incubated at ambient room temperature (approximately 25 °C) on filter papers moistened with distilled water for 12 h. The vertical error bars represent SE ($n = 10$).

3.3. Temperature Treatments

The seeds of *P. hallaisanensis* do not germinate under four different temperature regimes within four weeks. Generally, if seeds do not germinate within 30 days under favorable conditions, they are considered to have physiological and morphophysiological dormancy. In this study, the seeds of *P. hallaisanensis* do not exhibit physical or morphological dormancy. Therefore, they are considered to have only PD. Most alpine plants, including the *Pedicularis* genus, are known to exhibit various levels of PD [6,17]. To break PD, seeds require specific conditions such as cold or warm stratification or germination-improving chemicals like GA₃ and KNO₃ [18,19]. The seeds of the semiparasitic weed *P. kansuensis* have nondeep PD, and their germination is promoted by treatments to break seed dormancy [20]. *P. fletcheri* has nondeep PD and dormancy cycling. The seeds germinate after winter and early spring to break dormancy. Therefore, the seeds of *P. hallaisanensis* do not germinate after dispersal until PD is broken in their natural habitat. For mass propagation of this species, treatments to break PD are necessary.

3.4. Cold Stratification

Cold stratification treatments were conducted for 8, 12, 16, and 20 weeks. The seeds of cold-stratified treatments began germinating five weeks after the temperature was raised to 25 °C/15 °C. The TG increased with the duration of cold stratification. Seeds stratified for 8 weeks did not germinate during the experiment. The TG for 12 and 16 weeks of cold stratification was 15% at 16 weeks after sowing (Figure 5). The total germination for 20 weeks of cold stratification was 45% at 16 weeks after sowing. There was no significant difference between 12 and 16 weeks of cold stratification. A minimum of 12 weeks of cold stratification is required, and 20 weeks of cold stratification more efficiently promotes germination.

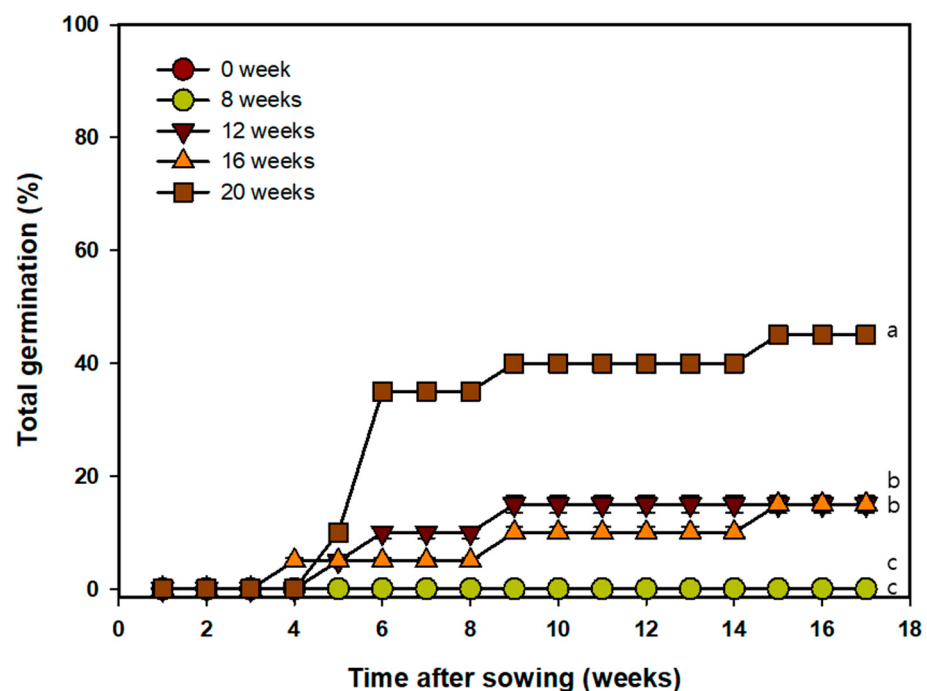


Figure 5. Total germination percentage in seed of *Pedicularis hallaisanensis* for 0, 8, 12, 16, and 20 weeks of cold stratification. The vertical error bars represent SE ($n = 3$). The different letters represent statistically significant differences, as determined by Tukey's HSD tests ($p < 0.05$).

