Building evidence for conservation globally

Journal of Threatened Taxa

10.11609/jott.2025.17.8.27323-27406
www.threatenedtaxa.org

26 August 2025 (Online & Print)
17(8): 27323-27406
ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

Open Access

40 zoOreach Zoo Outreach Organisation Years

ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher
Wildlife Information Liaison Development Society
www.wild.zooreach.org

Host
Zoo Outreach Organization
www.zooreach.org

Srivari Illam, No. 61, Karthik Nagar, 10th Street, Saravanampatti, Coimbatore, Tamil Nadu 641035, India
Registered Office: 3A2 Varadarajulu Nagar, FCI Road, Ganapathy, Coimbatore, Tamil Nadu 641006, India
Ph: +91 9385339863 | www.threatenedtaxa.org
Email: sanjay@threatenedtaxa.org

For Focus, Scope, Aims, and Policies, visit https://threatenedtaxa.org/index.php/JoTT/aims_scope
For Article Submission Guidelines, visit https://threatenedtaxa.org/index.php/JoTT/about/submissions
For Policies against Scientific Misconduct, visit https://threatenedtaxa.org/index.php/JoTT/policies_various

continued on the back inside cover

Cover: Little Andaman is part of the island chain with incredible biodiversity, but these amazing species are threatened by development projects, and need our support. Pen and ink artwork by Priyanka Iyer.

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 August 2025 | 17(8): 27323–27332

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

https://doi.org/10.11609/jott.9610.17.8.27323-27332

#9610 | Received 04 January 2025 | Final received 31 July 2025 | Finally accepted 16 August 2025

OPEN ACCESS

ARTICLE

Taxonomic studies and breaking seed dormancy of *Hibiscus lobatus* (Murray) Kuntze, 1898 (Magnoliopsida: Malvales: Malvaceae) — a native plant of the central Western Ghats

T.D. Karthik [1], V. Krishna [2], B.U. Sourabh Giri [3], K. Raagavalli [4] & A.S. Syeda [5]

[1,2,3,5] Department of Biotechnology, Kuvempu University, Shankaraghatta, Karnataka 577451, India.
[4] Department of Biotechnology, Sahyadri Science College, Shivamogga, Karnataka 577203, India.
[1] karthiktdtke@gmail.com, [2] krishnabiotech2003@gmail.com (corresponding author), [3] sourabhgiribu@gmail.com, [4] raagavallik2014@gmail.com, [5] irshad.com30@gmail.com

Abstract: *Hibiscus lobatus* (Murray) Kuntze is a medicinal plant of the Malvaceae family, very sparsely and seasonally distributed, particularly in the Western Ghats of Karnataka. This species, known for its ethnopharmacological uses, especially in wound healing, faces a declining population due to habitat loss, overexploitation, and poor seed germination. Seed dormancy has been identified as a major factor limiting its natural regeneration. In this study, the distribution, habitat, and taxonomic diagnostic features of *Hibiscus lobatus* were investigated across different floristic regions of the central Western Ghats. Seed viability and dormancy-breaking treatments were assessed both in the field and in vitro. Tetrazolium testing confirmed seed viability, but field germination rates were low (4–6%), indicating strong dormancy. Among the treatments tested, sulfuric acid scarification combined with GA_3 application proved most effective, substantially enhancing germination and reducing germination time. These findings establish an optimised protocol for overcoming seed dormancy in *Hibiscus lobatus*, which can be applied to conserve and propagate this important medicinal species, addressing its declining population.

Keywords Annual herb, ethnobotanical survey, Gibberellic acid (GA_3), native flora conservation, propagation techniques, scarification, seasonal germination, seed viability, tetrazolium test, Western Ghats biodiversity.

Editor: Sanjaykumar R. Rahangdale, PDEA's A. W. Arts, Science & Commerce College, Pune, India. **Date of publication:** 26 August 2025 (online & print)

Citation: Karthik, T.D., V. Krishna, B.U.S. Giri, K. Raagavalli & A.S. Syeda (2025). Taxonomic studies and breaking seed dormancy of *Hibiscus lobatus* (Murray) Kuntze, 1898 (Magnoliopsida: Malvales: Malvaceae) — a native plant of the central Western Ghats. *Journal of Threatened Taxa* 17(8): 27323–27332. https://doi.org/10.11609/jott.9610.17.8.27323-27332

Funding: None.

Competing interests: The authors declare no competing interests.

Author details: KARTHIK T.D. is a research scholar at the Department of Biotechnology, Kuvempu University, Shankaraghatta, Karnataka, India. His research focuses on plant tissue culture, phytochemistry, and pharmacology. KRISHNA V. is a senior professor in the Department of Biotechnology, Kuvempu University, Shankaraghatta, Karnataka, India. His research expertise spans plant biotechnology, phytochemistry, plant taxonomy, and pharmacology, with extensive contributions to the study and conservation of medicinal plants. SOURABH GIRI B.U. is a research scholar at the Department of Biotechnology, Kuvempu University, Shankaraghatta, Karnataka, India. His research expertise lies in plant pharmacology, with a focus on traditional medicinal plant formulations, ethnobotanical studies, and ethnomedicinal plant surveys. RAAGAVALLI K. is a research scholar at the Department of Biotechnology, Sahyadri Science College, Shivamogga, Karnataka, India. Her research interests are in plant phytochemistry and pharmacology, with a focus on bioactive compounds from medicinal plants. SYEDA AYESHA SIDDIQUA is a research scholar at the Department of Biotechnology, Kuvempu University, Shankaraghatta, Karnataka, India. Her research focuses on plant tissue culture, phytochemistry, and pharmacology.

Author contributions: KTD—conducted plant taxonomical study in the Central Western Ghats of Karnataka and studied the morphometric feature of Hibiscus lobatus, designed and performed seed dormancy-breaking experiments. KV—mentor, corresponding author, overseeing the study's conceptualization and coordination. SGBU— Conducted ethnobotanical survey and explored traditional medicine uses of *Hibiscus lobatus*. RK—assisted in evaluating the in vivo seed dormancy-breaking experiments of *Hibiscus lobatus*.SAS—Assisted in evaluating the in vitro seed dormancy-breaking experiments of *Hibiscus lobatus*.

