SAWING AND MACHINING PROPERTIES OF PLANTED FALCATARIA MOLUCCANA IN SARAWAK

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ABSTRACT

Falcataria moluccana or locally known as Batai is now widely planted in Sarawak as an alternative source of material for wood based industries. These plantation logs are of fast grown, small diameter with high growth stress and high variability that would affect the sawn timber quality. As such, sawing efficiency and machining properties for juvenile plantation logs need to be conducted. This paper describes the assessment approach on 10-year-old planted Batai for sawing volumetric recovery, quality yield and grades of sawn timber. It also examines the various machining characteristics, namely: planing, sanding, boring, mortising, shaping and turning. Specimens were prepared and tested according to the ITTO harmonized Testing Methods for Plantation Grown Tropical Timbers and ASTM D-1666 87 Standard Test Methods for Conducting Machining Tests of Wood and Wood-Base Materials. The study showed that Batai has achieved 32% recovery rate by using Modified Cant sawing pattern. The sawn timber quality of Batai was graded at 77% ‘Standard’ and ‘Serviceable’ based on the Malaysian Grading Rules. Wood machining properties were graded as ‘Easy’ to work, with ‘Fair’ to ‘Excellent’ grades by visual grading.

Keywords: Batai, sawing, machining, wood quality, utilizations.

INTRODUCTION

Sarawak State Government has embarked on planting both exotic and indigenous tree species through smart partnership with the private sector since 1980s and alienated a net plantable area of 2.89 million hectares for forest plantations in Sarawak. To achieve this, the State Government enacted the Forest (Planted Forests) Rules, 1997 gazetted on 23rd January 1997 and targeted to establish one million hectares of planted forest by the year 2020. This intention is to reduce the extraction of timber from natural forests and replace it with targeted 150m³ logs per hectare and 15-20 million m³ timber per annum to be produced by planted forests for the timber industry. To date, 43 Licenses for Planted Forests (LPFs) have been issued and as of December 2017, only 408,000 hectares of plantation forests have been established with its composition comprised of Acacia spp. (69%), Batai (13%), Eucalyptus (7%), and Kelampayan (6%).

Batai is one of the major indigenous fast-growing timber species used by plantation programs which accounted for an about 13% of the total planted forest areas in Sarawak. As industrial forestry is gaining more attention as an alternative source of raw materials for the wood-based industries in many nations nowadays, sawing efficiency and machining properties have become essential, especially when dealing with plantation logs which are fast growing with small diameter, high growth stress and high variability that would affect the sawn timber quality due to their juvenile growth phase.

Over the years, sawing efficiency has become more a function of processing or machine innovation than of timber properties. In the light of growing national interest and desire to develop industrial forest amongst the tropical countries, it is pertinent to evaluate potential plantation species before planting decisions are made. The evaluation of sawmilling and machining properties is an essential and decisive part of the required evaluation. Machining operations are the common practices for commercial secondary wood processing industries. Wood utilization aspect is influenced by quality of the machining operations. Information concerning the sawing and machining of planted juvenile Batai is still lacking.

OBJECTIVES

The objectives of this study are:

i. to assess 10-year-old planted Batai for sawing volumetric recovery, quality yield and grades of sawn timber;
ii. to examine the various machining characteristics, namely: planing, sanding, boring, mortising, shaping and turning.

METHODOLOGY

Tree stems of 10 years old Batai were collected from a plantation site located at Bintulu, Sarawak. The trees represent the age group population selected from the site and are made up of an entire range of merchantable diameters available. They were marked before they were felled such that relevant information including tree/ identification number, total merchantable tree...
height, height at first branch, diameter at breast height (DBH) and tree vigour were recorded. The logs were processed within one month after harvesting.

The study was conducted at Timber Technology Centre, Sarawak Forestry Corporation Sdn Bhd, Kuching Sarawak. All the testing procedures were carried out in accordance with the methodologies as stipulated in the ITTO harmonized Testing Methods for Plantation Grown Tropical Timbers (Wong et al., 2010) and ASTM D-1666 87 (Reapproved 1999). Standard Test Methods for Conducting Machining Tests of Wood and Wood-Base Materials.

After debarking, 30 logs with breast height diameter at least 15cm meant for sawing yield test were cut to 3 meters length. Modified Cant Sawing pattern (Figure 1) was applied in this study. The target sizes were 50mm T x 150mm W, 50mm T x 125mm W, 50mm T x 100mm W, 25mm T x 150mm W, 25mm T x 125mm W and 25mm T x 100mm W. Assignment of grade by means of visual grading based on Malaysian Grading Rules after the sawing yield test. For the machining study, fifty (50) specimens for each of the six tests, i.e. planing, sanding, boring mortising, shaping and turning were prepared (Figure 2).

