

The king of fruits

1 | INTRODUCTION

Esteemed across Asia, the durian (genus *Durio*, family Malvaceae) is often dubbed 'the king of fruits'. Durian is considered a delicacy—especially in Southeast Asia—where it has had a profound influence on history and culture for millennia (Brown, 1997). It is highly sought after, either eaten as the fresh pulp (aril), stored frozen or used in a variety of desserts from the region. Durian seeds are also consumed after roasting and boiling, and the flowers and unripe flesh are used in curries (Idris, 2011), for example, Maznah Gulai Tempoyak (fermented durian curry). To a lesser extent, durian is processed to make *lempuk* (durian 'cake'—a traditional dessert) and *tempoyak* (fermented pulp), both of which are consumed widely across Indonesia and Malaysia (Jaswir et al., 2008). Indeed, durian is now used widely across South-east Asia in confectionery, patisserie and popular snacks such as ice cream, drinks, biscuits and crisps; it has become a mainstream flavour. During durian season, the fruit is sold locally in 'Durian Malls' where different grades and prices of fruit are available (Figure 1b–d). The durian's strong and arguably offensive smell has been described as onion-like and sulphurous, with sweet notes of fruitiness (Li et al., 2012). The aroma is so strong, in fact, that the fruit is often banned from public venues and transport systems, and it has been described as the 'skunk fruit of the orchard' (Lim & Luders, 2009). Indeed, durian can elicit devotion as well as revulsion: The naturalist Alfred Russel Wallace remarked of the fruit: 'the more you eat of it, the less you feel inclined to stop' (Teh et al., 2017; Wallace, 1856).

Here, we provide a brief review of the commercial and cultural importance, ecology and evolution of this extraordinary genus. The wild relatives of domesticated crops possess genetic diversity useful for developing more productive, nutritious and resilient crop varieties (Castañeda-Álvarez et al., 2016). Therefore, we suggest that further research into the obscure wild relatives of the single widely grown commercial species (*Durio zibethinus*) is needed in the context of land conversion, growing demand for the fruit and an increasing reliance on commercial cultivars. Poorly known taxa may represent useful, untapped genetic resources or have potential as novel crops. We suggest extending research into the genomics of durian, for example, to identify resistance-related genes, to species beyond commonly cultivated cultivars such as 'Musang King', which are the focus of most recent studies (see, e.g. Cortaga et al., 2022).

2 | TAXONOMY AND RECENTLY DESCRIBED SPECIES IN THE GENUS *DURIO*

The genus *Durio* s.l. comprises about 30 species of large trees native to the tropics, from Sri Lanka, India and Myanmar in the west, through Thailand, Peninsular Malaysia, Borneo (the centre of diversity: 15 endemic species), Sumatra and the Philippines, east to Papua New Guinea (Brown, 1997; Idris, 2011; Kostermans, 1958). Relatives of *Durio*, such as *Coelostegia* (known as 'black durian') (Figure 2b), also occur in the region and are used by people, for example, as timber trees. *Durio* is characterised by showy, often bat-pollinated whitish or reddish flowers and large, spiny fruits with seeds encased by a fleshy or leathery aril (Nyffeler et al., 2001). The durian fruit is superficially similar to the unrelated jackfruit (*Artocarpus heterophyllus*, family Moraceae); however, it has a more prominently thorny rind.

Of the 30 species of *Durio*, 24 species are recognised to occur across the states of Malaysia (13 species in Sabah, 16 species in Sarawak and 13 species in Peninsular Malaysia) (Idris, 2011), and this is the region where research into taxonomy and diversity of the genus has been concentrated. Wild species in Malaysia have various local names such as *nyekak*, *durian batang*, *durian daun*, *durian burong* and many more besides, each relating to a particular race or locality. Some of these naturally occurring trees are similar, and resemble mainstream durian (*D. zibethinus*) so closely, that they are difficult to identify correctly from fallen leaves, if not observed with flowers or fruits. Due to interest in the much celebrated durian fruit, the genus *Durio* has been the focus of many researchers' efforts in collecting, characterising and conserving genetic diversity among wild species for future research and development (R&D), particularly crop performance improvement.

