Table 3. Observation on flowering and fruiting in air-layered and seed-origin *Prosopis cineraria* trees

Propagated by	Height range (m)	DBH range (cm)	Observation during	Flowering %	Flowering Score	Fruiting %	Fruiting Score	Germination %
Air layering	3.2–7.6	7.0–29.1	Regular	100	5–8	100	5–8	45.50
			Off-season	50	1–2	45	1–2	6.67
Seed	7.5–11.7	19.0–43.4	Regular	100	4–10	100	2–9	70.50
			Off-season	62	1–2	48	1	7.50

Score represents the quantity gradients, viz. very less (1) to plenty/full (10) flowering and fruiting.

normal season of flowering and fruiting (April–June).

Difference in off-season flowering and fruiting over years was observed; and it was more in 2011 than in 2012. This kind of natural off-season flowering and fruiting in Khejri needs further understanding for its better usage like in the case of mango[14]. This kind of off-season flowering might be due to the new shoots arising, mostly as laterals from auxillary buds, around the stump of the twigs fruited in the previous season/year and such growth either remains unextended or makes further extension growth in subsequent months as in mango[15]. It may also be due to the initiation of shoot growth (the first event of vegetative growth) from buds of resting stems, which leads to the development of off-season flowers[16].

Observations were made on 25-year-old Khejri trees raised from seeds and air-layering for off-season flowering/fruiting in November–December 2011 and compared with the normal season of April–June 2012 for pod yield, seed germination, etc. Flowering, fruiting percentage in seed origin and air-layered trees did not significantly vary, whereas flowering and fruiting varied significantly between off-season and normal season (Table 3). Seed germination in June was 45.5% for seeds of normal season, whereas it was only 6.67% for off-season seeds. The winter availability of 'sangri' (local name of Khejri pod as vegetable), which contains more protein may fetch more market price due to its off-season availability, demand and presence of lesser seeds in the pod. If this off-season flowering and fruiting in Khejri continue over the years, there will be more demand for this vegetable pod in the market. On the contrary, this off-season fruit/pod production of Khejri might be an unnecessary phenomenon if the crown is preferred for pruning to meet the fodder demand. Further in-depth structured studies for a period of at least a decade on its cause and impact are necessary for sustainable utilization of off-season fruiting in Khejri.

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Acrobotrys disolenia Haeckel from the late Miocene of Andaman and Nicobar Islands

In the present-day oceans, radiolarians are one of the most significant components of the plankton community. They utilize opaline silica to build their skeleton[1]. They have considerable influence on the oceanic silica cycle. There is disputed report of this old group of protozoans in the Precambrian strata[2]; however, there is confirmed report of radiolarians from the early Cambrian black cherts of Yangtze Platform, China[3]. Molecular data indicate that radiolarians originated approximately 1 billion years ago[4,5], but there is no fossil evidence in support of these molecular data. Apart from their natural beauty, radiolarians are useful for biostratigraphy owing to their wide distribution, considerably high species diversity

Table 1. Distribution of *Acrobotrys disolenia* in time and space

Locality	Age	Reference
Central Pacific, Challenger Expedition	Oceanic surface sediment	17
Central Pacific, ODP Leg 199 sites 1218 and 1219	Late Oligocene and early Miocene	39
Eastern Pacific sediments deposited within equatorial region (± 2° of the Equator), IODP Leg 320 sites U1331–U1336	Early Eocene to early Miocene	40
Northwest Pacific, DSDP leg 7	Oligocene to Pleistocene	41
Offshore eastern New Zealand, Southwest Pacific, ODP Leg 181 site 1124	Late Quaternary	42
Equatorial Pacific, ODP Leg 199 sites 1218, 1219 and 1220	Late Oligocene and early Miocene	43
Southern South China Sea, ODP Leg 184 site 1143	Late Miocene	44

