

seed viability, erratic seed production, unfavourable micro-sites, overgrazing by domestic livestock and increased incidences of forest fires. Despite the large number of medicinal properties, religious importance and critically endangered status, *N. jatamansi* has not received much attention regarding conservation and sustainable utilization. Now, the Government of India has imposed a ban on its mass collection or removal of planting materials for any purpose from the natural habitats.

Keeping in view its endangered status and medicinal, aromatic and ecological significance, development of *ex situ* conservation areas may help in effective conservation. Detailed studies on different aspects of its biology will be helpful as well. The work done by HAPPRC suggests that propagation and multiplication of *N. jatamansi* through biotechnological methods is not too successful and therefore, development of a large number of seedlings through conventional methods, i.e. seed germination and splitting of

rhizomes is a better approach for conservation of this valuable species.

Active participation of the Forest Department and local communities residing in nearby areas could help conserve the species. By improving the living standards and sharing the benefits of conservation with the local communities, long-term conservation goals can be achieved. To improve the understanding of ecosystems and to develop a holistic description of the landscape, both intensive studies on small areas and assessment of much larger areas are required. Serious effort is required to raise public awareness about the economic and ecological significance of the species and expand studies on development of efficient conservation methods. Long-term preservation of germplasm for further studies on different aspects of biology is also required. The National Medicinal Plant Board, Government of India, has been providing encouragement to carry out conservation programmes for this valuable species in the Indian Himalayan region.

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Does the tiny mite matter? Revisiting invasive pest problem under global climate change scenario

Red Palm Mite (RPM), *Raoiella indica* Hirst (Arachnida: Acari: Tenuipalpidae) is a pest of coconut, arecanut, date palm and many other ornamental as well as commercial palm species. The mites establish colonies on the under sides of leaves (Figure 1), usually along the mid-rib and feed on cellular contents of the leaves accessed through the leaf stomata. Feeding causes localized yellowing of the leaves followed by tissue necrosis. Symptoms on coconut leaflets start as

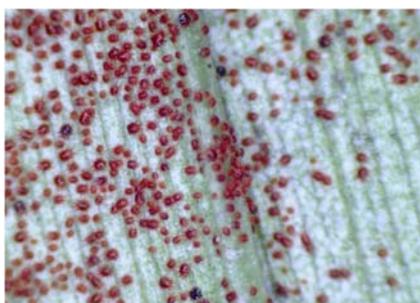


Figure 1. Red palm mite (RPM) colony on the under surface of a coconut leaflet.

small yellow spots on the abaxial leaflet surface, which develop into larger chlorotic spots.

The mite was first reported from Tamil Nadu, India about eight decades ago¹. It attained economic significance when it was first reported as an invasive species in the Caribbean². Later, the mite has spread widely throughout the Caribbean islands and has now been reported in Florida³, Venezuela⁴, Mexico⁵, Brazil⁶ and Colombia⁷.

RPM has a wide host range in New World than the Old World. In India, infestation has been reported on arecanut and coconut^{8,9}. The host list of RPM is extensive; according to the literature, prior to its introduction in the Caribbean, the mite was reported on *Areca catechu* and *Cocos nucifera* in India, Mauritius and Sri Lanka. Infestations on date palms (*Phoenix* sp.) have also been reported across the Middle East¹⁰. In the invasive range, the hosts reported for RPM include members of the families Musaceae, Heliconiaceae, Zingiberaceae and Stre-

litziaceae. Numerous hosts of the family Arecaceae are also reported, including those reported in the Old World⁷. Since the introduction of the mite, more than 60 host plants were recorded from the Caribbean region alone.

