

# **Genoproteomics-assisted improvement of *Andrographis paniculata*: toward a promising molecular and conventional breeding platform for autogamous plants affecting the pharmaceutical industry**

## **ABSTRACT**

*Andrographis paniculata* (Burm. f.) Wall. ex Nees. (AP) is a hermaphroditic, self-compatible, and habitual inbreeding plant. Its main bioactive component is andrographolide, which is capable of inducing autophagic cell death in some human cancer cells and helps fight HIV/AIDS. Increasing the andrographolide content by investigating the genetic mechanisms controlling its biosynthesis in order to improve and develop high-yielding cultivars are the main breeding targets for AP. However, there might exist some limitations or barriers for crossability within AP accessions. Recently, this problem was addressed in AP by using a combination of crossbreeding and biotechnology-aided genetic methods. This review emphasizes that development of a breeding platform in a hard-to-breed plant, such as AP, requires the involvement of a broad range of methods from classical genetics to molecular breeding. To this end, a phenological stage (for example, flowering and stigma development) can be simplified to a quantitative morphological trait (for example, bud or stigma length) to be used as an index to express the highest level of receptivity in order to manage outcrossing. The outcomes of the basic crossability research can be then employed in diallel mating and crossbreeding. This review explains how genomic data could produce useful information regarding genetic distance and its influence on the crossability of AP accessions. Our review indicates that co-dominant DNA markers, such as microsatellites, are also capable of resolving the evolutionary pathway and cryptic features of plant populations and such information can be used to select the best breeding strategy. This review also highlights the importance of proteomic analysis as a breeding tool. In this regard, protein diversification, as well as the impact of normal and stress-responsive proteins on morphometric and physiological behaviors, could be used in breeding programs. These findings have immense potential for improving plant production and, therefore, can be regarded as prospective breeding platforms for medicinal plants that have an autogamous mode of reproduction. Finally, this review suggests that novel site-directed genome editing approaches such as TALENs (Transcription Activator-Like Effector Nucleases) and CRISPR (clustered regularly interspaced short palindromic repeats)/Cas9 (CRISPR-associated protein-9 nuclease) systems together with other new plant breeding technologies (NPBT) should simultaneously be taken into consideration for improvement of pharmaceutical plants.

**Keyword:** Andrographolide; Xenogamy; Crossbreeding; Transcriptome analysis; Metabolic pathways; Molecular plant breeding