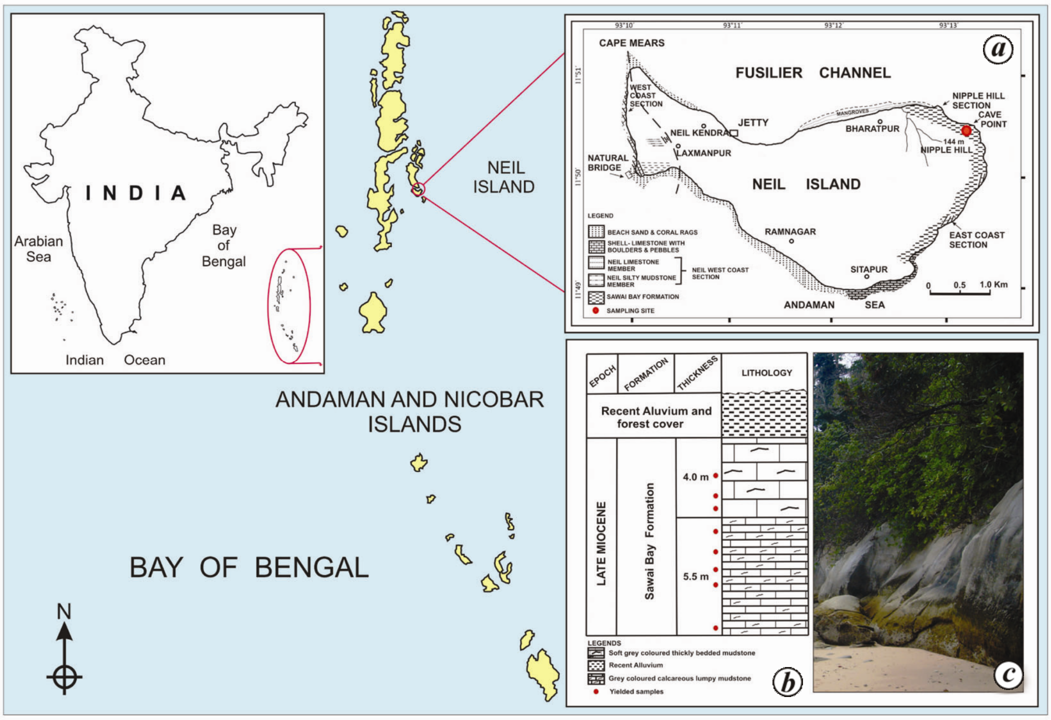

Figure 1. ***a***, Geological map of Neil Island, Andaman–Nicobar Islands showing the study area; ***b***, Litholog of Cave Point Section, Neil Island showing the levels of yielding samples; ***c***, Field photograph showing the outcrop.

and vertical as well as latitudinal distribution[6–12]. They are widely distributed in the modern oceans, but the number of radiolarian species may be depth-stratified[13]. The species in the surface sediments relate the groups of taxa in the overlying oceanic water column[13]. As a matter of fact, relationship between the radiolarians in the bottom sediments and the water masses also exists in the modern oceans. They are also significant in palaeoceanographic[14] and palaeoclimatic studies[15,16].

While studying the diatoms, radiolarians and silicoflagellates from the Neogene sediments of the Andaman and Nicobar Islands, *Acrobotrys disolenia* Haeckel[17], a characteristic radiolarian hitherto not known from the Indian Ocean was identified. The genus *Acrobotrys* belongs to the family Cannobotryidae. *A. disolenia* was first described from the Central Pacific Ocean (Station 264–274, depth 4298–5359 m) by Haeckel[17] in the Challenger Expedition during 1873–1876. Previously, *A. disolenia* was only reported from the low latitudes (between 0° and 30°), early Eocene to late Quaternary sediments of central, eastern, northwest, southwest and equatorial Pacific Ocean, including southern South China Sea (Table 1).

In the Andaman and Nicobar Islands, Neogene sequences predominantly of deep water origin are rich in siliceous and calcareous microfossils. Siliceous microfossils are represented by diverse and well-preserved diatoms, silicoflagellates and radiolarians. Amongst the siliceous microfossils, radiolarians have been extensively applied to decipher evolutionary changes, and to interpret biostratigraphy, palaeoceanography and palaeoclimatology based on DSDP and ODP cores as well as samples from the outcrops of the Andaman and Nicobar Islands and Indonesia[18]. Studies on Neogene radiolarians from this part of the Indian Ocean have been done by several workers[18–28], specifically on the Neil Island radiolarian assemblages[13,20,21,23].

