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ABIES PINDROW (Royle ex D. Don) - AN ECOLOGICALLY AND ECONOMICALLY IMPORTANT FIR OF WESTERN HIMALAYA

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ABSTRACT

Abies pindrow (Royle ex D. Don), commonly known as the Western Himalayan fir,is an ecologically significant plant species with a wide geographical distribution. The species is native to the Western Himalaya and the adjacent mountains, and is found in Afghanistan, Pakistan, India and Nepal. It is typically a cold-adapted species that can survive a wide range of topographical factors. Variable climate, increased demand for fodder, fuel, and timber, as well as the human-induced pressure caused by inadequate grazing and urbanization, are the main factors that led to the plant losing its natural regeneration potential. As a result, it has been classified as "Least Concern" on the IUCN Red List. While the local communities rely heavily on this species for wood, fodder, fuel, and ornamental purposes, the species has been reported to have therapeutic potential against a variety of health ailments since ancient times. In this background, its propagation and conservation is becoming increasingly relevant for maintaining the environmental balance. In-vitro regeneration might be a suitable alternative for its long-term survival and growth. Insight on its rhizosphere microbiome, particularly the plant growth promoting microorganisms, may contribute to its survival strategies and lead to improve its regeneration.

Keywords: Himalaya,Abies pindrow, Least concern, Rhizosphere microbiome, Biodiversity conservation

INTRODUCTION

With a geographical area of over 5.3 lakh kilometer square, the Himalaya is recognized for its great heights with pointed peaks, huge valleys, alpine glaciers, degraded terrains, inaccessible river gorges, complicated geologic structures, and a network of elevation belts. It displays distinct biological relationships of flora and fauna due to the unique environment, and has a considerable effect on the climate of Asia. The Indian Himalayan region (IHR) is home to a diverse range of plants, both angiosperms and gymnosperms including categories that are important from biodiversity conservation viewpoint.

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The majority of gymnosperm vegetation is made up of conifers. The living members of this family are known as Acrogymnospermae, which translates to "bare seeds." One of these conifers is *Abies pindrow* (Royle ex D. Don), commonly known as the Western Himalayan fir, pindrow fir, and pindrau. Firs (*Abies*) represent a genus consisting 48-56 species of evergreen conifers of the family Pinaceae. With an IUCN status categorized as “least concern”, *A. pindrow* requires firm propagation, conservation and management strategies (Sharma et al., 2010).

HABITAT

*Abies pindrow*is found all over the world, although it is most common in North and Central America, Europe, Asia, and North Africa. The tree grows in the Western Himalaya of India, Afghanistan, Nepal, and Pakistan at elevations ranging from 2000 to 3600 meters above sea level (Sharma et al., 2010) The plant prefers a pre-monsoonal climate that is cool, damp, and progressively snow-dominated from west to east (Thapa et al., 2016). The type of soil, pH levels, high soil moisture and sunlight are few of the limiting factors for its growth. The plant commonly occurs in pure stands, but is also frequently co-dominant with species like *Abies spectabilis*, *Pinus wallichiana*, *Picea smithiana*, or *Cedrus deodara* (Joshi & Samant, 2004)

PHYTOGRAPHGY

The trees are high, reaching 40 to 60 meters in height (Fig. 1a), with a single straight rough trunk (Fig. 1b) and short branches (Fig. 1c). The fir leaf is one of the longest in the fir family, ranging 4 to 9 cm long and having a long needle-like form, a glossy dark green surface, and a flattened cross section (Fig. 1d). A distinctive feature of the species is the foliar arrangement and two silver streaks on the underside of the *Abies pindrow* leaves (Kumar & Kumar, 2017). When young, the cones are 7-14 cm long and 3-4 cm broad; as they develop, they turn into a dark reddish-brown hue and release seeds 5-6 months after pollination. The seeds of this species mature from October to November. The monoecious plant contains flabellate seed scales and a somewhat straight surface with hidden bracts (Farjon, 2010).

REGENERATION STATUS

The regeneration condition of *A. pindrow* has been a concern of the researchers. Decrease in the trees' inherent regeneration potential with the increasing altitude has been reported (Gairola et al., 2012). This results in the inadequate amount of seedlings and saplings required for the regeneration of the fir. These trees are exposed to a range of anthropogenic impacts even in their native lands. Available literature suggests that the fir forest replacement may occur in the near future if the present rate of seedlings to trees is not closely monitored and corrected (Thakur et al., 2021). Poor regeneration has been linked to higher altitude grazing and adverse environmental factors, suggesting that stronger management is required to protect this native forest species.

BENEFICIAL ASPECT

Over time, local populations in the Himalayan area have been documented to employ silver fir extensively for medicinal and non-medicinal uses (Fig. 2). The plant is grown for decorative and structural uses as well. Because of the high content of "terpenes" of the plant, its wood is used in construction of doors, windows, and furniture. It is considered highly durable and impervious to the majority of microorganisms and insects. Further, it is also considered a better alternative to timber in

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hilly areas (Khan et al., 2010). The tree's leaves and bark are used as feed. Its cones are also recognized to be highly attractive and are used for decoration (Sinha, 2019) Therapeutically, the species has been reported to possess a pivotal place in Ayurveda since ancient times; it exhibits anti-inflammatory, antispasmodic, anti-diabetic (Sinha, 2019) carminative, stomachic and astringent properties (Hasnain et al., 2013) and is used in treating fever, bronchitis, hypoglycemia, inflammation and hemoptysis.