Various species of *Durio* occur naturally in lowland forests, which may be a reservoir for genetic improvement of cultivated commercial durian species. About a third of *Durio* species produce edible fruits (some listed below and Figure 3), of which just one, *D. zibethinus*, is grown on a commercial scale. This species is widely cultivated in private gardens, mixed orchards and smallholdings and more extensively on estates as a cash crop. Selected landraces of the wild relatives of *D. zibethinus* such as *D. graveolens* and *D. kutejensis* are also being domesticated in Sabah and Sarawak (Malaysia) and *D. oxleyanus* (Figure 4e) is cultivated in roadside stands in Sabah; meanwhile, a



FIGURE 1 (a) *Durio zibethinus* for sale at a market stand in Sabah, Malaysian Borneo. (b) *D. zibethinus* for sale during durian season in Kuala Lumpur, Malaysia, at ‘Durian Malls’—stands where fruits are sold at various grades and prices. (c) Gina Copp at the Durian Mall, Kuala Lumpur. (d) *Durio kutejensis* in Indonesia. (e,f) *Durio lowianus* eaten by local communities in Kelantan, Malaysia. Photos (b) and (c) by Gina Copp; photo (d) by Yayan Wahyu Candra Kusuma; photos (e) and (f) by Dome Nikong

handful of other species grow wild and are also semi-domesticated in some regions of Malaysia (Idris, 2011). Some of these are also grown in home gardens and orchards, in combination with commercial fruit

crops. Nine such species produce fruits with edible starch flesh, namely, *D. dulcis*, *D. graveolens*, *D. grandiflorus*, *D. kutejensis*, *D. lowianus*, *D. oblongus*, *D. oxleyanus*, *D. testudinarius* and *D. zibethinus*. The



FIGURE 2 (a) *Durio graveolens* in the Philippines, cut open to reveal the red aril of the fruit. (b) *Coelostegia* sp. in Peninsular Malaysia—a wild relative of *Durio*. (c) *Durio lowianus* var. *durimerah*. (d) *Durio malacca*, showing the habit of the fruit which sprouts directly from the trunk of the tree (an adaptation called cauliflory). (e) *Durio oblongus*. (f) *Durio carinatus*. Photo (a) by Pastor Jr Malabrigo; photos (b–d) by Dome Nikong; photos (e) and (f) by Mohd Norfaizal Ghazalli

remaining ca two-thirds of species in the genus produce inedible fruits (Idris, 2011; Nyffeler et al., 2001; Soegeng, 1962) and are not cultivated (see, e.g. Figure 4a,b,f). Hybrids among the species listed above

also produce edible fruits. For example, ‘durian suluk’ (also known as ‘durian siunggong’) is a naturally occurring hybrid between *D. zibethinus* and *D. graveolens*; the fruit of the hybrid is described to possess