Samples for the present study were collected from the Cave Point Section of Neil Island (93°03.900′E, 11°50.523′N), situated about 32 km east of Port Blair (Figure 1 *a*). This island is included in the youngest lithostratigraphic group,

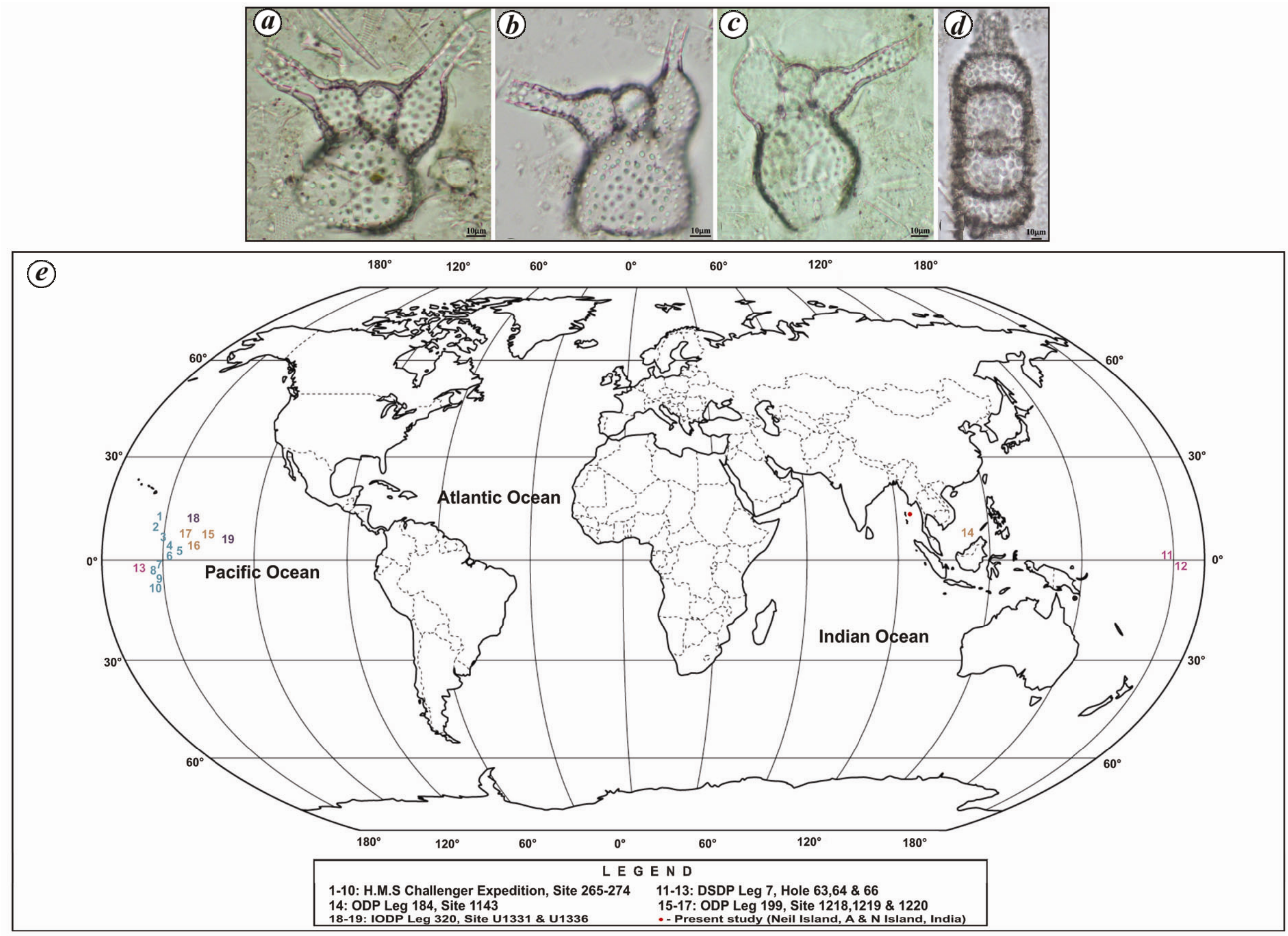

Figure 2 *a*–*e*. *Acrobotrys disolenia* Haeckel. ***a***, BSIP Slide No. 15150; ***b***, BSIP Slide No. 15149; ***c***, BSIP Slide No. 15150; ***d***, *Didymocyrtis penultima* (Riedel) Sanfilippo and Riedel, BSIP Slide No. 15150; ***e***, Map showing global distribution of *Acrobotrys disolenia*.

i.e. Ritchie's Archipelago Group of the Andaman and Nicobar Islands, and lies in the central part of Burma–Java subduction zone. Almost a continuous sequence of late Miocene to Pleistocene sediments is exposed in different outcrops of Neil Island occurring on the east and west coasts. The east coast sections belong to the Sawai Bay Formation, whereas the west coast section belongs to Neil West Coast Formation. The Mio-Pliocene Archipelago Group includes alternations of siliciclastic turbidites and subaqueous pyroclastic flow deposits in the lower part and carbonate turbidites in the upper part[29]. The sediments of the studied outcrop comprise soft, light to bluish-grey, calcareous, lumpy mudstone with occasional siltstone bands (Figure 1 *b* and *c*). The samples marked in Figure 1 *b* yielded well-preserved radiolarians and diatoms. During microscopic observation, *A. disolenia*[17] (Figure 2 *a*–*c*) has been documented from the late Miocene sediments of Cave Point Section (Figure 1 *b* and *c*) situated on the east coast of Neil Island[17] and it is the first unequivocal report of the taxon from the Neogene sediments of the Andaman and Nicobar Islands. The slides of illustrated specimens are archived in the museum of the Birbal Sahni Institute of Palaeobotany, Lucknow (Statement No. 1369).