Acknowledgements: The authors would like to express their gratitude to the Registrar of Kuvempu University, India, for providing financial support. We also extend our thanks to the Chairman of the Department of Biotechnology for offering the necessary facilities to conduct this research.

INTRODUCTION

Global ecological changes driven by human activity and climate shifts have significantly impacted plant biodiversity. Ecological degradation and its consequent biodiversity loss, pose a serious threat to the natural distribution of plant species. Intensive plant exploration studies conducted across various floristic regions have helped taxonomists recognise the vulnerable status of many native species, often impacted by habitat disturbance, and the spread of exotic species. In recent years, habitat loss, overexploitation, pollution, and illegal trade of plant resources have further contributed to biodiversity decline, pushing several species toward threatened status (Tali et al. 2015). These growing stresses are also linked to climate change (Urban 2015; Bachman et al. 2018; Hamid et al. 2020). Therefore, extensive plant surveys and identification of threat status are crucial for assessing extinction risks, formulating conservation strategies, and raising awareness to protect declining habitats. Continuous plant exploration and conservation assessments are essential for understanding species vulnerability, formulating protective strategies, and promoting sustainable use. This is particularly important for lesser-studied native species like *Hibiscus lobatus* (Murray) Kuntze, which faces seasonal growth constraints and germination barriers, making it a valuable candidate for conservation and regenerative studies.

Hibiscus lobatus (Murray) Kuntze (Synonyms: *Hibiscus solandra* L'Hér, *Solandra lobata* Murray, *Hibiscus torulosus* Salisb., *Hibiscus pumilus* Roxb., and *Laguna lobata* Willd.) (WFO 2025) is an annual herb of Malvaceae, primarily growing in the seasonally dry tropical biome of the world. This species was recorded in several monumental taxonomic publications, including flora of the Presidency of Madras (Gamble 1915), flora of Tamil Nadu Carnatic (Matthew 1983), flora of Karnataka (Saldahna 1984), flora of South Kanara (Bhat 2014), flora of Sri Venkateswara National Park and Andhra Pradesh (Benjamin & Murthy 2013). In addition to climatic changes, anthropogenic pressures such as road construction, resort development, mega power projects, deforestation, and agricultural activities in the core forest regions of the Central Western Ghats have severely disturbed natural habitats, pushing the native herbaceous species *Hibiscus lobatus* to the threshold of extinction (Noori et al. 2025). Intensive plant exploration studies in various floristic provinces of the central Western Ghats of Karnataka, such as, flora of Shimoga District (Ramaswamy et al. 2001), flora of Davanagere District (Manjunatha et al. 2004), flora of British India (Hooker 1875), have not listed *Hibiscus lobatus*. Furthermore, detailed morphometric studies, and diagnostic characteristics of this species have not been thoroughly investigated. Hence, the present work is undertaken.

Seed dormancy is an adaptation that helps plants to survive unfavourable environmental conditions by coordinating germination and establishment with the surrounding environment (Donohue et al. 2010). Environmental factors such as soil temperature and humidity play a crucial role in controlling dormancy in mature seeds, serving as key determinants for dormancy cycling (Leubner 2006). Previous studies have investigated the seed viability of various *Hibiscus* species, including *Hibiscus acetosella* Welw. ex Fic., *H. calyphyllus* Cav., *H. surattensis* L., *H. lobatus* Kuntze, *H. radiatus* Cav., *H. vitifolius* L., and *H. panduriformis* Burm. F (Kak et al. 2015); as well as *Hibiscus waimeae* ssp. *hannerae*, and *Hibiscus waimeae* ssp. *waimeae* (Wolkis et al. 2018).

In the present study, field surveys, and ethnobotanical investigations were conducted to explore the distribution, and traditional uses of *Hibiscus lobatus* (Murray) Kuntze in the central Western Ghats, particularly in the forest regions of Tirthahalli (Shivamogga District) and Narasimharajapura Taluk (Chikkamagaluru District). These surveys revealed valuable traditional knowledge, with local practitioners using whole-plant extracts for various skin-related treatments. Notably, these traditional uses have not been recorded in official pharmacopeia or documented in previous scientific literature. Although anti-aging properties have been reported in related species such as *Hibiscus syriacus* (Di Martino et al. 2017; Yang et al. 2019), *H. manihot* L., and *H. abelmoschus* L. (Luan et al. 2020), such properties in *H. lobatus* remain unexplored, and neglected in terms of scientific investigation. This study aims to document the morphological characteristics and distribution of *Hibiscus lobatus* in the central Western Ghats, assess its seed viability, and dormancy status, and develop effective in vivo, and in vitro dormancy-breaking protocols. These efforts are intended to overcome regeneration barriers and support the conservation of this native, and underutilised species.

MATERIALS AND METHODS

Study area

Western Ghats in Karnataka State, India, is a global biodiversity hotspot covering an area of approximately 20,668 km^2, popularly known as the Sahyadri Hills. This region encompasses the largest portion of the Western Ghats, accounting for about 37% of its total area, and is located between 13.769°–15.732° N and 74.124°–75.169° E. The mountain range runs parallel to the western coast of India. The climate is semi-arid and cooler, the mountain range runs parallel to the western coast of India. The climate is semi-arid to temperate, with higher elevations averaging around 15°C (60°F) annually, while lower elevations record mean annual temperatures varying from 20°C (68°F) in the south to 24°C (75°F) in the north (Ramachandra et al. 2019). The geographical habitat of *Hibiscus lobatus* in different study locations within the Sahyadri Hills includes both moist and dry forests.

Taxonomy

The standard herbarium method (Bridson & Forman 1992) was followed during the collection, processing, and preparation of the herbarium specimens. Voucher specimens have been deposited at Kuvempu University, DBT-BUILDER Herbarium (KUDBH- Mal 21-Hb). An ethnobotanical survey was conducted in the study area to document the traditional use of this plant species. The survey typically began with the interview of authorised traditional medicine practitioners residing in and around Sahyadri Hills.