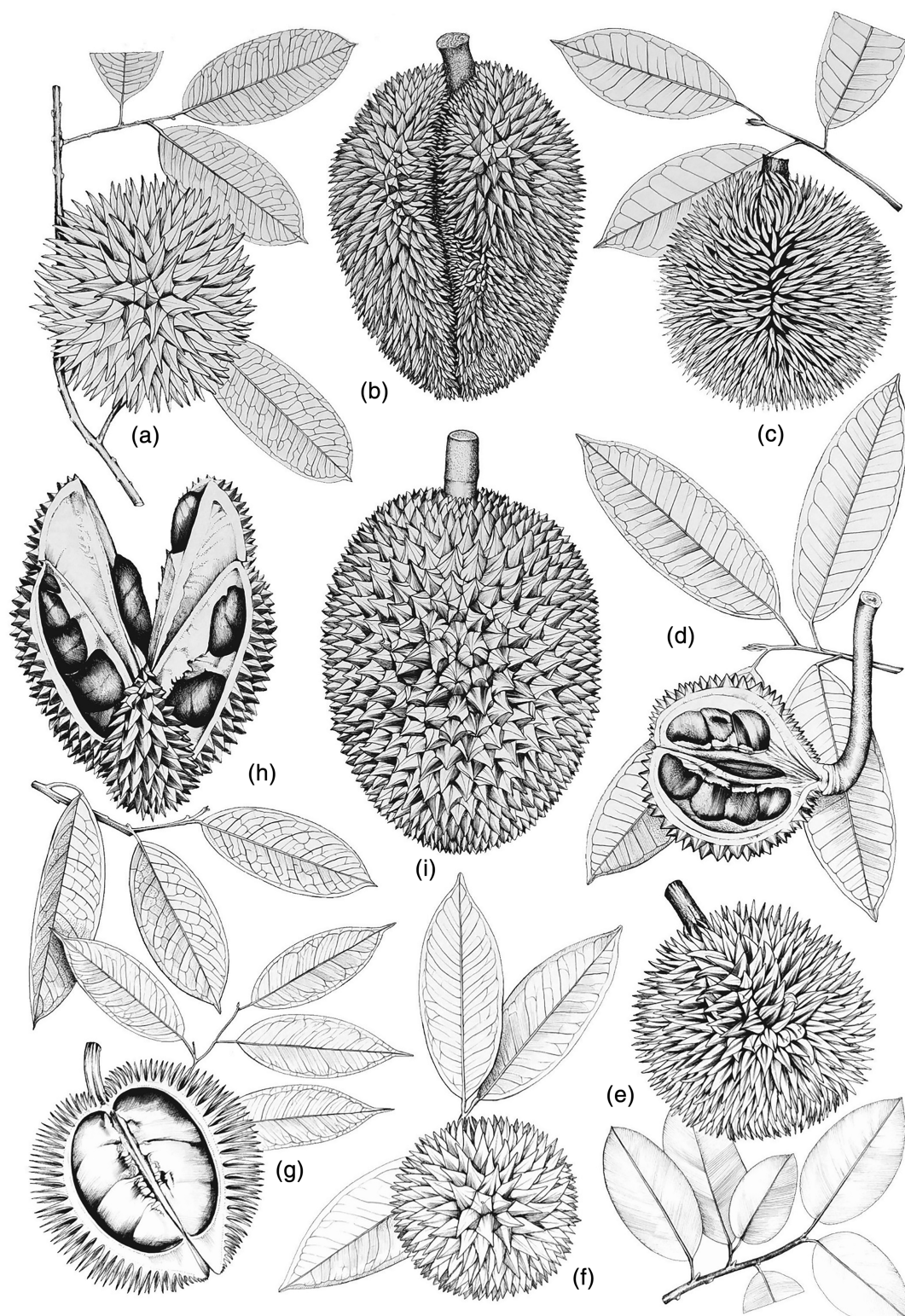


FIGURE 3 Some of the edible species of *Durio*: (a) *Durio oxleyanus*; (b) *Durio lowianus*; (c) *Durio dulcis*; (d) *Durio testudinarius*; (e) *Durio wyatt-smithii*; (f) *Durio graveolens*; (g) *Durio kinabaluensis*; (h) *Durio grandiflorus*; (i) *Durio zibethinus*. Illustrations not to scale. Drawn by Chris Thorogood

the texture of *D. zibethinus* with burnt caramel overtones of *D. graveolens* (Lim, 2012). Hybridisation between *D. zibethinus* and *D. kutejensis* has also been explored as a possible route to introducing superior cultivars in Indonesia (Hariyati et al., 2013). However, reports of artificial

hybridisation in *Durio* are scarce, and this may be an underutilised tool for optimising crop performance in the genus.

Remote and inaccessible habitats together with seasonal flowering and fruiting have impeded the documentation of diversity in the



FIGURE 4 (a) *Durio johoricus*. (b) *Durio griffithii*. (c) *Durio testudinarium*. (d) *Durio grandiflorus*. (e) *Durio oxleyanus*. (f) *Durio singaporensis*. Photos by Mohd Norfaizal Ghazali

genus *Durio* historically. However, recent work in Malaysia has led to the description of new species and enhanced our understanding of species limits in the genus. For example, exploration in Hulu Perak by the Malaysian Agricultural Research and Development Institute

(MARDI), and Universiti Putra Malaysia (UPM), together with free-lance researchers, led to the successful collection and characterisation of arilless *Durio* species named as *D. gerikensis* (Mohd Norfaizal et al., 2022). Meanwhile in 2015, another interesting reddish-pink

arilled wild *Durio* species, *D. johoricus*, was described from southern Peninsular Malaysia (Idris, 2015). Indeed, there are many inedible wild *Durio* species and their natural hybrids that remain undescribed and require documentation and conservation (Mohd Norfaizal & Masrom, 2014). Further work to resolve taxonomic diversity in the genus, together with a greater awareness and appreciation of the importance of these wild crop relatives, is now required to foster community-level participation in the conservation of Southeast Asia's underutilised *Durio* species. These taxa, and their hybrids, may represent an untapped resource during a time of unprecedented international demand and growing pressures associated with durian farming.