PHYTOCONSTITUENTS

Extensive research has been conducted in the Himalayan area over the years to uncover possible bioactive components of *A. pindrow* that may be extracted and employed medicinally or industrially for improved medications and plant-based future goods. The leaves have been discovered to be rich in flavonoids and bioflavonoids that can be employed as an alternative medical strategy in treating inflammatory disorders and osteoarthritis; pindrolactone (a novel triterpene), maltol, terpenoids, fatty acids, chalcones, and cyclic polyol (pinitol), with the majority of them having biological and pharmacological activities (Tripathi et al., 1996). Leaf extracts of *Abies pindrow* are potential source of natural antioxidants and might serve as a foundation for future medications (Gupta et al., 2011).

MICROBIOLOGICAL STUDIES

Literature on the microbiological aspects of the Himalayan conifers is limited. The Conifers and many other plants of Himalayan region create a distinct setting for the growth of endophytes and extend opportunity to understand the plant-microbe associations under very unique climatic conditions (Adhikari & Pandey, 2020; Dasila et al., 2020). *Abies pindrow* has been reported to inhabit diverse endophytes such as *Daldina fissa*, *Apiosordaria otanii*, *Penicillium oxalicum*, and *Polyporus arcularius* with a range of applications (Qadri et al., 2013).

CONCLUSION AND FUTURE PROSPECTS

In view of the ecological and economic importance of the Himalayan fir, the first and foremost task is the propagation and conservation of this tree species in the present climate change scenario. Several conservation studies are in progress for its establishment in nature. The measures such as avoiding excessive grazing and deforestation in order to provide adequate growing area of such species and implementation of the awareness programmes about the benefits of such neglected plant varieties can help to avoid the extinction of these species. With all the ecological and economic abilities, *Abies pindrow* is one of those species whose maintenance and conservation is essential to regulate the environmental balance in nature.

Understanding on the microbial associates particularly the plant growth promoting microbes and their inclusion in the conservation strategies will be useful. These microbial associates will consist of rhizosphere microbial communities including mycorrhizae and other endophytes. Isolation and characterization of these microbes will lead to screen and select the promising microorganisms that can be developed in form of bioinoculants. Inoculation with these bioinoculants will be helpful in raising healthy saplings at nursery stage that can be further transferred at the appropriate sites.

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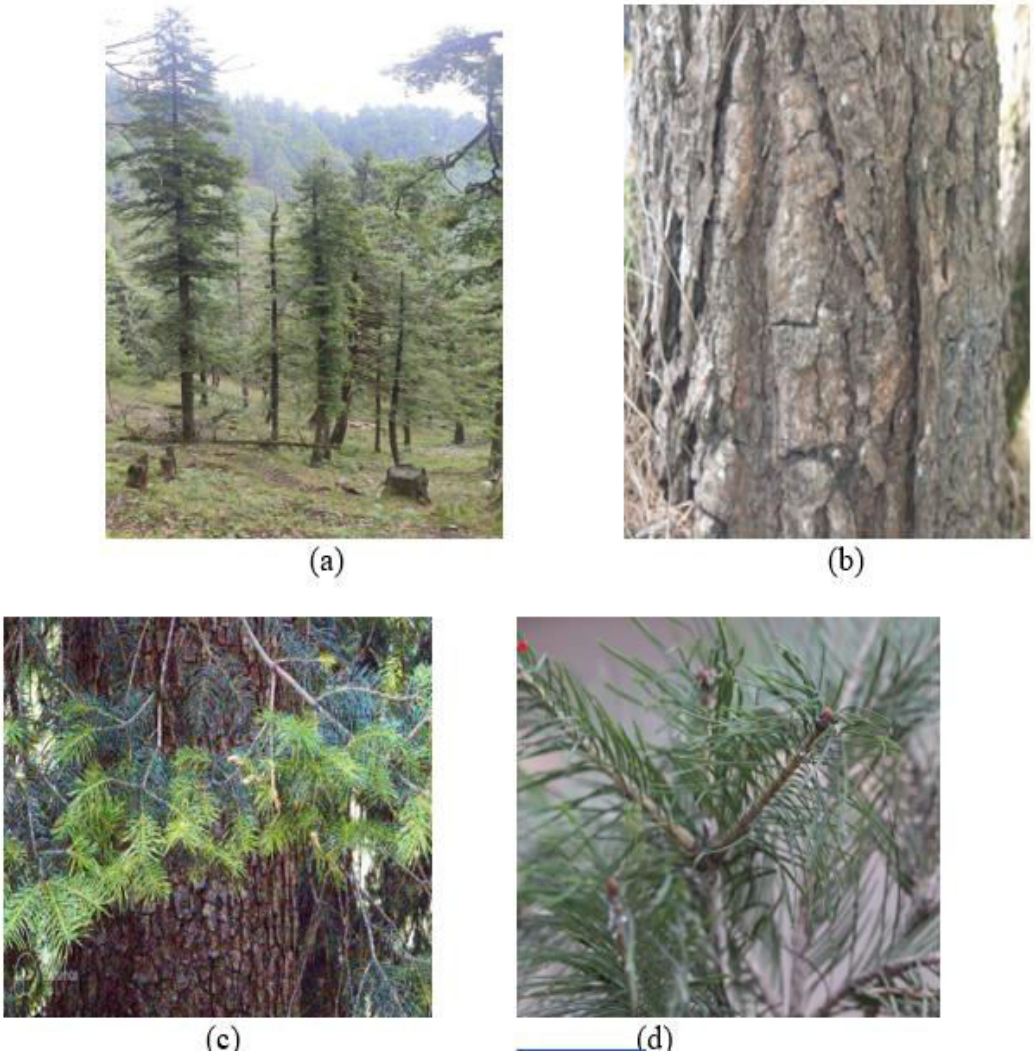

