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Review Article

A note on *Aeginetia indica* L.: a holoparasitic plant of India

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Abstract: *Aeginetia indica* L. is a holoparasitic flowering plant belonging to the family Orobanchaceae and is widely distributed across different regions of India. As a holoparasite, it lacks chlorophyll and depends entirely on host plants, primarily grasses and members of Poaceae, for its nutritional requirements. Present review compiled and synthesized available literature on the taxonomy, morphology, biology, host association, distribution and ecological significance of *A. indica*. The plant exhibits distinctive morphological adaptations such as reduced vegetative structures and specialized haustorial connections that facilitate parasitism. Although often overlooked due to its parasitic nature and seasonal appearance, *A. indica* plays a notable role in natural ecosystems by influencing host population dynamics and contributing to biodiversity. Ethnobotanical reports also indicated its traditional medicinal use in certain regions of India, highlighting its potential pharmacological importance. Despite its ecological and ethnobotanical relevance, comprehensive studies on its life cycle, reproductive biology and conservation status remain limited. The current study aims to provide an updated and consolidated account of *A. indica*, identify existing research gaps and encourage further studies on this unique holoparasitic plant of India.

Keywords: Ecosystem, haustorial, morphological adaptations, research gap

Introduction

Parasitic plants represent a unique and specialized group of angiosperms that derive some or all of their nutritional requirements from other plants through specialized organs known as haustoria (Tesitel, 2016; Yoshida et al., 2016). Among them, holoparasitic plants are entirely dependent on their hosts, having completely lost photosynthetic ability due to the absence of chlorophyll (Roquet et al., 2016). These plants exhibit remarkable morphological, physiological and ecological adaptations that enable survival without autotrophic nutrition (Casadesus and Munné-Bosch, 2021). The study of holoparasitic plants is important not only for understanding plant evolution and adaptation but also for assessing their ecological roles and impacts on host plant communities (Mkala et al., 2022). *Aeginetia indica* L. is a notable holoparasitic species belonging to the family Orobanchaceae (Saxena and Brahmam, 1995; Parnell, 2012). It is widely distributed in tropical and subtropical regions of Asia, particularly across various parts of India (Saxena and Brahmam, 1995). The plant is commonly found parasitizing grasses and other monocotyledonous hosts, especially members of the family Poaceae (Ekanayake et al., 2015). Due to its seasonal emergence, reduced vegetative structures and underground parasitic habit, *A. indica* often remains unnoticed and under-studied compared to other flowering plants (Watazu et al., 2025). Morphologically, *A. indica* is characterized by the absence of functional leaves, a fleshy underground tuber and a prominent colourful inflorescence that emerges above the soil surface during the flowering season (Dwari et al., 2019). These features reflect its complete dependence on the host plant for water, minerals and organic nutrients. The species demonstrates specialized haustorial connections that facilitate efficient transfer of resources from the host, making it an excellent model for studying holoparasitic interactions (Jhu and Sinha, 2022). In addition to its biological significance, *A. indica* holds ecological and ethnobotanical importance. It contributes to plant diversity in natural ecosystems and may influence host population dynamics (Lahlou et al., 2025). Traditional medicinal uses of the plant have been reported in certain regions of India, suggesting potential pharmacological value (Prasathkumar et al., 2021). However, despite its wide distribution and significance, detailed information on its life cycle, reproductive biology, host specificity and conservation status remains fragmented (Meenu and Shukla, 2015). The present review aims to compile and critically analyze existing literature on *A. indica*, with emphasis on its taxonomy, morphology, biology, host associations, distribution and ecological significance in India. By consolidating current knowledge and identifying research gaps, current study seeks to promote further scientific investigation and conservation awareness of this unique holoparasitic plant.

Methodology

The present review is based on a comprehensive survey of published literature on *A. indica*. Relevant research articles, review papers, floras, monographs and ethnobotanical reports were collected from scientific databases such as Google Scholar, PubMed, Scopus, and Web of Science. Additional information was gathered from regional floras and herbarium records. Keywords including *Aeginetia indica*, “holoparasitic plants”, “host plants”, “distribution”, “ecological” and “ethnobotany” were used for literature retrieval. The collected literature was critically analyzed and synthesized to summarize the

taxonomy, morphology, parasitic biology, host range, geographical distribution and ecological significance of the species in India (Kumar, 2025).