3 | COMMERCIAL AND CULTURAL IMPORTANCE

Numerous cultivars of the species *D. zibethinus* have been propagated by cloning in Southeast Asia. Locally, the various clones have differing levels of commercial value. Since the 1990s, domestic and international demand for durian has soared, and this has driven a rapid expansion of the area under cultivation (O'Gara et al., 2004). Returns from the crop are high, and demand for the fruit is increasing with a rise in affluence in Asia (Lim & Luders, 2009). Durian is now economically and culturally significant in Thailand, Malaysia, Indonesia, Brunei, Vietnam, Myanmar, Cambodia and Laos (Lim & Luders, 2009; O'Gara et al., 2004). Leading exporters of the fruit include Thailand, Malaysia and Indonesia; the crop also has significant potential in northern Australia where a growing market has been identified (Lim & Luders, 2009). Production across these regions varies seasonally, generating opportunities for trade across an extensive range, especially to markets in mainland China, Singapore, Hong Kong and Taiwan (O'Gara et al., 2004). Production and trade of minor tropical fruits, including durian, is gaining importance internationally. Altendorf (2018), provides a detailed account of production and export volumes of minor tropical fruits, including durian, for the period of 2015–2017. Global production of durian was estimated to be 2.3 million metric tonnes (MT) during the period. The largest producer was Indonesia, which produced 0.86 million MT, followed by Thailand (0.72 million MT) and then Malaysia (0.38 million MT). Thailand and Indonesia together accounted for ~70% of world durian production in 2017. Global trade accounts for ~10% of production for fresh minor tropical fruits such as durian. However, the quantities exported by country do not correlate with the volumes they produce. Global durian trade reached 609,000 MT in 2017, an increase of 437,000 MT in a decade; exports during this period were dominated by Thailand, accounting for 82% of world shipments. China is the leading importer of durian and procured an estimated annual average of 300,000 MT in 2015–2017. Because durian is such a high-value crop, the fruit is experiencing significant growth; indeed, the value of durian exported from Thailand to the United States increased by 68% in 2017 to approximately USD 5.1 million (Altendorf, 2018). The rise in international demand for tropical fruits such as durian may be due to a reduction or elimination in trade tariffs; advances in logistics—for example, the introduction of

refrigerated shipping containers; the desire for new nutritional foods; and growing demand from immigrant populations. The dramatic rise in international durian consumption has been described as the 'durian boom' (Airriess, 2020). Recently, attention has turned to potential uses of durian besides consumption of the fresh fruit, for example, in yielding edible 'fruit leather' (Jaswir et al., 2008), seed gum to replace egg yolk in vegan mayonnaise (Cornelia et al., 2015) and even as a raw material for combustion, as an alternative source of household thermal energy (Hirunpraditkoon et al., 2014). Together, this points to the growing interest and importance of durian internationally and calls for further examination of the genus *Durio* holistically.