Evaluation of seed viability

a) Tetrazolium Method: Tetrazolium method (Patil & Dadlani 2009) was followed to test the viability of seeds of *Hibiscus lobatus.* Three groups of seeds, aged 10 months, five months, and one month old, were prepared with 100 seeds per group, and were divided into four replicates of 25 seeds each. For hydration, seeds were placed on the moist paper towels, and were soaked directly in distilled water for 12 hours. Following pre-soaking, seed coats were removed, and a small puncture was made near the embryonic axis to facilitate better staining. The seeds were then treated in 1% tetrazolium chloride solution for 4 hours at diurnal room temperature, allowing the solution to react with viable seeds, which stained red or pink. After staining, seeds were rinsed with distilled water, and viability was assessed based on colour intensity in the embryo, with red or pink indicating viable cells. The viability of each seed group was recorded by counting stained (viable) versus unstained (non-viable) seeds in each replicate. Viability percentage for each group was calculated using:

Viability Percentage = (Number of Viable Seeds/ Total Number of Seeds Tested) *100

b) Seed germination test: Seed germination test under field condition (Pace et al. 2016) was conducted to assess germination rates of 12 hr hydrated seeds of 10 months, 5 months, and 1 month old. Seeds were sown in manually prepared plots using humus-rich topsoil corresponding to the O horizon, and regular watering was provided to create conditions favourable for seed germination. In each plot, 25 seeds from each age group were sown, with four replicates per group, totalling 100 seeds per age group. Germination percentages were recorded based on seedling emergence over time under natural environmental conditions in the experimental garden.

Breaking of seed dormancy

To break the dormancy of *Hibiscus lobatus* seeds, experiments were conducted using two pretreatment methods: hot water stratification (Benedito et al. 2019) and acid stratification (Dilaver et al. 2017) were employed. Seeds were divided into triplicates of 30 seeds for each treatment group. For hot water stratification, seeds were immersed in hot water (60–70°C) for 10 min. Acid scarification involves treating the seeds with sulphuric acid (H_2SO_4) at concentrations ranging from 5% to 20% for 5 min. Following these treatments, seeds were sown in vivo in the field condition and cultured in vitro on Murashige and Skoog (MS) medium supplemented with gibberellic acid (GA_3) at concentrations of 0.75–1.5 mg/L (Zhang et al. 2020).

RESULTS AND DISCUSSION

Morphometric studies

Annual, erect, herbaceous plant attaining 50–70 cm in height. Stems fibrous, branched; branchlets hairy; scabrid or stellate trichomes; glabrescent on maturity. Leaves dimorphic, alternate, membranous; lower leaves ovate-cordate, 1.5–3 cm long; middle leaves trifoliolate, up to 9 cm; upper leaves either deeply lobed or trifoliolate, with roundly dentate margins. Lamina lanceolate, villous, up to 8 cm long; petiole equal to or slightly longer than the lamina. Flowers axillary, solitary or in sparse racemes, 1–1.5 cm across; pedicel 0.7–0.9 cm long; flower diameter 2.2–2.5

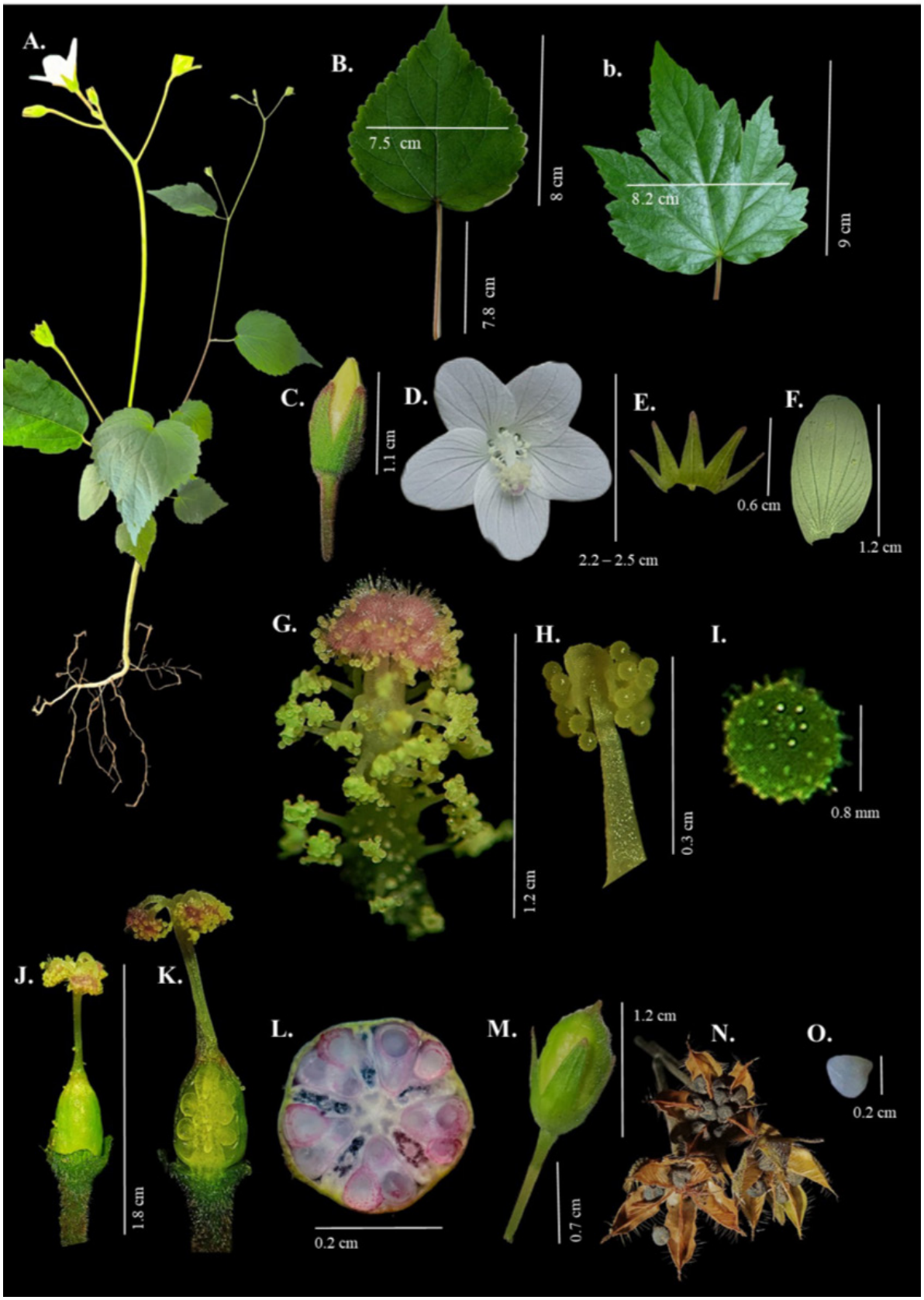

Image 1. Morphometric analysis and diagnostic feature of *Hibiscus lobatus*: A—*Hibiscus lobatus* habitat | B—Leaf | C—Flower bud | D—Blossomed flower | E—Sepals | F—Insect wing like petal | G—Staminal tube | H—Staminal branchlet | I—Pollen grain | J—Pistil | K—LS of ovary | L—TS of ovary | M—Capsule | N—Opened capsule | O—Seeds with hairs. © Karthik T.D.

