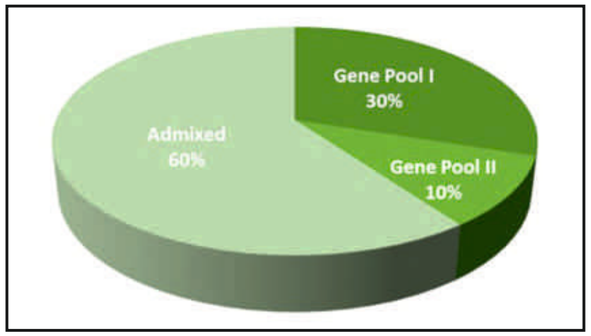
multiple genetically diverse populations combined with adequate sampling within each population will help develop resilient and adaptable Rohida plantations. FST (0.386) estimates indicated moderate population differentiation, suggesting that each region contains somewhat distinct genetic resources, although gene flow (0.494) still occurs among populations.

Gene pools of *Tecomella undulata*

Population structure analysis identified two major ancestral gene pools (K = 2) shared among the studied populations that indicates that Rohida populations contain two main genetic lineages, with several populations



showing mixed ancestry due to past gene flow (Fig. 2). For conservation, populations representing distinct genetic groups i.e., Jodhpur, Sikar, Jhunjhunu (gene pool I; Q > 0.8) and Bikaner (gene pool II; Q < 0.2), which forms a relatively separate genetic background should be maintained as priority conservation seed stands to preserve unique genetic resources. For plantation programmes, including planting material from both genetic groups and selected admixed populations (Pali, Barmer, Jaisalmer, Jalore, Deesa, Nagaur) can help maintain broader genetic diversity, thereby improving long-term adaptability, resilience to environmental stress, and stability of plantations.

Unique Genetic Resources

Several populations contained private alleles (Table 2), with Bikaner showing the highest number, followed by Jaisalmer, Jalore, and Barmer. These populations represent important reservoirs of unique genetic variation and should receive conservation attention.

Table 2: Private allele composition of the *Tecomella undulata* populations

Population	Private Alleles
Bikaner	8
Jaisalmer	5
Jalore	4
Barmer	3
Jodhpur / Jhunjhunu	2

Key Future Recommendations

- Prefer seeds from high-diversity populations (Bikaner, Barmer, Jalore, Jaisalmer); mix moderate- and low-diversity sources with these to maintain diversity.
- Sample seeds from 30–50 well-spaced trees within each population to capture genetic variation and avoid inbreeding.
- Combine seeds from genetically distinct populations, where ecologically suitable, to improve plantation resilience and adaptability.
- Include planting material from both identified genetic lineages and admixed populations to maintain broad genetic re- presentation.
- Protect and manage populations with private alleles (especially Bikaner, Jaisalmer, Jalore, Barmer) as priority conservation and seed production stands.

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Genetic Diversity for Conservation and Plantation Planning of *Tecomella undulata* (Rohida)

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(AN AUTONOMOUS BODY OF MOEF & CC, GOVT. OF INDIA)

Rohida: Keystone Species of the Desert

Tecomella undulata (Rohida), is one of the most valuable native tree species of India's arid and semi-arid zones, particularly in Rajasthan and adjoining regions. It has ecological, economic and cultural significance.

Ecological Importance

- Acts as a keystone species of desert ecosystems, supporting biodiversity.
- Helps in sand dune stabilization, reducing soil erosion and desertification.
- Provides windbreaks and shelterbelts, protecting agricultural fields and settlements.

Economic Importance

- Produces high-quality, durable timber widely used for furniture, handicrafts, and construction.
- Supports local livelihoods through timber trade and traditional crafts.
- Possesses medicinal value, contributing to traditional healthcare systems.

Cultural Significance

- Recognized as the State Flower of Rajasthan, symbolizing the heritage of desert landscapes.
- Holds traditional and aesthetic value in rural communities.

However, natural populations of Rohida have declined in several areas due to habitat degradation, overexploitation, and limited natural regeneration and is currently characterised as an endangered species as per IUCN. Therefore, scientifically planned restoration and plantation activities are essential for both conservation and sustainable utilization of this species.