The present specimens of *A. disolenia* Haeckel are characterized by trilobed cephalis. Amongst these, the middle lobe is somewhat smaller in size. Three odd-sized ovate lobes range in size from 19.23 to 24.21 µm, 15.79 to 18.82 µm and 18.02 to 19.42 µm respectively. There are two divergent, straight, slender cylindrical tubes present on the lobes. A vertical apical tube with diameter 5.57–7.35 µm on the occipital lobe and a horizontal nasal tube with diameter 9.89–10.97 µm on the frontal lobe are present. Thorax measures 52.03–53.40 µm and cephalis measures 56.91–60.88 µm. There are several pores throughout the body measuring 1.1–2.4 µm. In all morphographic features, the present specimens resemble *A. disolenia* described by Haeckel[17].

Based on planktic foraminiferal assemblage namely *Globorotalia tumida tumida* and lower part of *Sphaeroidinella dehiscens*[30] and radiolarian assemblage represented by *Didymocyrtis penultima* and *Stichocorys peregina* zone[23], the east coast section of Neil Island has been dated as late Miocene to early Pliocene. However, the nannofossil zone represented by *Discoaster berggrenii* subzone (CN9A)[31] corresponding to the lower part of *D. quinqueramus* zone (NN11)[32] indicates Late Miocene age[33]. The analysed samples from the Cave Point Section of the east coast of Neil Island indicate a Late Miocene[34] age based on the presence of marker radiolarian taxon *Didymocyrtis penultima* (Riedel) Sanfilippo and Riedel[35] (Figure 2 *d*). *D. penultima* zone

(RN08)[36] indicates a depth range of about 700 m (ref. 13).

Previous records of *A. disolenia* are mainly from DSDP and ODP cores (Figure 2 *e*) of the Pacific and South China Sea. The present record is a significant addition to the radiolarian database from this region of the world. Based on the planktonic foraminiferal biogeographic and isotopic analysis, it has been postulated that the closure of the Indonesian Gateway took place during the early Pliocene[37]. In view of this, it can be interpreted that *A. disolenia* could have migrated from the Pacific Ocean through the Indonesian Gateway with the help of South Equatorial Current[38].

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