cm. Calyx cup-shaped, 0.6 mm long, membranous, 5-lobed; lobes lanceolate, pilose, and strigose abaxially, persistent. Petals 5, white, 1.2–1.4 cm long, insect wing-like in appearance. Staminal tube 1.2 cm long; staminal branches up to 0.3 cm, staminal column bearing numerous monadelphous stamens with apical hairs. Pollen grains spheroidal, polycolporate, echinate, approximately 0.8 mm in diameter. Gynoecium with a superior ovary, ellipsoid, 1.3–1.8 cm long and 0.1–0.3 cm wide, 5-locular (occasionally up to 10), with axile placentation and multiple ovules per locule. Stigma 5, free, pinkish, arising from a single style column. Capsule broadly ovoid to cylindrical, 0.8 cm long, beaked at apex; fruit composed of five mericarps; endocarp thin, villous along the ventral side. Seeds minute, 0.2 mm, with scale-like hairs (Image 1).

Distribution

Hibiscus lobatus is distributed in the dry deciduous forests of India, tropical Africa, Madagascar, tropical and southeastern Asia, Sri Lanka, and Malaysia (Rao et al. 2019).

Distribution in India

Hibiscus lobatus is distributed in the forests of Andhra Pradesh, Bihar, Delhi, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, Uttarakhand, West Bengal, and Assam (India Biodiversity Portal 2025).

The ethnobotanical survey in the central Western Ghats of Karnataka, India, revealed that *Hibiscus lobatus* is very sparsely distributed in the moist deciduous forests of Belagavi, Uttara Kannada, Shivamogga, Chikkamagaluru, Hassan, Dakshina Kannada, Kodagu, and Mysuru districts. The sites of herbarium specimen collection, along with their latitude and longitude, are shown in Image 2, and Table 1. This species is found only in two sites in the Shivamogga region, namely Kuruvalli Village, of Tirthahalli Taluk, and Thammadihalli Village, of Bhadravathi Taluk, in the form of small pockets during the spring season. In other localities, a sparse distribution was observed due to the spread of invasive species such as *Eupatorium odoratum*, *Lantana camara*, *Parthenium hysterophorus*, *Hyptis suaveolens*, *Senna siamea*, *Borreria stricta*, and *Amaranthus spinosa*.

Traditional medicinal value

The traditional medicine practitioners residing in the Tirthahalli Taluk of Shivamogga District and Narasimharajapura Taluk of Chikkamagaluru grind the leaves of *Hibiscus lobatus* and *Terminalia arjuna* in a 3:1 ratio. The fine paste is then boiled with coconut water for 10 to 15 minutes. The oil content is filtered and used as a cosmetic for glowing skin. It is also used for epithelization and the cosmetic treatment of burnt wounds. The anti-aging property of *Hibiscus sabdariffa* L. (Li et al. 2020) and *H. rosa-sinensis* L. (Dos et al. 2021) has been investigated. The extracts and compounds from many species of *Hibiscus* are used in the cosmetic industry to produce various skin-glowing creams and lotions, such as plant science Hibiscus night cream and Saint Jane hydrating petal cream.

Seed viability

Seed viability of *Hibiscus lobatus* was evaluated using the tetrazolium method across three age groups: 1 month old, 5 month old, and 10 month old seeds. A gradual decline in viability was observed with increasing seed age. The 1 month old seeds exhibited the highest viability at 72.6±2.2%, followed by the 5 month old seeds at 69.8±1.8%, and the 10 month old seeds at 65.2±2.3%. Staining patterns revealed that 1month old and 5 month old seeds were uniformly stained and showed minimal necrosis, reflecting healthy, and active embryonic tissues. In contrast, the 10 month old seeds displayed superficial staining in some seeds, particularly at the distal tip of the radicle, along with slightly higher necrosis. Despite these differences, the variation among seed groups was minor, highlighting that seeds of *Hibiscus lobatus* retain viability, and physiological integrity effectively over the time. This resilience is consistent with the plant's annual growth cycle, ensuring the seeds remain robust, and capable of germination in subsequent growing seasons.

Seed germination test in the field

Viable seeds of *H. lobatus*, confirmed through the tetrazolium test, were sown in fertile soil under optimal environmental conditions during the post-fruiting months of October to December, which align closely with the plant's natural growth cycle. Germination was monitored over 45 days, and the results showed that 1 month old seeds had a germination percentage of 25.8±2.6%, 5 month old seeds 18.6±2.4%, and 10 month old seeds 17.2±2.2% as shown in Figure 1. Although the seeds were viable and in healthy condition, their germination potential under field conditions was low, confirming the presence of dormancy. The minimal variation in germination percentages between seed age groups indicates that seed age is not a major influencing factor in this context. These results emphasize the

Table 1. Distribution sites and geographical locations of *Hibiscus lobatus* in the central Western Ghats, Karnataka.