Fig.1. Morphological characters of Abies pindrow, (a) its habitat, (b) rough textured stem, (c) foliar arrangement, and (d) onset of budding at the tip of the branches which later develops into cones

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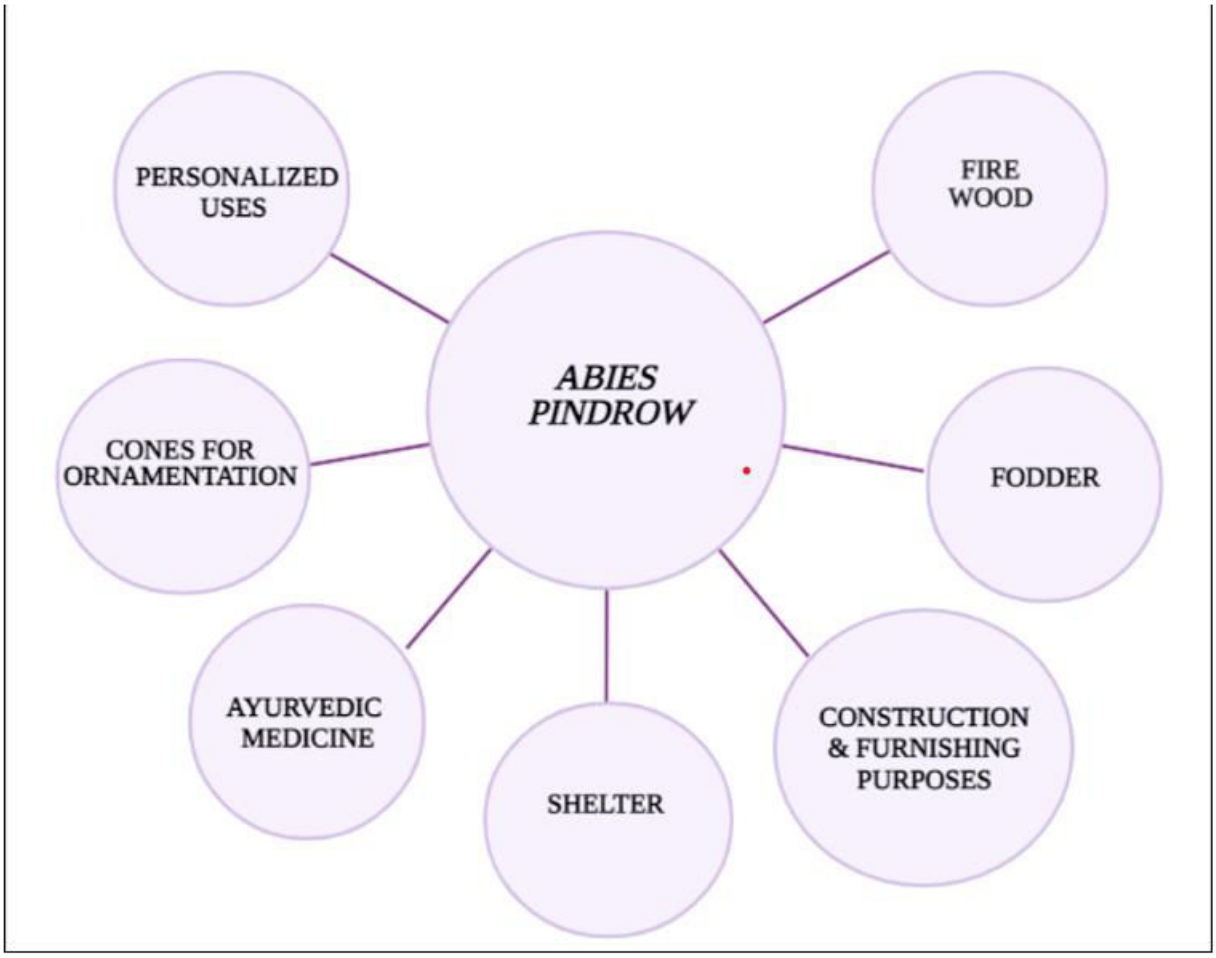

Fig.2. Uses of Abies pindrow