Figure 1: Modified Cant sawing pattern

Figure 2: Specimen sizes for various machining tests
The mean recovery (volumetric yield) of Batai is 32%. Mean density of the specimens tested is 230-450kg/m³ at 18% moisture content. Occurrence of severe end splitting of slabs after sawing was observed. This was attributed to release of internal stresses brought about by fast growth rates. Batai produced equivalent yields as well-established plantation species like Rubberwood (*Hevea brasiliensis*) that had been reported to have average recovery of 32% (Gan et. al., 1985).

The sawn-timber grades obtained for Batai in this study were better than expected given the occurrence of end-splits. The sawn timber quality of Batai was graded at 77% ‘Standard’ and ‘Serviceable’ based on the Malaysian Grading Rules as shown in Figure 3 below.

![Figure 3: Sawn Timber MGR Grades](image)

Table 1 showed the wood machining properties of Batai in relation with ease of machining and surface quality. Ratings were carried out by visual grading.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Ease of Machining</th>
<th>Surface Quality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planing</td>
<td>Easy</td>
<td>Good to Excellent (73)</td>
</tr>
<tr>
<td>Sanding</td>
<td>Easy</td>
<td>Good to Excellent (100)</td>
</tr>
<tr>
<td>Boring</td>
<td>Easy</td>
<td>Good to Excellent (57), Fair (18)</td>
</tr>
<tr>
<td>Mortising</td>
<td>Easy</td>
<td>Good to Excellent (48), Fair (26)</td>
</tr>
<tr>
<td>Shaping</td>
<td>Easy</td>
<td>Good to Excellent (87)</td>
</tr>
<tr>
<td>Turning</td>
<td>Easy</td>
<td>Fair to Good (63)</td>
</tr>
</tbody>
</table>

i) Planing test
Batai is assessed as easy to plan. Surface quality is graded as Good to Excellent. However, planing defects such as fuzzy grain (Figure 4), chip mark and torn grain (Figure 5) were observed in more than 70% of the specimens tested.
Figure 4. Fuzzy grain from planing test

Figure 5. Torn grain from planing test

ii) Sanding test
Batai is assessed as easy to sand as surface quality from sanding test was consistently graded as Good to Excellent. Sanding defects, namely ‘scratching’ (Figure 6) and ‘fuzzing’ (Figure 7) were observed in more than 50% of the specimens tested.

Figure 6. “Scratching” defect of sanding test

Figure 7. “Fuzzing” defect of sanding test

iii) Boring test
Batai is assessed as easy to bore. The boring property of Batai is graded as Fair to Good. Boring defects such as tear-outs (Figure 8), crushing (Figure 9) and fuzziness are observed in more than 60% of the specimens tested.

Figure 8. Tear-outs from boring test

Figure 9. Crushing from boring test
iv) Mortising test
Batai is assessed as easy to mortise. The mortising property of Batai is graded as Fair to Good. Mortising defects such as crushing (Figure 10) and tearing (Figure 11) are observed in more than 90% of the specimens tested, particularly at the corners of the mortise.

![Figure 10. Crushing from mortising test](image1)
![Figure 11. Tearing from mortising test](image2)

v) Shaping test
Batai is assessed as easy to shape. Batai has Good to Excellent shaping properties. Fuzzy grain (Figure 12) as shaping defect is observed (for side grain cut) in more than 50% of the specimens tested. Rough-end grain (Figure 13) and chipped grain as shaping defects are also observed (for end grain cut) in more than 60% of the specimens tested.

![Figure 12. Fuzzy grain as shaping defect](image3)
![Figure 13. Rough-end grain as shaping defect](image4)

vi) Turning test
Batai is assessed as easy to turn. The turning property of Batai is graded as Fair to Good. Turning defects of fuzzy grain (Figure 14) and torn grain (Figure 15) are observed in more than 80% of the specimens tested.

![Figure 14. Turning defect of fuzzy grain](image5)
![Figure 15. Turning defect of torn grain](image6)
CONCLUSION
Batai is a good plantation species in terms of sawing recovery and certain machining properties provided with further study on upstream research particularly genetic improvement to overcome or reduce the end splitting issue. Sawing test indicates that Batai timber species is highly reliable working material. It is also inferred that Batai timber is suitable for the purpose of solid timber utilizations such as furniture and furniture parts, wall panelling, joinery products, toys and wooden frame.

REFERENCES