Observation Sites (S)	Location	Forest type	Latitude (Decimal)	Longitude (Decimal)
S1	Alavalli Village, Siddapur Taluk, Uttara Kannada	Semi Evergreen	14.308° N	74.764° E
S2	Chamundi Hill, Mysore	Deciduous	12.288° N	76.688° E
S3	Bhutaramanahatti Village, Belgaum Taluka, Belgaum.	Deciduous	15.993° N	74.517° E
S4	Kuruvalli Village, Tirthahalli Taluk, Shivamogga	Evergreen	13.684° N	75.249° E
S5	Thammadihalli Village, Bhadravathi Taluk, Shivamogga	Moist deciduous	13.741° N	75.624° E
S6	Monnageri Village, Madikeri Taluk, Kodagu	Evergreen	12.426° N	75.716° E
S7	Kodekkal, Beltangadi Taluk, Dakshina Kannada	Evergreen	13.013° N	75.323° E
S8	Thendihalli, Hassan Taluk, Hassan	Deciduous	12.999° N	76.173° E
S9	Balekoppa, Narasimharajapura Taluk, Chikkamagaluru	Moist deciduous	13.614° N	75.506° E

Table 2. Effect of seed pre-treatments on germination of *Hibiscus lobatus* under field conditions.

Treatments	Concentrations	Germination (%)			Number of days to germinate		
		1 month	5 months	10 months	1 month	5 months	10 months
Control (No pretreatment)		25.8±2.6	18.6±2.4	17.2±2.2	32–36	32–36	32–36
Hot water Treatment (°C)	20	26.5±1.4	18.8±1.2	18.6±1.4	28–31	28–31	28–31
	40	27.4±2.4	21.8±2.4	20.5±1.2	28–31	28–31	28–31
	60	**32.6±2.2**	**30.6±1.5**	**29.4±1.2**	**24–28**	**24–28**	**24–28**
	80	18.6±1.2	17.8±1.2	17.4±1.2	32–36	32–36	32–36
Sulphuric acid concentration (%)	5	25.4±1.4	19.4±1.2	19.2±1.2	28–31	28–31	28–31
	10	30.8±1.6	29.2±2.1	26.5±1.4	29–32	29–32	29–32
	15	**38.5±1.4**	**35.6±1.2**	**32.8±1.5**	**22–26**	**22–26**	**22–26**
	20	21.8±1.6	19.5±1.4	19.2±1.2	28–31	28–31	28–31

The value: mean of ± SE four replicates of 25 seeds of each group.

dormancy mechanism in *H. lobatus*, which ensures the seeds remain synchronized with favourable environmental conditions, a crucial adaptation in its annual life cycle (Harel et al. 2011).

Reliable method for assessing seed germination, dormancy, and mortality of seeds is under field conditions. The result indicated that highest percentage of seed germination was noticed between 30–45 days (Figure 1). In this period, the average germination percentage of 1 month old, 5 month old, and 10 month old seeds was 13.3 ± 0.83, 10.8 ± 0.83, and 10.7 ± 0.86, respectively, which were higher than those recorded during the other observation phases (0–15, 15–30, and 45–60 days). Several environmental factors control seed germination success under field conditions**.** Pradhan et al. (2011) also evaluated the effects of microhabitat, light, and temperature on seed germination of a critically endangered Himalayan medicinal herb, *Swertia chirayita* (Roxb.) H. Karst. for conservation implications.

Breaking of seed Dormancy

In vivo method of breaking of seed dormancy

Experiments to break dormancy of seeds conducted *in vivo* under field condition following the method of Tiwari et al. (2018). The results revealed significant differences in germination percentages among seeds treated with hot water and sulphuric acid (Table 2). A decline in germination percentage was observed with increasing seed age. The control group, without any pretreatment, exhibited germination percentages of

