

Limitations, Progress and Prospects of Application of Biotechnological Approaches in Improvement of *Prosopis*: An Important Genus of the Arid Regions

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Abstract: Introduction and selection of fast-growing exotic tree and shrub species into the arid regions of Indian subcontinent is imperative to ensure a sustained livelihood under harsh agro-climatic conditions in the region. Large scale mortality of perennials, mechanized agriculture, industrialization and population explosion, increased demand of fuel and fodder, and cutting of trees without adequate reforestation has also fueled the concern for saving such fragile ecosystems from degradation. *Prosopis*, a multipurpose, leguminous, nitrogen fixing genus encompassing approximately 45 species of trees and shrubs remains one of the most widely accepted genera in the arid regions as many of the species of the genus are highly adapted for survival in arid, semi-arid and usar lands. However, there is an urgent need to modify and improve the undesirable features like thorniness, bushy architecture, slow growth rate and high alkaloid content in leaves of important *Prosopis* spp. by developing tailored genotypes suitable for plantation and rapid growth in these dry regions. Limited progress has been made for improvement of the genus through conventional breeding programs due to lack of identified superior parental lines, lack of knowledge about extent of hybridization possible between species, genetic linkage maps and QTL linkage maps. Conventional propagation methods i.e., through seeds and rooting of cuttings are in place, but have limitations for development of genetically uniform planting material on a larger scale. Therefore, application of modern tools of biotechnology need to be standardized for harnessing maximum benefits from this plant. Improvement of this genus through genetic transformation requires an efficient regeneration system, which is yet to be perfected for large scale production of planting material. Genetic diversity studies, taxonomic delineation of species and subspecies and also the breeding programs can be more robustly addressed using molecular markers. An attempt has been made to review the need and the scope of genetic improvement of this important genus using modern tools of biotechnology.

Key words: Fabaceae, *Prosopis*, micropropagation, molecular markers, tree improvement.

Arid regions are usually characterized by limited and highly variable annual precipitation, extreme variations in temperature (daily and annual) and high potential evapo-transpiration in addition to poor soil structure. Frequent occurrence of droughts, another characteristic feature of the region, has an adverse effect on agricultural productivity. To evade the adverse effects of these frequent droughts, the native people have developed production systems having both annual and perennial components. This dual component cropping system ensures sustenance of human and livestock requirements even in adverse climatic conditions. Therefore, trees are much more intricately associated with the life of human beings in the arid regions compared to other

regions. In addition to providing food, feed, fodder, fuel wood and other products, trees are used as wind breaks, for improving the soil microclimate for growth of under storey crops, to enrich the soil during fallow period and to prevent soil erosion. However, the harsh agro-climatic conditions of the arid regions restrict the number of tree species suitable for growth and are also responsible for their slow growing habit. Therefore, only a limited number of sparsely distributed, slow growing tree species are usually found in the arid regions. Concern for saving fragile ecosystems from degradation has been fueled by large scale mortality of perennials, mechanized agriculture, industrialization and population explosion, increased demand of fuel and fodder, and cutting of trees without adequate reforestation. The dependence of arid populations on agri-

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