

## New Aloe species discovered from a desert in northwestern India

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- Botanists have described a new species of Aloe, Aloe trinervis, from the desert in the Bikaner district of Rajasthan. It is the second Aloe species recorded in the wild in India.
- Compared to Aloe vera the only wild Aloe species known in India prior to this discovery which bears triangular teeth on the margins of its leaves and orange-yellow flowers, the new species has bent teeth on the leaf margins and its flowers are pale green.
- Experts believe that a molecular phylogenetic analysis is needed to identify the new species and also reveal its evolutionary origins.

Botanists have described a new Aloe species from the desert of India's northwestern state of Rajasthan. The species, Aloe trinervis, is based on a distinct observation: the leaf-like structures beneath the flowers bear three nerves. Experts say a molecular phylogenetic analysis is needed to identify the plant species and shed light on how it evolved and its relationship with other Aloe species.

Scientists have been scouring the world in their quest to document new species. Hotspots of biodiversity, such as rainforests, are obvious places to venture out into. Desert ecosystems are probably unlikely places scientists would search but these findings show that deserts can also harbour new species.

This is a very important and significant discovery from India because earlier there was only one species noted growing in the wild in India, namely, Aloe vera, said Ravikaran N. Kulloli, an author of the report and research associate at the Arid Forest Research Institute in Jodhpur, Rajasthan. Aloe species including Aloe vera are widely cultivated in India for ornamental and medicinal purposes.

## An endangered plant species

Native to Africa, Madagascar and the Arabian Peninsula, the succulent plants of the genus Aloe L. comprise almost 600 species, with the greatest diversity of about 150 species found in southern Africa. Aloe vera, the most widely known species, is native to Oman and was introduced into India. It escaped cultivation and became naturalised.

During field surveys, researchers collected live Aloe specimens from Rajasthan and brought them to grow in the Desert Botanical Garden at the Indian Council of Agricultural Research-Central Arid Zone Research Institute at Jodhpur. The team stumbled across an interesting Aloe specimen that was collected from a protected area of Shivbari-Jorbhir in Bikaner district. Curious, they conducted detailed taxonomical studies comparing it with Aloe vera, (also known botanically as Aloe barbadensis Mill. and other names) and another species Aloe rivae (native to Ethiopia and Kenya).

The new plant species is rare and it could only be collected from four sites in the region with an extent of occurrence of about 500 square kilometres. Based on these observations, the species is classified as 'endangered' by the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species.



Map showing the locations where Aloe trinervis was found in the district of Bikaner, Rajasthan. Map from Kumar, Purohit & Kulloli, 2020.

Local people were observed to collect young buds and tender leaves of the plant for making pickles and cooking. Like A. vera, the leaves were used medicinally on the skin. "This hampers its population build-up," explained Kulloli, adding that since this species is

succulent, it is adapted to dry conditions and can be easily grown around agricultural farms and utilised for different purposes. It can also be grown as a potted plant in home gardens. The author says that its medicinal properties and chemical compounds need to be analysed in further studies.

## Comparing the new species with Aloe vera

While on the surface the plant may look like A. vera, the botanists carefully compared the morphological (form and structure) features of this plant with A. vera and several key differences emerged. The most distinctive character observed was the presence of three nerves on the 'floral bract' or the leaf-like structure present beneath the flower or inflorescence, which explains the species epithet trinervis.

Unlike A. vera, which has triangular pointed teeth on the leaf margins, the teeth on this plant are bent backward. The former has unbranched flower clusters, while they are branched in this species. Flowers of A. vera are orange-yellow, but in this plant, they are pale green, brownish in the middle, and longer in length. The new plant species also has longer stamens.



Plant parts of Aloe trinervis and Aloe vera (A & B) were compared with respect to (1) inflorescence, (2) corolla ventral view, (3) corolla dorsal view, (4) teeth arrangement, (5) bud, (6) floral bract, (7) teeth shape. Photo from C.S. Purohit & R.N. Kulloli.

R. Ganesan, Fellow at the Ashoka Trust for Research in Ecology and the Environment (ATREE), who was not connected with this study, said that in some groups of plants, natural hybridisation or crossbreeding occurs, a process through which new species appear over time.

"Hybridisation is one among the many mechanisms through which species originate," said Ganesan.

Parent plants that occur together in one area, share the same space and resources, and could be sharing pollinators as well. Also, wind pollination could result in hybridisation. "The

morphological differences [between the two Aloe species discussed] are not so much distinguishable and they live side by side," explained Ganesan.

A 'species complex' is a group of closely related species that resemble each other and 'cryptic species' in the complex cannot be identified by traditional morphological features, Ganesan said.

"To understand the hybridisation process and the relationship within the units of the 'species complex', nowadays, molecular phylogenetics [analysis of genetic sequences in DNA to understand relationships between species and their evolution] is extensively used," Ganesan explained. "The study is carried out by sampling the population of the species complex to understand the genome contribution from different species to the 'new species'."

He further explained that molecular phylogenetic tools that delve into the genomes of the species can tease out the relationship of species such as A. vera and A. rivae with the newly proposed species. Such studies can "unravel the history of species, the climate under which the species has lived or evolved, timing, their parents, and spatial distribution." With such information, one can also predict the future of these plants under the impact of climate change, he added.



Inflorescence of Aloe trinervis. Photo by Ravikaran N. Kulloli.

According to Ganesan, A. vera, A. rivae and the proposed species A. trinervis have a lot of overlapping characteristics and he would like to see molecular phylogenetic approaches used to study the new species.

Ganesan observed that the region from which the plant has been collected from, that is, Bikaner, is in the continuum of dry arid plant groups of the African continent. The "arid floristic region of Africa continues into Rajasthan, Punjab, Gujarat, and in fragments found in Mysore (Karnataka), Coimbatore, Dindigul and Tirunelveli districts (Tamil Nadu)," he elaborated.

Satyabrata Maiti, a freelance consultant for the Food and Agricultural Organization of the United Nations, shares similar views. He said that identification by DNA barcoding of the new species should be carried out. This involves sequencing short sections of DNA from specific genes and comparing the sequences to those from other species that are present in reference libraries. Multiple markers or DNA barcodes should be used by the research team because a single barcode marker for plants is usually unreliable, added Maiti.

Study author Kulloli mentioned that his team is considering carrying out a comparative molecular analysis with collaborators.

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