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Popular Article

Conservation of *Swertia chirayita* - a threatened and highly valued medicinal herb

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Introduction

Swertia chirayita, is a highly valued medicinal herb belonging to the Gentianaceae family. It is native to the temperate Himalayas and has been used in Ayurvedic medicine for centuries. However, overexploitation of its natural habitat has led to be classified it as an endangered crop by the IUCN (Scartezzini and Speroni, 2000).

S. chirayita, is commonly known as "chirata," and it is an annual/biennial herb found at altitudes between 1400 - 3270 m in cool, shady, marshy forest slopes of the eastern Himalayas and Jammu & Kashmir (Anon, 1982; Kirtikar and Basu, 1984). Figure 1 shows the chirata plants in its natural habitat and at flowering stage. It contains various biomolecules having carminative, expectorant, laxative, stomachic, anthelmintic and anti-diarrhoeal properties also it has many ethnobotanical purposes. It is only used as conventional medicine which results in over-exploitation of this plant, and as such Chirata is becoming extinct from the natural habitats. Thus, alternative approaches for cultivation, conservation and maintenance are urgently required to defeat the possible extinction due to this over-utilization of this valuable species (Joshi and Dhawan, 2005).

Its Medicinal properties and uses

In ayurvedic world, Chirarta ranks at higher position as one of the most important medicinal plants, the leaf extract of chirata contains antibacterial, antifungal, anti-cancer, anti-inflammation activities etc (Verma et al., 2008; Alam et al., 2009; Arya et al., 2011; Chen et al., 2011; Laxmi et al., 2011). Though the whole plant of Chirata is used as orthodox remedies but the root part has been mentioned as the most important bioactive part (Kirtikar and Basu, 1984). Bioactive compounds such

as amarogentin, swertiamarin, gentianine, sweroside, and oleanolic acid, etc. are found in chirata plant. Interesting fact is that first isolated dimericxanthone was chiratanin available in different parts of this plant. And it is also used for treatment of various diseases such as diabetes, inflammation, hepatitis, digestive disease, fever, cold, skin disease, hypertensions, malaria, anaemia, bronchial disorder, blood purification etc. (Bhatt et al., 2006; Banerjee et al., 2000; Rai et al., 2000; Saha et al., 2004; Chen et al., 2011).

Figure 1. *Swertia chirayita* at natural habitat (A) and at flowering stage (B)

Its Propagation Methods and Difficulties

Large-scale cultivation of *S. chirayita* is challenging due to limited seed availability and poor seed viability. However, modern biotechnological techniques offer solutions such as micropropagation produces genetically uniform plants from nodal cuttings as well as synthetic seed technology and cryopreservation facilitate germplasm conservation, and seed enhancement methods also would improve germination rates (Gantait et al. 2015 and Kumar and Staden, 2016). Various methods of propagation would be employed for *Chirata* plants, each involving specific protocols.

1. In-vitro propagation

In-vitro propagation is utilized, where shoots develop from root explants cultivated in Murashige and Skoog medium with 6-benzyladenine. The pH of the medium is adjusted, and after a series of cultivation steps, healthy shoots are collected, dipped in NAA solution, and further cultivated on a hormone-free MS medium.

2. Micro-propagation of Chirata

2.1. Micro-propagation of Chirata using nodal explants. Shoot regeneration is facilitated through a half-strength MS basal medium supplemented with 6-BAP and 6-furfurylaminopurine. The shoots are collected, and the medium is reused with additional nutrients before transferring the plantlets to the field.

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2.2. Micro-propagation through shoot tip explants is another method, involving the collection of callus, its transfer to a medium with Benzylaminopurine and kinetin, and subsequent transplantation to an expanded medium with gibberellic acid. The best rooting frequency is observed in a half MS medium with NAA.

3. Indirect organogenesis

The third approach involves the indirect organogenesis for shoot generation, through taking callus from various plant parts. The callus are induced on MS basal medium with cytokinins and auxin to promote fast multiplication. Shoot development occurs in a basal medium containing synthetic cytokinins, and rooting is induced with IBA or NAA in full or half MS media.