Cold stratification can prevent germination during the winter, allowing seeds to germinate under optimal conditions afterward. This dormancy mechanism is shared by alpine plants that germinate in spring [17,21]. Cold stratification at 0–10 °C breaks PD by eliminating germination inhibitors (ABA) and increasing germination-promoting hormones

(GA and IAA) in many species [6,22,23]. The authors of [22] reported that cold stratification treatment promotes GA and IAA in mature imbibed seeds while decreasing ABA, which induces seed dormancy in rice. The nondeep PD of *P. kansuensis* seeds was released by 2–8 weeks of cold stratification [20]. *Primula beesiana* seeds with PD required 4–16 weeks of cold stratification to efficiently promote germination by breaking seed dormancy [17].

P. hallaisanensis flowers from August to September, with seed dispersal occurring from October to November. The dispersed seeds, with fully developed embryos and PD, do not germinate and undergo cold stratification (under 4 °C) for at least five months (winter to early spring). This cold exposure breaks their PD without warm stratification, allowing them to germinate from late spring to early summer.

3.5. Gibberellic Acid Treatments

Gibberellic acid treatment significantly influenced seed dormancy break and germination. Seeds soaked in GA₃ germinated within 2 weeks at 25 °C/15 °C, while untreated seeds did not germinate. The germination rate increased with GA₃ concentration. After 2 weeks, the total germination for seeds treated with 500, 1000, 1500, and 2000 mg/L GA₃ was 0%, 25%, 25%, and 80%, respectively (Figure 6). GA treatments at concentrations of 500–1000 mg/L were observed to partially break dormancy and slightly promote germination. However, these concentrations were deemed insufficient to fully release the seeds from dormancy. Higher GA₃ concentrations resulted in higher total germination, with the highest total germination served at 2000 mg/L. Therefore, a 2000 mg/L GA₃ treatment is effective for breaking the seed dormancy of *P. hallaisanensis*.

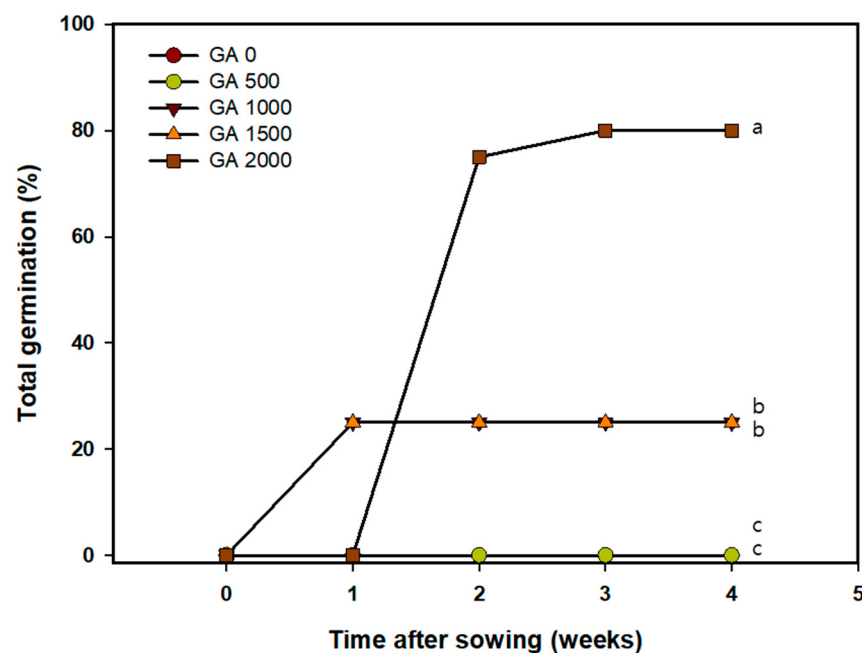


Figure 6. Total germination percentage in seeds of *Pedicularis hallaisanensis* with 0, 500, 1000, 1500, and 2000 mg/L GA treatments. The vertical error bars represent SE ($n = 3$). The different letters represent statistically significant differences, as determined by Tukey's HSD tests ($p < 0.05$).

Generally, GAs promote seed germination, while ABA induces primary seed dormancy [24]. External treatment with GAs can break dormancy and promote germination by increasing the internal GA concentration of the seed. In seeds with PD, changes in the balance of GA and ABA regulate dormancy breaking and germination [7]. Physiological seed dormancy can be broken by cold stratification and hormone treatments and is subdivided into three levels (nondeep, intermediate, and deep) by depth and characteristics. Deep PD cannot be broken with GA, but nondeep PD and intermediate PD seeds can be. Nondeep PD requires a relatively short period of cold or warm stratification about a few

days to 2 months, but intermediate PD at least requires 2–3 months of cold stratification for dormancy break stratification [6,25]. Because the seeds of *P. hallaisanensis* required a high GA concentration treatment or 3–4 months of cold stratification to break seed dormancy, the seed dormancy type of *P. hallaisanensis* is classified closer to intermediate PD than nondeep PD.