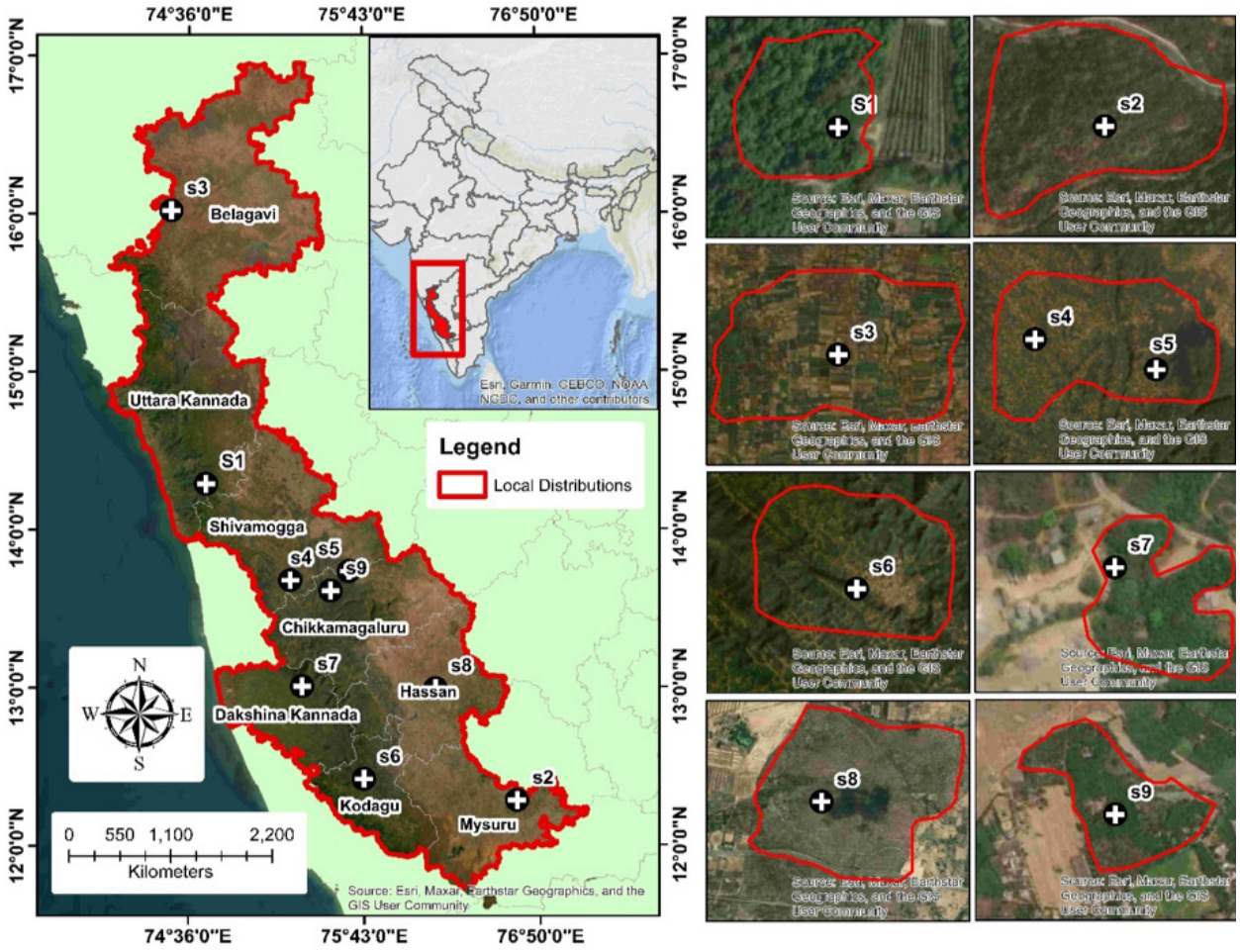

Image 2. Distribution of *Hibiscus lobatus* in the central Western Ghats of Karnataka.

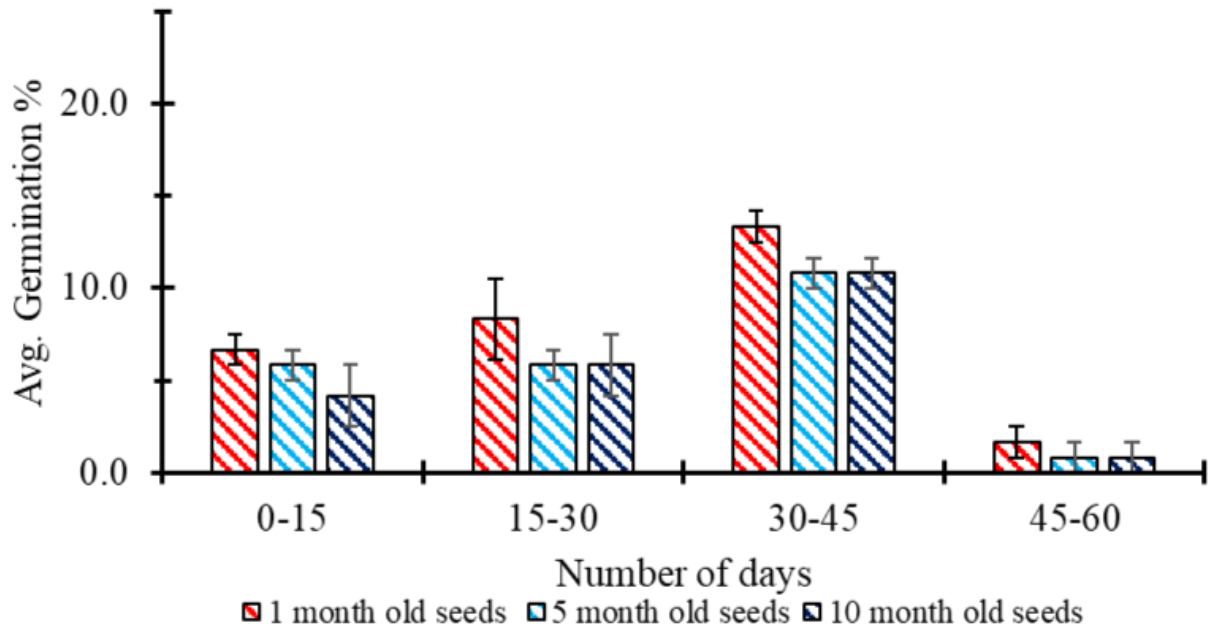

Figure 1. Percentage of *Hibiscus lobatus* seed germination under field condition.

Table 3. Effect of GA_3 treatment on breaking seed dormancy of *Hibiscus lobatus* under in vitro conditions.

	Concentrations	Germination (%)			Number of days to germinate		
		1 month	5 month	10 month	1 month	5 month	10 month
GA_3 (mg/ml)	0.75	35.6±2.2	24.3±2.1	18.3±2.1	24–28	24–28	24–28
	1	58.8±3.6	56.6±3.2	55.5±3.2	16–20	16–20	16–20
	1.25	48.8±1.2	48.6±1.4	46.6±2.4	17–21	17–21	17–21
	1.5	40.6±2.4	38.6±2.2	36.8±2.2	28–31	29–32	29–32
Hot water Treatment (°C) + 1 mg/ml GA_3	20	34.2±2.2	31.4±2.2	29.2±2.1	22–25	22–25	22–25
	40	68.8±4.6	65.8±3.6	59.8±3.4	15–18	15–18	15–18
	60	69.4±4.8	66.8±3.4	63.5±3.2	11–15	11–15	11–15
	80	28.6±2.2	23.8±1.8	16.4±1.2	18–21	19–21	19–21
Sulphuric acid (%) + 1 mg/ml GA_3	5	38.8±2.4	34.8±1.2	34.6±1.3	21–25	21–25	21–25
	10	74.5±4.4	68.6±3.2	66.4±3.2	13–15	13–15	13–15
	15	76.3±4.2	72.5±5.3	71.5±5.3	10–13	10–13	10–13
	20	28.8±1.6	21.6±1.2	19.6±1.2	17–20	17–20	17–20

The value: mean of ± SE three replicates of 30 seeds of each group.

25.8±2.6% for 1 month old, 18.6±2.4% for 5 month old, and 17.2±2.2% for 10 month old seeds. Germination in the control group occurred between 32–36 days, reflecting the persistence of dormancy of seeds of *H. lobatus* .

Hot water scarification treatments of seeds moderately enhanced germination rates compared to the control group. The highest germination percentage of 32.6±2.2% was observed at 60°C, with germination times reduced to 24–36 days. Sulphuric acid scarification showed a more pronounced effect, particularly at a concentration of 15%, achieved percentages of germination of seeds was 38.5±1.4%, 35.6±1.2%, and 32.8±1.5% for 1 month old, 5 month old, and 10 month old seeds respectively. Germination of seeds was observed between 22–26 days, demonstrating its relative effectiveness in overcoming seed dormancy.

