

AGARWOOD BACKGROUND

Aquilaria malaccensis and agarwood production

Aquilaria malaccensis is one of 15 tree species in the Indomalaysian genus *Aquilaria*, family Thymelaeaceae, (Mabberley, 1997). It is a large evergreen tree growing over 15-30 m tall and 1.5- 2.5 m in diameter, and has white flowers (Chakrabarty *et al.*, 1994).

A. malaccensis and other species in the genus *Aquilaria* sometimes produce resin-impregnated heartwood that is fragrant and highly valuable. There are many names for this resinous wood, including agar, agarwood, aloeswood, eaglewood, *gaharu* and *kalamabak*, this wood being in high demand for medicine, incense and perfumes across Asia and the Middle East.



Chevit Tony Soehartono

Leaves of *Aquilaria malaccensis* tree

Distribution and habitat

Aquilaria malaccensis is widely distributed in south and south-east Asia. There are differing accounts of the countries in which it occurs. According to Oldfield *et al.* (1998), *A. malaccensis* is found in 10 countries: Bangladesh, Bhutan, India, Indonesia, Iran, Malaysia, Myanmar, Philippines, Singapore and Thailand. The supporting statement accompanying India's proposal to list this species in the appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) also names Lao PDR and Vietnam as range States. The status of *A. malaccensis* in these two countries requires confirmation, Oldfield *et al.* (1998) noting that they are range States for *A. crassna*, which is also heavily exploited for agarwood. There is also a question regarding whether *A. malaccensis* occurs in Iran (T. Soehartono, *in litt.* to TRAFFIC International, 25 April 2000; H. Heuveling van Beek, TRP, *in litt.* to TRAFFIC International, 2 May 2000). *Aquilaria* species have adapted to live in various habitats, including those that are rocky, sandy or calcareous, well-drained slopes and ridges and land near swamps. They typically grow between altitudes of 0-850 m, in locations with average daily temperatures of 20-22°C (Afifi, 1995; Keller and Sidiyasa, 1994; Wiradinata, 1995).

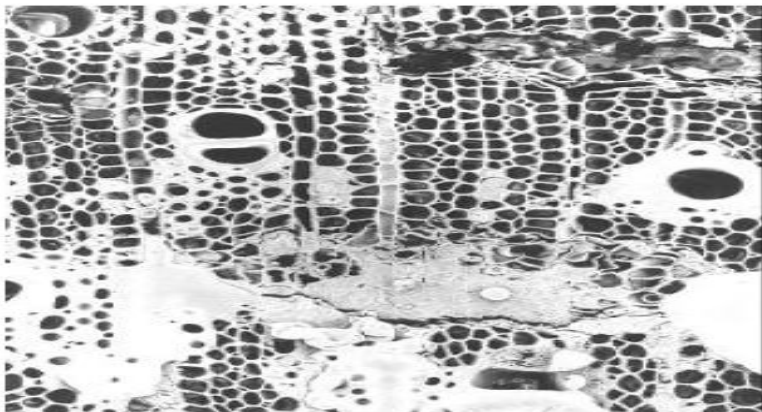
Conservation status

Aquilaria malaccensis is considered 'Vulnerable' according to the current IUCN Red List Categories, and has been included in *The World List of Threatened Trees* (Oldfield *et al.*, 1998). Considerable harvest pressure was noted in range States such as Indonesia, Malaysia and Thailand at the time when the species was proposed for inclusion in Appendix II. Very little recently published information is available regarding the status of this species. Information collected during this study indicates that overexploitation remains a significant concern. A report by Chakrabarty *et al.* (1994) documenting India's trade in agarwood concluded that *A. malaccensis* is highly threatened in that country due to exploitation of the species for commercial purposes.

Seven other *Aquilaria* species are also considered threatened according to the IUCN Red List Categories, five of which are considered to be at risk from overexploitation for agarwood: *A. beccariana* (Vulnerable); *A. crassna* (Critically Endangered); *A. cumingiana* (Vulnerable); *A. hirta* (Vulnerable) and *A. microcarpa* (Vulnerable) (Oldfield *et al.*, 1998).