3.1 | Malaysia

Durian trees have long been planted in private gardens in Malaysia; traditionally, each village house would possess one to three trees that would bear fruit seasonally, which would be of intergenerational importance to communities. Durian has grown in popularity in the region, and demand for the fruit has spiked dramatically in recent years. The demand for durian-related products is demonstrated by a number of Malaysian companies penetrating new markets to satisfy durian-lover demand. Recently, Hernan Corporation Sdn Bhd, one of Malaysia's largest exporters of durian and its related products, made its presence in the Japanese market with a maiden shipment of Musang King and D101 frozen durian cultivars. The durian products are distributed and available at local supermarkets, speciality grocery stores and restaurants. The Ministry of Agriculture and Food Industries (MAFI) is even developing a 'Durian Strategy' geared towards capitalising on the rising appeal of the fruit to international tourists, especially those from China, where demand for the fruit is growing annually, yet it is reputedly available mainly in frozen, chilled or pulp form (Neo, 2019). Growing international demand and revenue may have implications for habitat destruction, if cultivation expands. Indeed, durian is now one of the most profitable fruits for farmers and exporters in Malaysia. In line with growing demand for the fruit, there has been significant scale-up of cultivation from gardens and small-holdings, intercropped with other fruit trees, to extensive plantations or 'Durian Farms'. Durian has been estimated to occupy 41% of cultivated land in Malaysia, and interest in the fruit is still growing, mirroring a decrease in the prices of oil palm, cocoa and rubber; furthermore, the market for the fruit appears to have been relatively unaffected by the Covid-19 pandemic and continues to expand (27Group, 2021). High revenue from durian cultivation is driving a concerning trend towards clearing forests for plantations across Southeast Asia (Baqi et al., 2022), and farmers appear to be extending the propagation of durian trees from forest fringes into reserves, integrating the trees among natural stands of vegetation. There is little available literature on this trend, so the extent of durian-driven habitat destruction remains unquantified in Malaysia, or elsewhere. Extensive damage to ecosystems in Malaysia has been observed first-hand by the authors (Siti-Munirah). Meanwhile, environmental groups in Malaysia are lobbying for new tracts of durian to be restricted to

existing oil palm plantations to avoid exacerbating deforestation (Airriess, 2020). However, the extent of the threat durian cultivation poses to biodiversity loss and extinction remains virtually undocumented, and we suggest here that this requires greater research focus and attention.

The MARDI has over the decades, promoted and strengthened durian cultivation with its R&D, resulting in new varieties to cater to consumer demand. Such work is important as Malaysia's MAFI also expects durian production in the country to increase to 443,000 tonnes by 2030. MARDI is also promoting tourism related activities or so-called Durio-tourism. In 2017, MARDI launched its first Durio-tourism destination, situated in Kuala Kangsar, Perak.

National policy is in place to safeguard key ecosystems, species and genetic diversity in Malaysia (National Policy on Biological Diversity 2016–2025). A specific target to adequately conserve the genetic diversity of cultivated plants and farmed and domesticated animals, and of wild relatives, must be by 2025. MARDI has also strengthened the conservation of plant genetic resources (PGR), with the establishment in 2014 of the genebank MyGeneBank™. MyGeneBank™ encompasses field and seed conservation, in vitro propagation, cryo-preservation and herbarium accessioning mainly on agriculturally important species and crop wild relatives (CWR). This should help safeguard rare genetic resources, for example, the living collection of *Durio* that has been cultivated since the 1980s, together with other rare native fruit species in Malaysia (Mohd Shukor et al., 2015).

3.2 | Indonesia

Durian has been an important part of Indonesian culture for centuries; indeed, a durian tree is depicted in one of the relief panels of Indonesia's ninth-century Borobudur temple (Matsuyama, 2003; Montanari, 2017). Today, durian is an important food for local communities throughout Indonesia, particularly in Java, Sumatra and Kalimantan.

In recent years, durian cultivation in Indonesia has extended across community plantations and gardens, is intercropped with other trees (agroforestry), or more intensively in dedicated plantations or 'durian farms'. Fruit yields fluctuate in Indonesia seasonally with wind and rainfall. High winds cause the premature abscission of young fruits, whereas heavy rain can cause fruit rot prior to harvest (Wibowo et al., 2019). Nevertheless, in 2020, Indonesia produced ~1.13 million tonnes of durian, most of which was from East Java (275.8 thousand tonnes), followed by Central Java and West Sumatra (138.1 thousand tonnes and 131.43 thousand tonnes, respectively) (Central Bureau of Statistics, 2022). The production was slightly lower than in the previous year (1.16 million tonnes). Most of this produce is consumed locally, but some is exported, for example, to Malaysia and Singapore, with a total value of about US\$ 232,000 in 2020 (Rizaty, 2021). Recently, durian fruit sales were affected by the Covid-19 pandemic; to overcome this, farmers have begun selling the fruit on online platforms. Durian agrotourism is another strategy implemented by farmers to increase revenue (Lestari et al., 2020). Online

sales and agrotourism together indicate a recent shift in durian commerce in Indonesia.