4. Conclusions

Because seed dormancy type corresponds with dispersal and propagation cycles in their habitat from an ecophysiological aspect, classifying seed dormancy provides insight into adaptation strategies for specific species in natural habitats [11,26]. This study revealed that *P. hallaisanensis* seeds have intermediate PD. The seeds germinated after a minimum of 12 weeks of cold stratification and treatment with 1000 mg/L GA₃ treatments. In natural habitats, *P. hallaisanensis* seeds disperse with fully developed embryos and have PD from August to September. The seeds experience cold stratification (under 4 °C) for winter (October–February) in the soil for at least five months. Through cold stratification, the intermediate PD of the seeds is broken, and as temperatures rise the following year, the seeds germinate.

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Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Jang, R.-H.; Kim, S.; Jung, J.-W.; Tho, J.-H.; Cheong, S.; Yoon, Y.-J. Development of a Habitat Suitability Index for the Habitat Restoration of *Pedicularis hallaisanensis* Hurusawa. *J. Ecol. Environ.* **2022**, *46*, 32. [\[CrossRef\]](#)
2. Singh, S.; Thakur, S.; Mehta, J.; Dutt, H.C. *Pedicularis cheilanthifolia* var. *albida* (Orobanchaceae): A New Record for the Flora of Uttarakhand, India. *Korean J. Plant Taxon.* **2023**, *53*, 65–68.
3. Chung, G.Y.; Jang, H.-D.; Chang, K.S.; Choi, H.J.; Kim, Y.-S.; Kim, H.-J.; Son, D.C. A checklist of endemic plants on the Korean Peninsula II. *Korean J. Plant Taxon.* **2023**, *53*, 79–91. [\[CrossRef\]](#)
4. Son, D.C.; Jang, J.E.; Park, B.K.; Lee, K.-H.; Kang, E.S.; Chang, K.S.; Jung, S.-Y.; Gil, H.-Y.; Kim, S.-J.; Choi, K. An updated checklist of the vascular flora native to Korea. *J. Asia-Pac. Biodivers.* **2025**, *18*, 651–687. [\[CrossRef\]](#)
5. Geneve, R.L. Impact of Temperature on Seed Dormancy. *HortScience* **2003**, *38*, 336–340. [\[CrossRef\]](#)
6. Baskin, J.M.; Baskin, C.C. A Classification System for Seed Dormancy. *Seed Sci. Res.* **2004**, *14*, 1–16. [\[CrossRef\]](#)
7. Finch-Savage, W.E.; Leubner-Metzger, G. Seed Dormancy and the Control of Germination. *New Phytol.* **2006**, *171*, 501–523. [\[CrossRef\]](#)
8. Baskin, C. *Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination*; Academic Press: Cambridge, MA, USA, 1998.
9. Li, A.-R.; Guan, K.-Y.; Probert, R.J. Effects of Light, Scarification, and Gibberellic Acid on Seed Germination of Eight *Pedicularis* Species from Yunnan, China. *HortScience* **2007**, *42*, 1259–1262. [\[CrossRef\]](#)
10. Kirmizi, S.; Güleriyüz, G.; Arslan, H.; Sakar, F.S. Effects of Moist Chilling, Gibberellic Acid, and Scarification on Seed Dormancy in the Rare Endemic *Pedicularis olympica* (Scrophulariaceae). *Turk. J. Bot.* **2010**, *34*, 225–232. [\[CrossRef\]](#)
11. Park, H.; Ko, C.; Lee, S.; Kim, S.; Yang, J.; Lee, K. Ecophysiology of Seed Dormancy and Germination in Four *Lonicera* (Caprifoliaceae) Species Native to Korea. *J. Ecol. Environ.* **2019**, *43*, 25. [\[CrossRef\]](#)
12. Kim, L.K.; Park, E.H.; Gang, G.; Hwang, B.Y.; Jung, H.J.; Kim, M.Y.; Choo, G.C. Form and embryonic characteristics of *Pedicularis hallaisanensis* seeds as endangered wild species II-class using host plants. *J. Korean Soc. For. Sci.* **2019**, *108*, 290–295.
13. Martin, A.C. The Comparative Internal Morphology of Seeds. *Am. Midl. Nat.* **1946**, *36*, 513–660. [\[CrossRef\]](#)
14. Nikolaeva, M. On Criteria to Use in Studies of Seed Evolution. *Seed Sci. Res.* **2004**, *14*, 315–320. [\[CrossRef\]](#)
15. Hu, D.; Baskin, J.M.; Baskin, C.C.; Yang, X.; Huang, Z. Ecological Role of Physical Dormancy in Seeds of *Oxytropis racemosa* in a Semiarid Sandland with Unpredictable Rainfall. *J. Plant Ecol.* **2018**, *11*, 542–552. [\[CrossRef\]](#)