Despite these improvements, the overall germination rates remained low, indicating that these treatments partially alleviated seed dormancy, but they were insufficient to fully overcome it under field conditions. These results suggest that more targeted or refined dormancy-breaking methods may be necessary to achieve optimal germination. To address these limitations, in vitro approaches were undertaken. These methods aim to explore controlled environments and specific treatments to achieve higher germination success, and provide a more effective solution for breaking dormancy in *Hibiscus lobatus* seeds.

In vitro method of breaking of seed dormancy

The in vitro methods of breaking of seed dormancy experiments were employed to know the conjugative effect of pretreated seeds cultured *in vitro* on MS medium (Murashige & Skoog 1962) supplemented with 0.75–1.25 mg/L of GA_3. The result of the experiment showed that pretreatment of seeds with either hot water or sulphuric acid and cultured on MS medium fortified with GA_3 showed improved seed germination in *Hibiscus lobatus* (Table 3).

In the culture of untreated seeds, GA_3 at the concentration of 1 mg/L was found to be effective to induce germination of 58.8±3.6% for 1 month old seeds, 56.6±3.2% for 5 month old seeds, and 55.5±3.2% for 10 month old seeds between 16–20 days of culture. Pretreatment of seeds with 15% sulphuric acid when cultured on 1 mg/L of GA_3 showed the highest germination percentages: 76.3±4.2% for 1 month old seeds, 72.5±5.3% for 5 month old seeds, and 71.5±5.3% for 10 month old seeds, respectively. These findings indicate the most effective in vitro approach, offering significantly higher percentage of germination, and shorter germination periods compared to other treatments. The combination of hot water treatment (60°C) and 1 mg/L of GA_3 also showed increased percentage of germination as compared to individual

treatments and the germination time was reduced to 11–15 days. Similar results were also observed in breaking of seed dormancy of *Hibiscus coddii* ssp. *barnardii* (du Plessis et al. 2019).

CONCLUSION

The present study highlights the taxonomic, ethnobotanical, and ecological significance of *Hibiscus lobatus* in the central Western Ghats. Traditional medicinal knowledge confirmed its therapeutic potential in skin healing and anti-aging applications, reinforcing its relevance in pharmaceutical, and cosmetic industries. Seed dormancy was identified as a critical factor limiting natural regeneration. Pretreatment with sulphuric acid followed by culture on MS medium fortified with GA_3 significantly improved seed germination, demonstrating an effective dormancy-breaking strategy. These findings provide a foundation for large-scale propagation.

REFERENCES

Anjali, A.K.K., S. Agarwal, C. Pandey & V. Gupta (2015). Responses to seed dormancy breaking treatments in wild *Hibiscus* species. *Vegetos* 28(2): 143.

Bachman, S.P., E.M.N. Lughadha & M.C. Rivers (2018). Quantifying progress toward a conservation assessment for all plants. *Conservation Biology* 32(3): 516–524. https://doi.org/10.1111/cobi.13071

Benjamin, J.F. & G.V.S. Murthy (2013). *Flora of Sri Venkateswara National Park, Andhra Pradesh*. Botanical Survey of India, Kolkata, 492 pp.

Benedito, C.P., M.C.C. Ribeiro, E.P.D. Paiva & H.L.D.S. Medeiros (2019). Dormancy overcoming and germination test in *Piptadenia stipulacea* (Benth.) Ducke seeds. *Revista Ciência Agronômica* 50(2): 338–344. https://doi.org/10.5935/1806-6690.20190040

Bridson, D. & L. Forman (1992). *The Herbarium Handbook*. 3rd edition. Royal Botanic Gardens, Kew, England.

Davies, P.J. (ed.) (1995). *Plant Hormones: Physiology, Biochemistry and Molecular Biology*. Kluwer Academic (Springer Science & Business Media), Dordrecht, 833 pp.

di Martino, O., A. Tito, A. de Lucia, A. Cimmino, F. Cicotti, F. Apone & V. Calabrò (2017). *Hibiscus syriacus* extract from an established cell culture stimulates skin wound healing. *BioMed Research International* 2017: 7932019. https://doi.org/10.1155/2017/7932019

Dilaver, Z., M. Mirzapour & H. Kendir (2017). Breaking seed dormancy and micropropagation of perennial vulneraria milkvetch (*Astragalus vulnerariae* DC.). *Acta Scientiarum Polonorum. Hortorum Cultus* 16(4): https://doi.org/10.24326/asphc.2017.4.9

Donohue, K, R.R. de Casas, L. Burghardt, K. Kovach & C.G. Willis (2010). Germination, post-germination adaptation, and species ecological ranges. *Annual Review of Ecology, Evolution, and Systematics* 41: 293–319. https://doi.org/10.1146/annurev-ecolsys-102209-144715

Dos, S.N.L.B., A. Gori, A. Raffaelli, F. Ferrini & C. Brunetti (2021). Phenolic compounds from leaves and flowers of *Hibiscus roseus*: Potential skin cosmetic applications of an under-investigated species. *Plants* 10(3): 522. https://doi.org/10.3390/plants10030522

Du Plessis, H.J., R. Kleynhans, R.V. Nikolova & B.A. Egan (2019). Factors affecting seed propagation of *Hibiscus coddii* subsp. *barnardii*: a new potential ornamental plant. *Propagation of Ornamental Plants* 19(2): 38–47.

Bhat, K.G. (2014). *Flora of South Kanara: Dakshina Kannada and Udupi Districts of Karnataka*. Taxonomy Research Centre, 251 pp.

Hamid, M., A.A. Khuroo, A.H. Malik, R. Ahmad, C.P. Singh, J. Dolezal & S.M. Haq (2020). Early evidence of shifts in alpine summit vegetation: a case study from Kashmir Himalaya. *Frontiers in Plant Science* 11: 421. https://doi.org/10.3389/fpls.2020.00421

Harel, D., C. Holzapfel & M. Sternberg (2011). Seed mass and dormancy of annual plant populations and communities decreases with aridity and rainfall predictability. *Basic and Applied Ecology* 12(8): 674–684. https://doi.org/10.1016/j.baae.2011.09.003

Henry, A.N. (1983). *Flora of Tamil Nadu, India. Series I: Analysis*, Vol. 1. Botanical Survey of India, Coimbatore, 38–42 pp.

Hooker, J.D. (1875). *The Flora of British India: Ranunculaceae to Sapindaceae*, Vol. 1. Reeve & Co., London, 317–353 pp.