Results and discussion

Aeginetia Indica is a leafless herb, with a slender rootstock bearing fleshy, fibrous roots and usually several erect shoots. The scape is solitary, purple and striate about 15-30 cm long, bearing a single flower and remaining naked except for 1-2 bracts at the base. The flowers are solitary, terminal, nodding and crimson in colour (Figure 1). The calyx is spathaceous, with many prominent veins. The corolla is tubular and curved, sub-bilabiate, with very short and flattened lobes. Placentation is parietal, with four much-branched placentas. The capsule is thin-walled and dehisces by rotting, producing minute brown seeds (Saxena and Brahmam, 1995; Sharma and Uniyal, 2009).

Figure 1: Habitat of *A. indica* in wild

Biological characteristics: The current literature survey revealed that *A. indica* exhibits typical characteristics of a holoparasitic plant, including complete absence of chlorophyll, highly reduced leaves in the form of scales and a fleshy subterranean tuber. The above-ground floral shoot is the most visible part of the plant and displays brightly colored, tubular flowers that may aid in attracting pollinators. The reduction of vegetative organs reflects evolutionary adaptation toward complete nutritional dependence on host plants. The presence of well-developed haustorial structures enables the parasite to establish direct vascular connections with the host, facilitating the uptake of water, minerals and organic compounds (Dutt and Kant, 2007; Bhuiyan et al., 2025; Watazu et al., 2025).

Host association and parasitic mechanism: The literature survey indicated that *A. indica* primarily parasitizes grasses, particularly members of the family Poaceae. Host attachment occurs at the root level through specialized haustoria that penetrate host tissues and connect with the vascular system. This intimate physiological connection allows efficient resource transfer, often resulting in reduced vigor of the host plant. However, the degree of host damage varies depending on host species, environmental conditions, and intensity of parasitism. The host specificity observed in *A. indica* suggests a co-evolutionary relationship, although detailed molecular and physiological studies remain limited (Roquet et al., 2016; Tesitel, 2016; Yoshida et al., 2016; Casadesus and Munné-Bosch, 2021; Temviriyanukul et al., 2025).

Ecological significance: Ecologically, *A. indica* plays a role in shaping plant community structure by influencing host plant growth and distribution. While parasitism may negatively affect individual host plants, it can contribute to maintaining species diversity by preventing dominance of particular grass species. The plant also adds to floral diversity and may provide resources for pollinators during its flowering period. Despite being parasitic, *A. indica* should not be viewed solely as a harmful species but rather as an integral component of natural ecosystems (Schneeweiss and Weiss, 2003; Sharma and Uniyal, 2009; Khan and Khan, 2018).

Ethnobotanical and medicinal importance: Several ethnobotanical surveys documented the use of *A. indica* in traditional medicine across different regions of India. Extracts of the plant have been reportedly used in the treatment of ailments such as inflammation, skin disorders and general weakness. A pharmacological study that methanol extracts of the whole plant exhibit significant dose-dependent analgesic and antipyretic activities (Reza et al., 2021). Although these traditional claims and less pharmacological investigations indicated potential medicinal value, scientific validation through phytochemical and pharmacological studies remains scarce and limited (Reza et al., 2020). Existing reports highlight the need for systematic investigations to identify bioactive compounds and assess their therapeutic potential (Liu et al., 2012; On-Nom et al., 2024).

Research gaps and future perspectives: The reviewed studies collectively revealed that while basic information on taxonomy, morphology and distribution of *A. indica* is available, significant knowledge gaps remain. Limited data exist on its reproductive biology, pollination mechanisms, seed dispersal and population dynamics. Additionally, the impact of habitat loss and changes in land-use patterns on its survival has not been adequately assessed. Future research employing molecular, ecological and physiological approaches would provide deeper insights into the biology and conservation of this holoparasitic species.

Conclusion

A. indica is a unique holoparasitic plant of the family Orobanchaceae, characterized by complete dependence on grass hosts and specialized parasitic adaptations. The present review summarizes current knowledge on its taxonomy, biology, host associations, distribution and ecological importance in India. Although the species is widely distributed, scientific information on its reproductive biology,

ecology and conservation status remains limited. Reported traditional medicinal uses indicate potential pharmacological value, but these require further validation. Future studies focusing on ecological interactions, molecular characterization and conservation assessment are essential to improve understanding and management of this holoparasitic plant.

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