Indonesia is one of the world's centres of plant genetic diversity, especially for tropical fruits, including durian (Sastrapradja & Rifai, 1989). The island of Borneo, in particular, is a centre of diversity for wild relatives in the genus *Durio*. According to Uji (2005), 20 species of *Durio* occur in Indonesia. Eighteen of the 20 species of *Durio* occur in Kalimantan, seven species in Sumatra and a single species in Java, Bali, Sulawesi and Maluku, respectively. Of the 18 of species *Durio* in Kalimantan, 14 are recorded to be endemic, and nine are reported to bear edible fruits, namely, *D. dulcis* ('lahong'), *Durio excelsus* ('apun'), *D. grandiflorus* ('durian munyit'), *D. graveolens* ('tuwala'), *D. kutejensis* ('lai'), *D. oxleyanus* ('kerantungan'), *D. lowianus* ('teruntung'), *D. testudinarius* ('durian sekura') and *D. zibethinus* ('durian') (Uji, 2005).

Durio zibethinus is the species most commonly cultivated across Indonesia, as elsewhere in Southeast Asia. Cultivated durian in Indonesia is highly plastic and varies in habit; crown shape; branching geometry; leaf shape; fruit shape; colour, form and texture of the flesh; and seed morphology. Indeed, over 100 durian cultivars have been accessioned to the domestic database of registered cultivars (the Ministry of Agriculture of the Republic of Indonesia) (<https://varitas.net/dbvarietas/index.php>). Moreover, there are many local forms cultivated in Indonesia. For example, 19 local cultivars are grown by the local people of Tidore Island (North Maluku) (Sundari et al., 2015), six in Katingan (Central Kalimantan) (Susilawati Sabran, 2018), 36 in Ngawi (East Java) (Yuniastuti et al., 2018), four in Malang (East Java) (Bayu & Ashari, 2019), eight in Ogan Komering Ulu (South Sumatra) (Yulhasmir & Asroh, 2020) and five in Jember and Banyuwangi (East Java) (Sari et al., 2021). Some of these local durian cultivars may have superior characteristics to more widely grown forms and have significant untapped potential (Yuniastuti et al., 2018).

Bogor Botanic Garden, and its network, is a national leader in the conservation of *Durio* in Indonesia. About a dozen taxa have now been conserved in *ex situ* collections in the garden, namely, *D. dulcis*, *D. grandiflorus*, *D. graveolens*, *D. kutejensis*, *D. kutejensis* forma *ochroleucus*, *D. kutejensis* forma *luteus*, *Durio lanceolatus*, *Durio macrantha*, *D. oxleyanus*, *D. testudinarius* and *D. zibethinus* (Aprilianti, 2019). However, the conservation of the local cultivars of mainstream durian (*D. zibethinus*) has received far less attention. We suggest that germplasm collections for all durian cultivars, including commercially registered and locally grown forms, as well as wild species of *Durio*, will be an important resource for plant breeding in Indonesia and beyond, in the future.

3.3 | Outside Southeast Asia

Durian is grown locally throughout the tropics. Outside the tropics, durians must be grown under glass, so farming at a large scale is unfeasible. Here, the plant is occasionally cultivated as a curiosity; however, because of its large size at maturity, it is rarely grown. The durian was introduced to Britain as a glasshouse curiosity in 1825 and

was listed in the collections of Kew Gardens in 1885 (Brown, 1997). The only extant accessions to our knowledge are now grown under glass at the University of Bristol Botanic Garden (since 2008) and the University of Oxford Botanic Garden (since 2019), both of which were propagated from commercially sourced seed of *D. zibethinus* by CJ Thorogood. Other (wild) *Durio* species are unknown in cultivation in Europe to our knowledge.