In Kerala, a collaborative research programme by the Kerala Forest Research Institute and CABI-Europe, UK is ongoing to trace the population dynamics and the host range of the mite and its natural enemy complex. Growing concern about the pest is due to its rapid range expansion in subtropical regions and its possible invasion to other regions of the western hemisphere (Figure 2). It seems that tropical and subtropical countries are prone to attack and till date, the mite has been recorded from 35 countries. In many countries like the Dominican Republic, Guadeloupe, Puerto Rico, Saint Martin, Trinidad and Tobago, the US Virgin Islands, Granada, Haiti and Jamaica, the pest is considered as invasive and has a large impact on agriculture and biodiversity. Though this mite was treated as a

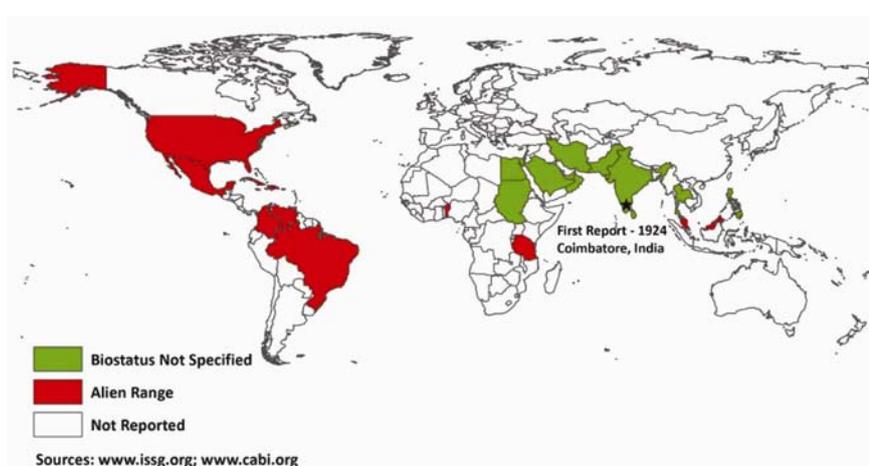


Figure 2. World occurrence of RPM (as on May 2012).

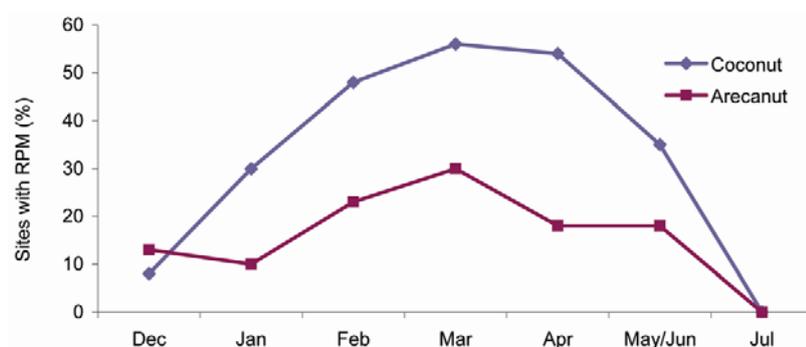


Figure 3. Population dynamics of RPM.

minor pest in India, it was recognized as a major pest in the Caribbean causing severe economic loss (<http://faostat.fao.org/>, [http://wiki.bugwood.org/Raoiella indica#Potential Economic Impact and Description of Damage](http://wiki.bugwood.org/Raoiella_indica#Potential_Economic_Impact_and_Description_of_Damage)).

Population dynamics of the mite is interesting. In Kerala, the population built-up after the post-monsoon period and peak population was observed during March–April, when the weather condition became more hotter (Figure 3). Both the hosts – coconut and arecanut – showed similar response, whereas proportionate increase in the number of sites infested showed a dumb-bell shape for coconut than arecanut, having peak population during April–May. The study revealed that site, temperature and humidity play a significant role in controlling the pest

in India along with phytoseiids natural enemies like *Amblyseius largoensis* and *Amblyseius tamatavensis*. Apart from arecanut and coconut, multi-generational colonies of mite were also observed in the pygmy date palm, *Phoenix roebelenii* O'Brien in Kerala. Though individual mites were found on the *Musa* sp. growing under the infested coconut palm here, no evidence of colonization was observed in the field or in laboratory experiment. So *Musa* sp. may be a host plant of RPM in Kerala. Global distribution of RPM shows that (Figure 2) if it is found throughout the county or has a restricted distribution, in consensus with that of host plant species.

It is believed that storms and hurricanes, which may be exacerbated by climate change, have helped to spread RPM

throughout the Caribbean. The mite may expand further to tropical and subtropical regions and adversely affect agriculture production. Further extending host range, lack of natural enemies in the invasive range along with favourable climatic conditions would provide an excellent niche to the pest. Hence continued monitoring of the pest is highly warranted.

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