16. Tang, L.; Baskin, C.; Baskin, J.; Luo, K.; Yu, X.; Huang, W.; Zhang, R.; Chen, Y. Methods of Breaking Physical Dormancy in Seeds of the Invasive Weed *Mimosa pudica* (Fabaceae) and a Comparison with 36 Other Species in the Genus. *PeerJ* **2022**, *10*, e13567. [[CrossRef](#)] [[PubMed](#)]
17. Yang, L.-E.; Peng, D.-L.; Li, Z.-M.; Huang, L.; Yang, J.; Sun, H. Cold Stratification, Temperature, Light, GA₃, and KNO₃ Effects on Seed Germination of *Primula beesiana* from Yunnan, China. *Plant Divers.* **2020**, *42*, 168–173. [[CrossRef](#)] [[PubMed](#)]
18. Lashkarian, G.; Kalatehjari, S.; Khosroshahli, M. Seed Dormancy Breaking Evaluation of Two Subspecies Seashore Iris, Iranian Native, through in Vitro Culture. *J. Agric. Food Technol.* **2012**, *2*, 56–60.
19. Lee, S.G.; Kim, H.Y.; Lee, K.C.; Ku, J.J. Effects of Seed Storage Methods and Shading on Seed Germination and Seedling Growth of Endangered Species, *Iris dichotoma* and *Iris setosa*. *J. Korean Soc. For. Sci.* **2015**, *104*, 60–66. [[CrossRef](#)]
20. Hu, J.; Li, K.; Deng, C.; Gong, Y.; Liu, Y.; Wang, L. Seed Germination Ecology of Semiparasitic Weed *Pedicularis kansuensis* in Alpine Grasslands. *Plants* **2022**, *11*, 1777. [[CrossRef](#)]
21. Wang, G.; Baskin, C.C.; Baskin, J.M.; Yang, X.; Liu, G.; Zhang, X.; Ye, X.; Huang, Z. Timing of Seed Germination in Two Alpine Herbs on the Southeastern Tibetan Plateau: The Role of Seed Dormancy and Annual Dormancy Cycling in Soil. *Plant Soil* **2017**, *421*, 465–476. [[CrossRef](#)]
22. Yang, B.; Cheng, J.; Wang, J.; Cheng, Y.; He, Y.; Zhang, H.; Wang, Z. Physiological Characteristics of Cold Stratification on Seed Dormancy Release in Rice. *Plant Growth Regul.* **2019**, *89*, 131–141. [[CrossRef](#)]
23. Zhou, M.; Xu, Y.; Wang, F.; Yang, X.; Lu, S.; Zhang, Y. Effects of Seasonal Temperature Regimes on Embryo Growth and Endogenous Hormones of *Taxus chinensis* var. *mairei* Seeds. *Front. Plant Sci.* **2023**, *14*, 1114629. [[CrossRef](#)]
24. Hilhorst, H.; Karssen, C. Seed Dormancy and Germination: The Role of Abscissic Acid and Gibberellins and the Importance of Hormone Mutants. *Plant Growth Regul.* **1992**, *11*, 225–238. [[CrossRef](#)]
25. Baek, S.G.; Im, J.H.; Kwak, M.J.; Park, C.H.; Lee, M.H.; Na, C.S.; Woo, S.Y. Non-Deep Physiological Dormancy in Seed and Germination Requirements of *Lysimachia coreana* Nakai. *Horticulturae* **2021**, *7*, 490. [[CrossRef](#)]
26. Wang, J.; Bu, Z.; Poschlod, P.; Yusup, S.; Zhang, J.; Zhang, Z. Seed Dormancy Types and Germination Response of 15 Plant Species in Temperate Montane Peatlands. *Ecol. Evol.* **2024**, *14*, e11671. [[CrossRef](#)] [[PubMed](#)]

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