India Biodiversity Portal (2025). *Hibiscus lobatus* (Murray) Kuntze. https://indiabiodiversity.org/observat ion/show/19088124. Accessed on 11.viii.2025.

Leubner-Metzger, G. (2006) Seed dormancy and the control of germination. *New Phytologist* 171: 501–523. https://doi.org/10.1111/j.1469-8137.2006.01787.x

Li, J., Y.R. Lu, I.F. Lin, W. Kang, H.B. Chen, H.F. Lu & H.M.D. Wang (2020) Reversing UVB-induced photoaging with *Hibiscus sabdariffa* calyx aqueous extract. *Journal of the Science of Food and Agriculture* 100(2): 672–681. https://doi.org/10.1002/jsfa.10063

Luan, F., Q. Wu, Y. Yang, H. Lv, D. Liu, Z. Gan & N. Zeng (2020). Traditional uses, chemical constituents, biological properties, clinical settings, and toxicities of *Abelmoschus manihot* L.: a comprehensive review. *Frontiers in Pharmacology* 11: 1068. https://doi.org/10.3389/fphar.2020.01068

Noori, S., Tabassum, H. & Inamati, S (2025). Geospatial analysis of Agroforestry landscape in the Central Western Ghats, India, using Google Earth Engine. *Agroforest Systems* 99(181): 3. https://doi.org/10.1007/s10457-025-01266-w

Pace, B.A., H.M. Alexander, D.J. Emry & K.L. Mercer (2016). Reliable method for assessing seed germination, dormancy, and mortality under field conditions. *Journal of Visualized Experiments* (117): e54663. https://doi.org/10.3791/54663

Patil, V.N. & M. Dadlani (2009). Tetrazolium test for seed viability and vigour, pp. 209–241. In: *Handbook of Seed Testing*. National Seeds Corporation, New Delhi, India.

Pradhan, B.K. & H.K. Badola (2011). Effects of microhabitat, light and temperature on seed germination of a critically endangered Himalayan medicinal herb, *Swertia chirayita*: Conservation implications. *Plant Biosystems* 146(2): 345–351. https://doi.org/10.1080/11263504.2011.620641

Ramachandra, T.V., A.H. Srijith & S. Bharath (2019). Land surface temperature responses to the land cover dynamics in Western Ghats. *Sahyadri E-news* 66: 3–66. https://wgbis.ces.iisc.ac.in/biodiversity/sahyadri_enews/newsletter/Issue66/biblio.html Accessed on 12.viii.2025.

Ramaswamy, S.N., R.K. Rao & G.D. Arekal (2001). *Flora of Shimoga District*. Prasaranga, University of Mysore, Mysore, 78–87 pp.

Saldanha, C.J. (1984). *Flora of Karnataka*, Vol. 1. Oxford & IBH Publishing Co., New Delhi, 250 pp.

Sankararao, K., R.K. Swamy, D. Kumar, R.A. Singh & K.G. Bhat (2019). Flora of Peninsular India. https://indiaflora-ces.iisc.ac.in/FloraPeninsular/herbsheet.php?id=5628&cat=7

Tali, B.A., A.H. Ganie, I.A. Nawchoo, A.A. Wani & Z.A. Reshi (2015). Assessment of threat status of selected endemic medicinal plants using IUCN regional guidelines: A case study from Kashmir Himalaya. *Journal for Nature Conservation* 23: 80–89. https://doi.org/10.1016/j.jnc.2014.06.004

Tiwari, R.K.S., K.K. Chandra & S. Dubey (2018). Techniques for breaking seed dormancy and its efficacy on seed germination

of six important medicinal plant species. *International Journal of Agriculture, Environment and Biotechnology* 11(2): 293–301. http://doi.org/10.30954/0974-1712.04.2018.10

Urban, M.C. (2015). Accelerating extinction risk from climate change. *Science* 348(6234): 571–573. https://doi.org/10.1126/science.aaa4984

WFO (2025). *Hibiscus lobatus* (Murray) Kuntze. Available at: http://www.worldfloraonline.org/taxon/wfo-0000722748. Accessed on 12.viii.2025.

Wolkis, D. & S.K. Walsh (2018). Dormancy and germination of two Kaua'i endemic *Hibiscus* taxa. *Seed Science and Technology* 46(2): 267–274. https://doi.org/10.15258/sst.2018.46.2.08

Yang, J.E., H.T. Ngo, E. Hwang, S.A. Seo, S.W. Park & T.H. Yi (2019). Dietary enzyme-treated *Hibiscus syriacus* L. protects skin against chronic UVB-induced photoaging via enhancement of skin hydration and collagen synthesis. *Archives of Biochemistry and Biophysics* 662: 190–200. https://doi.org/10.1016/j.abb.2018.12.020

Zhang, W., L.W. Qu, J. Zhao L. Xue, H.P. Dai, G.M. Xing & J.J. Lei (2020). Practical methods for breaking seed dormancy in a wild ornamental tulip species *Tulipa thianschanica* Regel. *Agronomy* 10(11): 1765. https://doi.org/10.3390/agronomy10111765

Journal of Threatened Taxa is indexed/abstracted in Bibliography of Systematic Mycology, Biological Abstracts, BIOSIS Previews, CAB Abstracts, EBSCO, Google Scholar, Index Copernicus, Index Fungorum, JournalSeek, National Academy of Agricultural Sciences, NewJour, OCLC WorldCat, SCOPUS, Stanford University Libraries, Virtual Library of Biology, Zoological Records.

NAAS rating (India) 5.64

Print copies of the Journal are available at cost. Write to:
The Managing Editor, JoTT,
c/o Wildlife Information Liaison Development Society,
3A2 Varadarajulu Nagar, FCI Road, Ganapathy, Coimbatore,
Tamil Nadu 641006, India
ravi@threatenedtaxa.org & ravi@zooreach.org

Journal of Threatened Taxa

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

August 2025 | Vol. 17 | No. 8 | Pages: 27323–27406
Date of Publication: 26 August 2025 (Online & Print)
DOI: 10.11609/jott.2025.17.8.27323-27406

Articles

Communications

Short Communications

Publisher & Host

WILD zoo reach
Zoo Outreach Organisation

Threatened Taxa