Production of agarwood

Three hypotheses exist regarding agarwood formation, namely that it is the result of pathological, wounding/pathological and/or nonpathological processes (Ng *et al.*, 1997). According to Ng *et al.* (1997), studies have not provided conclusive evidence for any of these hypotheses. Oldfield *et al.* (1998) states that resin production is in response to fungal infection, and Heuveling van Beek (TRP, *in litt.* to TRAFFIC International, 2 May 2000) that it is in response to wounding. He adds that fungal infection can increase resin production as a host response to increased damage due to fungal growth. *Aquilaria* trees are naturally infected by a variety of fungi including: *Aspergillus* spp., *Botryodiplodia* spp., *Diplodia* spp., *Fusarium bulbiferum*, *F. laterium*, *F. oxysporum*, *F. solani*, *Penicillium* spp., and *Pythium* spp. (Anon., 1998a; Santoso, 1996, cited in Soehartono and Mardiatuti, 1997; Wiriadinata, 1995). The ecological interaction between the host tree and the wound and/or the fungi in order to produce agarwood is poorly understood. Other factors such as the age of the tree, differences in the tree caused by seasonal variation, environmental variation and genetic variation of *Aquilaria* spp. may also play an important role in agarwood formation (Ng *et al.*, 1997).



Photograph showing cell structure within an *Aquilaria* tree; white areas indicate resin deposits.

Credit: Robert Eschschke, "Join agarwood research program" University of Melbourne and TRP

Not all *Aquilaria* trees produce agarwood, Gibson (1977, cited in Ng *et al.*, 1997) estimating that only approximately 10% of wild *Aquilaria* spp. produce resin. Gianno (1986, cited in La Frankie, 1994) suggested that only one-tenth of mature trees above 20 cm diameter at breast height (dbh) produce agarwood. According to Chakrabarty *et al.* (1994), infected trees produce resin from the age of 20 years onwards, Sadgopal (1960, cited in Soehartono, 1997) suggesting that the best yields are obtained from trees aged 50 years and over. Recent studies undertaken by The Rainforest Project (TRP) in Vietnam have shown that agarwood formation can occur in cultivated trees as young as three years of age, as confirmed by chemical analysis (H. Heuveling van Beek, TRP, *in litt.* to TRAFFIC International, 2 May 2000).

The yield and qualities of the resinous agarwood produced also varies considerably (Hartadi, 1997; Ng *et al.*, 1997; Oetomo, 1995; Wiriadinata, 1995). Research conducted in West Kalimantan, Indonesia, demonstrates that the yield of *Aquilaria* resin does not correspond with tree diameter or timber volume, even when trees have similar indications of infection (Soehartono and Mardiasuti, 1997). Gianno (1986, cited in La Frankie, 1994) suggested that those trees above 20 cm dbh that produced agarwood provided approximately one kilogramme of agarwood per tree.

Harvesting

Agarwood is extracted from trees by felling and splitting them to reveal the resinous product. The roots of *Aquilaria* trees may also contain resin and if so are also harvested for trade. As noted above, only a relatively small percentage of *Aquilaria* trees are likely to produce agarwood. Dying trees are thought especially likely to contain agarwood, indications that trees are dying including yellowish leaves, leafless branches with swollen spots along the branch and trunk and very dry bark.

Although infected trees apparently exhibit certain of the symptoms outlined above, it is not possible to identify agarwood-producing trees in a reliable manner by visual inspection. Consequently, numerous uninfected *Aquilaria* trees are felled in the search for those containing agarwood (Hartadi, 1997; Lambert, 1992, cited in Anon., 1994; Ng *et al.*, 1997; Oldfield *et al.*, 1998). In some cases, this may also reflect the belief that trees may become infected once felled.

Additionally, according to Heuveling van Beek (TRP, *in litt.* to TRAFFIC International, 2 May 2000) many trees produce very small amounts of low-grade agarwood that is difficult to detect if the harvester is searching only for high-grade dense deposits.

Dayak communities in Indonesia believe that dying seedlings and saplings (indicated by yellowish leaves) testify to infection of the mother tree. They appear to be able to identify infected trees by differentiating between the sound made by knocking on infected trunks and the sound made by knocking on non-infected trunks (Soehartono and Mardiasuti, 1997).