4. Through media propagation

Seed germination is achieved through aseptic resonance with low concentrations of BA and kinetin. In-vitro shoots are cultured on an MS medium with additional growth regulators, and the incorporation of potassium nitrate enhances shoot proliferation. The rooted plants are eventually transferred to soil. Each method presents a distinct approach to Chirata propagation, highlighting the versatility and adaptability of these techniques.

5. Improvement of seed germination through enhancement techniques

Various seed enhancement techniques like hydro, hormo, osmo, chemo, etc. can be employed to improve seed germination potential of this valuable medicinal herb. Some photographs are given in figure 2 to show its seed and development of seedling at various stages.

Conservation Recommendations

Integrated efforts between scientists and local communities are vital for *S. chirayita* conservation. Specific strategies such a promoting sustainable harvesting practices among indigenous healers, expanding micropropagation to meet pharmaceutical demand, educating locals to prevent overexploitation and preserving genetic diversity in seed banks.

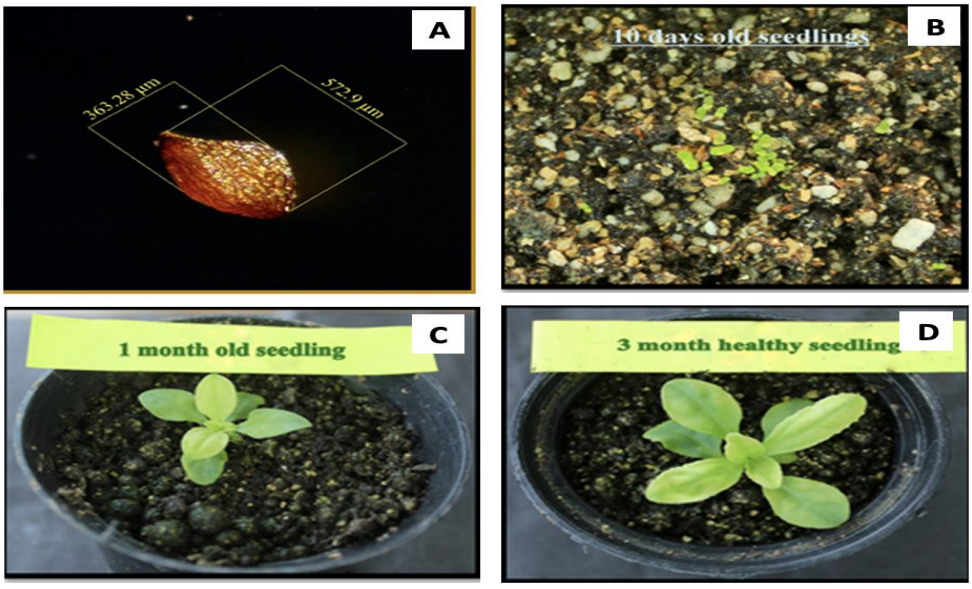

Figure 2. Chirata seed (A); healthy seedling at different ages (B-D)

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Harvesting

The determination of the harvesting season should be predicated upon the qualitative parameters established for the final product constituents rather than focusing solely on vegetative yields. Chirata seeds are typically collected in the second year of plantation during October-November, following seed maturation. Selection criteria for harvesting involve opting for healthy and matured black-coloured plants with ripe fruits. Subsequently, the harvested seeds undergo a drying process at temperatures between 25-35˚C for a duration of 24 hours, followed by storage in cotton bags (Parajuli and Thapa, 2010). Additionally, some mature plants are collected in October specifically for the purpose of cultivating the subsequent crop. The primary harvested plant parts include the leaf, root, and seed.

Conclusion

The plant *Swertia chirayita* Buch-Ham is a critically endangered small herb, consists of 180 species of which 8-10 species exist in Indian subcontinent. Major bio-actives compounds of *Swertia chirayita* are the secondary metabolites which played a huge role in biological activities like being hepatoprotective, digestive, astringent, laxative, anti-inflammatory and anti-malarial. The plant extracts can also be used for discovering several drugs. Hence, this herb provides potent therapeutic lead compounds, which would be beneficial for human.

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