THE GROWTH PERFORMANCE OF PLANTATION GROWN *AQUILARIA MALACCENSIS* IN PENINSULAR MALAYSIA

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Aquilaria malaccensis Lamk., a member of the Thymelaceae family, is known to produce pathologically diseased fragrant wood known as eagle or aloes wood and in Malay as 'gaharu' (Desch 1954). The species commonly occurred in the lowland forests of Malaysia, India, Myanmar, Sumatra, Borneo Islands and the Philippines (Corner 1940). It is a medium-sized tree reaching about 30 m high with trunk of old trees fluted at the base. The bark is usually dark to pale grey, smooth, entire, becoming finely and irregularly fissured; the innerbark cream-white, soft, striping in long pieces and glabrous. The wood is light-coloured, soft, light and usually shows no distinction in colour between sapwood and heartwood (Desch 1954). Although the timber (known as karas) is very light, it is suitable for making packing boxes, indoor light construction, veneers and traditionally used in native medicine for treating asthma (Burkill 1966, Whitmore 1972, Wong 1978).

A 0.9-ha research plot of *A. malaccensis* was established in 1928 at the Bukit Lagong Forest Reserve, Selangor, Peninsular Malaysia, located at 3° 14' N and 101° 38' E. Mean daily temperatures range from 27 to 32° C. The annual rainfall is between 2000 and 2900 mm. Aspects are southerly and westerly. The soil is light reddish loam, shallow with underlying rock and granite. The drainage system is good. In the planting trial, 750 seedlings were line planted at a spacing of 2 × 6 m (833 seedlings ha^{-1}).

The area was initially covered with secondary forests (belukar) prior to establishment. However, no details of the type of belukar are available. Line cleaning and cutting of belukar and palms were carried out for the first three years at every three-month intervals after which the plot was left unattended.

Quantitative characteristics including total tree height, diameter at breast height and clear bole height were measured in 1995 on the 28 available standing trees. From these data, the height curve was determined for the plot using the method of least squares.

The model used was $h = a + b \times \log d$ (Curtis 1967).

where; a and b are constants,
           d is the diameter at breast height (cm); and
           h is the total tree height (m)

From the height curve, the following mean heights were calculated: mean stand height (hg) and mean clear bole height (hc). The basal area was calculated for each tree (gi), the basal area per ha (G) was obtained by totalling the individual values and converting the result into a per ha value. Since no volume table was available, the tree volume (clear bole) was determined using an assumed reduction factor of 0.7 for taper (Table 1).

Table 1. Standing stock of *Aquilaria malaccensis* at Bukit Lagong, Forest Reserve, Selangor, Peninsular Malaysia (ha-values)

Age	N (ha)	hg (m)	hc (m)	dg (cm)	G (m^2 ha^{-1})	V (m^3 ha^{-1})
67	28	26.7	15.7	38.1	3.2	34.8

Note: N = number of trees ha^{-1} hg = mean height of the stand
            G = basal area ha^{-1} dg = mean diameter of the stand
            V = volume ha^{-1} hc = clear bole height

The stand was initially planted at a density of 833 trees ha^{-1}. As a result of competition among the trees and mortality, the density declined to 31 trees ha^{-1} in 67 years. The overall mean diameter (dg) was 38.2 cm with mean height of 26.7 m. The mean clear bole height was 15.7 m. The approximate standing volume (clear bole volume) was 34.8 m^3 ha^{-1}.

Figure 1 shows the diameter distribution of the 67-y-old *A. malaccensis* stand. The diameter range of 17.8 - 55.9 cm was extremely wide, with a difference of 38.1 cm.
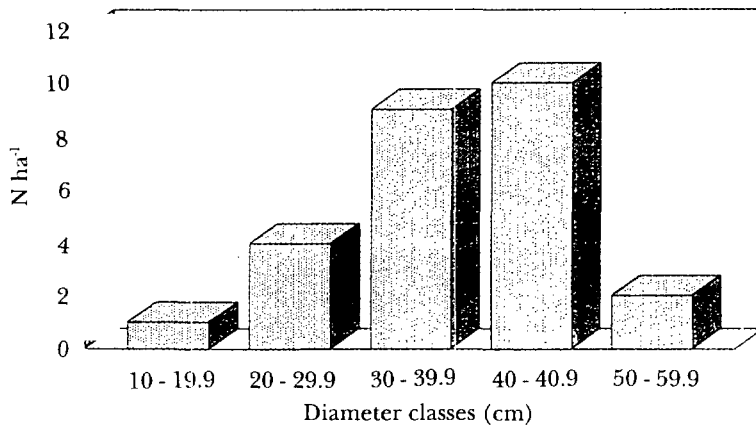
Figure 1. Diameter-classes distribution of *Aquilaria malaccensis* at Bukit Lagong F.R. Selangor

Aquilaria malaccensis can be planted as bare-rooted plants and rooted seedlings. The species can be line-planted and will survive with upward growth in the presence of strong lateral shade. The large diameter and height ranges of the stand are the single most disadvantaged feature of the stand. The results have to be judged with caution since they were obtained from unreplicated small plantation plots, which were designed as probing trials and not as formal experiment.

The potential of the species in plantation seems to be promising. However, before the species can be planted on a large-scale, the factors that contribute to the distinct differentiation in tree size and whether they are common features of even-aged stands must be determined. A tree selection programme is needed to achieve a more homogeneous growth performance within the planted populations.

Acknowledgement

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