Growth, Node Development and Estimated Yield of Calamus manan Planted under a Rubber Smallholding

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Key words: Stem length growth, node development, estimated yield.

ABSTRACT

Studies on growth, node development and estimated yield were conducted on Rotan manau (Calamus manan) planted under stands of rubber (Hevea brasiliensis) at Dengkil, Selangor. Survival in the 8th year was 74.8%. Mean stem length varied with those plants at the lower slope doing very well, (14.21 m) compared with the mean stem length for the whole plot (9.98 m). The relationship between the intemode number (X) and the total stem length and the length of stem that is dried can be obtained using a regression method. A few equations were produced through this method. Studies on the intemode diameter and projected yield were also carried out, but more observations are required for more precise results. Negative effects of rattan were not evident on the rubber trees. In establishing a rattan plantation under rubber, it is advisable that the planting distance be widened. The fronds of rattan need to be cut to allow better passage during tapping.

INTRODUCTION

Rotan manau (Calamus manan) is a spiny climbing palm with a large diameter (> 18 mm) cane and is the most sought after species for the rattan furniture industry (Salleh and Aminuddin 1986). Manau has been planted extensively in the Dipterocarp forests of Peninsular Malaysia by various state forest departments. Besides manau, other species of rattan are also found naturally or planted under rubber (Hevea brasiliensis) trees. The area of rubber smallholdings planted with rattan in Peninsular Malaysia has risen from 210 ha (211 smallholdings) in 1987 to 263.8 ha (219 smallholdings) in 1988 and to 517.7 (439 smallholdings) in 1989 (RISDA). These figures do not include three large scale plantations in Negeri Sembilan and Pahang. A rubber plantation of about 100 ha at Felda Serting Hilir 3, near Bahau, was planted with manau in 1986 (Nur Supardi 1988). The planting was a joint effort between the Federal Land Development Authority (FELDA) and the Forest Research Institute Malaysia (FRIM). Another 28.3 ha of rubber plantation at Sungai Munthoh, Kuala Klawang belonging to the Persatuan Peladang Jelebu (Farmers’ Organisation of Jelebu) was also planted with manau in October 1988. A private company, Syarikat Kurnia Setia, planted 237 hectares of a rubber plantation with rattan from 1986 to 1990 at Kampong Bongsu, Lanchang in Pahang.

The first recorded planting of manau under rubber is at Kampung Bukit Tampoi, Dengkil, Selangor (Aminuddin and Nur Supardi, 1986).
The growth rate after three years was found to be encouraging compared with figures obtained from trials in forest areas. This experimental plot of 1.4 ha is being monitored by the Rattan Silviculture unit of the Forest Research Institute Malaysia (FRIM). This paper reports the outcome of measurements and observations carried out over a period of eight years in the plot.

MATERIALS AND METHODS
The plot of 1.4 ha consists of rubber trees which were planted in 1967. Rattan seedlings were planted in between rubber rows in December 1980. Both the rubber trees and rattan were planted at a distance of 6 m x 3 m. The lower slope of the plot has richer soil nutrient and sparse undergrowth. It is bordered by a small patch of abandoned rubber trees through which passes a small stream. The middle and upper slopes have lateritic soils and more undergrowth. The east side bordering the area was opened a year after rattan planting. The southern and eastern borders were cleared for replanting two and four years respectively after the rattans were introduced. Details of the plot establishment were reported by Aminuddin and Nur Supardi (1986). Measurements on the stem length (root collar to the base of the petiole of the upper-most leaf) were carried out every year, except in the 4th year. In the 7th year, the length of each internode was measured. First, the internodes were measured using a measuring tape, and then those internodes beyond reach were measured using a measuring pole with digital reading. The measuring pole could reach up to 8.20 m in height. The number of internodes above this height were counted.

Diameter of exposed stems, i.e the lower part of the rattan where the leaf sheath had dropped off, was measured. The diameter was measured at mid-region of each internode using calipers. The diameter at 10 cm, 20 cm, 30 cm and 100 cm from the root collar were also recorded. The length of dried parts (i.e exposed stem or stem covered with dried leaf sheaths) were also measured. In the 8th year, only the stem length and the number of internodes were recorded.

Data collected were used to compare the growth and to estimate the yield of manau obtainable from the plot. The relationship between stem length, length of dried parts, internode number and stem diameter were also analysed.