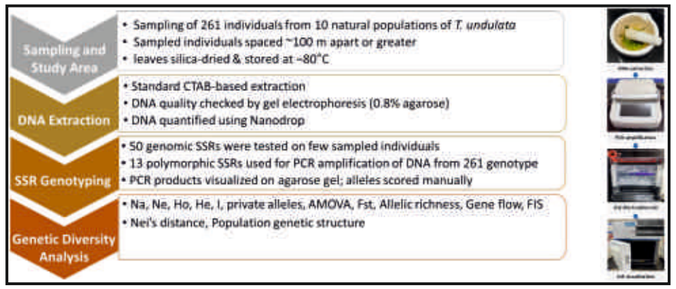
Genetic Diversity in *Tecomella undulata* (Rohida) - Why It Matters

Morphological features of Rohida (*Tecomella undulata*)
(a) Tree, (b) Bark, (c) Leaves, (d) Flowers

Genetic diversity refers to the natural variation in inherited traits among Rohida trees within and across populations. This variation influences growth performance, drought tolerance, wood quality, flowering, pest and disease resistance, and overall adaptability. Populations with higher genetic diversity are better able to survive harsh desert conditions and future climatic stresses. Planting material sourced from genetically diverse, locally adapted populations produces healthier, more resilient plantations and supports the long-term survival of Rohida in arid and semi-arid ecosystems.

Therefore, scientific assessment of genetic diversity and population structure was carried out across 10 representative populations of Rohida in Rajasthan and Gujarat to generate information useful for conservation planning and selection of suitable seed sources for plantation programmes.

Methodology



Result

Genetic analysis of ten populations across Rajasthan and Gujarat revealed the following:

Overall Genetic Diversity: Genetic analysis of Rohida populations indicates clear differences in their usefulness as seed sources for plantation programs (Table 1; Fig 1).

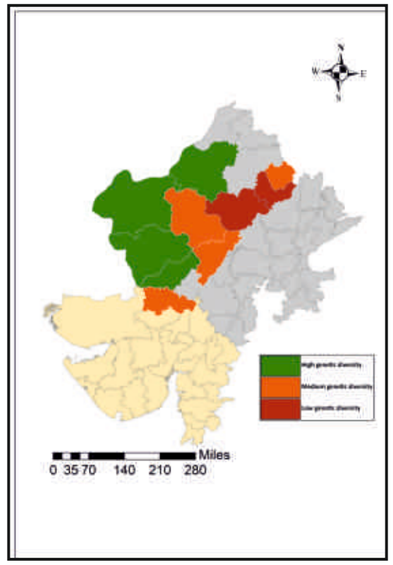
Table 1: Plantation recommendation based on genetic diversity of *Tecomella undulata* populations

Priority Level	Population	Diversity Status	Plantation Recommendation
High priority seed sources	Bikaner, Barmer, Jalore, Jaisalmer,	High allele richness and heterozygosity	Preferential seed collection for large-scale plantations
Moderate priority seed sources	Jhunjhunu, Jodhpur, Pali, Deesa	Moderate diversity	Use along with other populations to maintain diversity
Lower priority seed sources	Nagaur, Sikar	Lower allele richness and heterozygosity	Avoid using alone; mix with high-diversity sources

Some populations possess higher levels of genetic diversity, making them especially valuable for producing healthy, resilient plantations, while others show moderate or lower diversity and should be used carefully to maintain overall genetic balance. Accordingly, the populations listed in the table are grouped into high, moderate and lower priority seed sources, along with practical recommendations on how each group should be used during seed collection and plantation planning to ensure long-term plantation success.

Lower observed heterozygosity (Ho) than expected heterozygosity (He), and positive inbreeding coefficients (FIS) across populations trees often mate within small local groups and hence seeds should be collected from many widely spaced trees to maintain healthy genetic diversity in plantations.

Fig 1: Genetic diversity across sampled populations of *Tecomella undulata*



Genetic Differentiation and Population Relationships

Based on pairwise Nei's genetic identity values, some populations show very high genetic similarity and can therefore serve as alternative seed sources for each other. For example, Barmer–Jaisalmer (≈ 0.823) are genetically almost identical and can be used inter changeably for regional plantation programmes. Similarly, relatively high similarity is observed among Jaisalmer-Deesa (≈ 0.795) and Barmer–Jalore (≈ 0.777), indicating that these populations can act as regional substitute seed sources where local seed availability is limited provided ecological suitability exists.

In contrast, populations showing higher genetic distance represent genetically distinct resources and are suitable for genetic mixing to enhance plantation diversity and resilience. Notable genetically distinct combinations include Jodhpur-Bikaner (0.997) Bikaner-Seekar (0.9476) and Jodhpur-Jalore (0.873), which indicate regional differentiation between these populations. Mixing seed material from such genetically differentiated populations, while keeping ecological suitability in mind, can help improve long-term adaptability and stability of Rohida plantations.

AMOVA analysis showed that 70% of genetic variation occurs within populations, indicating that collecting seeds from many well-spaced trees within each population is essential to capture existing diversity. The presence of 25% variation among populations suggests that different regions possess distinct genetic components that should be represented in conservation and plantation programmes. Therefore, seed collection from