4 | ECOLOGY AND EVOLUTION

Unsurprisingly, this extraordinary fruit has long aroused the attention of botanists and evolutionary biologists. The eminent botanist Edred John Henry Corner (1906–1996) was, in his own words, a ‘convert to durianology’. He put forward a ‘Durian Theory’ for the origin of modern trees. Upon visiting a patch of virgin forest in the Singapore Botanical Garden in 1944, Corner examined the fallen fruits of *Elaeocarpus javanicus* from the family Tiliaceae (now in the family Elaeocarpaceae). He described how the fruits appeared to belong to the families Meliaceae, Sapindaceae, Flacourtiaceae, Sterculiaceae, Bombacaceae and Connaraceae; this confusion led him to believe that fruits resembling those he examined must have been the ancestral fruit form of this group of families. In his words ‘And if of this group, why not of all flowering plants?’, Corner then considered the occurrence of arils and spines across flowering plant families and set out his argument that fruits possessing such features could were unlikely to have evolved multiple times de novo, whereas the loss of such features (e.g. associated with drought and cold) repeatedly was a more logical explanation. Using *D. zibethinus* as an example, Corner hypothesised that the primitive fruit of angiosperms was a spiny, fleshy follicle with large black seeds and a red aril (Corner, 1949). His theory was met with some criticism by contemporary botanists, among them Kostermans, in his appraisal of the genus *Durio* a decade later (Kostermans, 1958). Since Corner’s theory, the advent of molecular systematics has placed the genus *Durio* in the Malvaceae, which sits in a clade of core eudicots—it is not primitive among flowering plants (APG Group, 2016), and Corner’s theory is firmly refuted. Recent research successfully assembled the complete sequence of the *D. zibethinus* chloroplast genome and identified shared ancestry with linden trees (*Tilia*) and cacao (*Theobroma cacao*) (Shearman et al., 2020).

The durian’s strong smell is famous for attracting a guild of rainforest-dwelling animals including elephants, tigers, pigs, deer, tapir, rhinoceros, monkeys and squirrels, as described by Corner (1949); orang-utan are also noted by many foresters in Sabah, Malaysia, to consume the fruit. Latterly, systematics and character evolution using internal transcribed spacer (ITS) regions of nuclear ribosomal DNA have identified two major syndromes in the genus: (i) dispersal by birds (in which fruits open on the tree and have red or yellow, odourless arils) and (ii) dispersal by terrestrial mammals (in which fruits open after falling to the ground and have pale, odorous arils) (Nyffeler et al., 2001). *Durio* flowers open at night, and like the fruits, they are visited by a variety of vertebrates, including birds, non-flying

mammals, flying foxes and especially bats (Aziz et al., 2017; Chaiyarat et al., 2020; Nyffeler et al., 2001). The flowers are large, often whitish, nocturnal and strongly scented—traits common among bat-pollinated flowers (Yumoto, 2000). Semi-wild durian trees are typically exposed to little or no artificial management in rural areas and set seed following open pollination; on the other hand, hand-cross pollination is often carried out in some commercial plantations to increase seed set (Aziz et al., 2017). Chaiyarat et al. (2020) recommend managing durian orchards non-intensively as a sustainable approach to fruit production, maintaining higher populations of natural pollinators and reducing the risk of pollination failure in the long term.

5 | CONCLUDING REMARKS

The conservation of wild *Durio* species as genetic resources is crucial in the face of land conversion, habitat destruction and an increasing reliance on commercial clones of the fruit. However, there still exists confusion over taxonomy in the genus, and there are limited studies focused on wild species (Nyffeler et al., 2001); meanwhile, new species are still being discovered. Assessing wild gene pools in *Durio* could be useful for identifying useful traits such as disease resistance and particular fruit characteristics (Brown, 1997). To this end, a collection of *Durio* clones of both *D. zibethinus* and its wild relatives is now being conserved by the MARDI across the states of Malaysia. These wild *Durio* taxa have already proven useful for providing rootstocks for grafting and enhancing disease resistance (Idris, 2011). We conclude that obscure wild relatives of the durian hold great potential in advancing our understanding of the biology, agronomy and commercial potential of the world’s most celebrated tropical fruit.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Chris J. Thorogood conceived and drafted the manuscript. Mohd Norfaizal Ghazalli analysed, documented and provide necessary information regarding wild *Durio* diversity in Malaysia. Siti-Munirah Mat Yunoh wrote the section on cultural, ecological and economic significance of *Durio* in Malaysia. Dome Nikong contributed significantly to the preparation of the plates. Yayan Wahyu Candra Kusuma, Sudarmono Sudarmono and Joko Ridho Witono wrote the section on *Durio* in Indonesia.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analysed in this study.

KEYWORDS

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