RESULTS AND DISCUSSION
Survival
The percentage survival was 74.8% in the eight year (Table 1). Mortality was observed to be high only in the first three years. Mortality in the following years was observed to come from unhealthy and poor plants in the upper slope. This could be due to the lateritic soil type available in the upper slope and the drastic changes in micro climate resulting from the opening of bordering areas of the upper slope during the earlier stage of growth.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>LO</th>
<th>2.0</th>
<th>3.0</th>
<th>4.0</th>
<th>4.8</th>
<th>5.5</th>
<th>7.2</th>
<th>8.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survival (%)</td>
<td>94.4</td>
<td>89.4</td>
<td>80.6</td>
<td>77.4</td>
<td>76.3</td>
<td>76.3</td>
<td>74.8</td>
<td></td>
</tr>
</tbody>
</table>

Stem length
The mean stem length for the lower, middle and upper slopes of the plot is shown in Table 2. The mean stem length increased slowly in the first 5.5 years. In the subsequent 1.7 years, there was a great

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Lower slopes</th>
<th>Middle slope</th>
<th>Upper slope</th>
<th>Whole plots</th>
<th>Range for whole plot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>0.15 ± 0.04</td>
<td>0.16 ± 0.04</td>
<td>0.13 ± 0.03</td>
<td>0.14 ± 0.04</td>
<td>r-0.22</td>
</tr>
<tr>
<td>2.0</td>
<td>0.27 ± 0.13</td>
<td>0.21 ± 0.08</td>
<td>0.14 ± 0.03</td>
<td>0.21 ± 0.10</td>
<td>r-0.27</td>
</tr>
<tr>
<td>3.0</td>
<td>0.83 ± 0.38</td>
<td>0.48 ± 0.20</td>
<td>0.19 ± 0.06</td>
<td>0.45 ± 0.30</td>
<td>0.57-22.1</td>
</tr>
<tr>
<td>4.8</td>
<td>1.80 ± 1.29</td>
<td>1.29 ± 0.82</td>
<td>0.41 ± 0.22</td>
<td>1.17 ± 0.78</td>
<td>0.14-5.10</td>
</tr>
<tr>
<td>5.5</td>
<td>2.78 ± 2.04</td>
<td>1.92 ± 1.24</td>
<td>0.50 ± 0.33</td>
<td>1.53 ± 1.20</td>
<td>0.15-7.60</td>
</tr>
<tr>
<td>7.2</td>
<td>11.07 ± 3.89</td>
<td>5.74 ± 3.14</td>
<td>1.01 ± 1.01</td>
<td>6.83 ± 5.04</td>
<td>0.23-18.6</td>
</tr>
<tr>
<td>8.2</td>
<td>14.21 ± 4.21</td>
<td>9.65 ± 4.52</td>
<td>2.10 ± 1.35</td>
<td>9.98 ± 5.99</td>
<td>0.57-22.1</td>
</tr>
</tbody>
</table>

(Note: V represents seedlings with no stem length or in the rosette stage)
increase in stem length. On the lower slope where the conditions were more favourable, there was an increase of almost 4 times. It was observed that the growth rate increased considerably when rattans were able to obtain support from rubber branches and twigs. Vigorous growth occurred when the younger leaves of manau were halfway in the rubber canopy.

In the third year, all the manau seedlings were below 1.52 m. In the 5th, 6th, 7th and 8th year, these plants below 1.5 m were 71.8%, 60.5%, 23.5% and 11.4% respectively. The percentage distribution of surviving plants according to stem length classes is shown in Table 3.

### TABLES

The percentage distribution of stem length classes for rotan manau in a rubber plantation

<table>
<thead>
<tr>
<th>Stem Length Classes (m)</th>
<th>Age (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.50</td>
<td>4.8 5.5 7.2 8.2</td>
</tr>
<tr>
<td>1.51-3.00</td>
<td>71.8 20.0 23.5 7.5 7.6</td>
</tr>
<tr>
<td>3.01-6.00</td>
<td>8.2 13.6 15.0 12.3</td>
</tr>
<tr>
<td>6.01-9.00</td>
<td>- 2.4 15.0 11.4</td>
</tr>
<tr>
<td>9.01-12.00</td>
<td>- - 17.9 13.3</td>
</tr>
<tr>
<td>12.01-15.00</td>
<td>- - 15.0 17.1</td>
</tr>
<tr>
<td>15.01-18.00</td>
<td>- - 4.7 17.1</td>
</tr>
<tr>
<td>18.01-21.00</td>
<td>- - 0.9 6.6</td>
</tr>
<tr>
<td>&gt;21.01</td>
<td>- - - 0.9</td>
</tr>
</tbody>
</table>

Node Development

As observations on the number of nodes was carried out only in the last two census, no conclusions could be drawn on node production during the early stages of development. The average number of nodes produced at age 7.2 and 8.2 was 40.1/year (range: 7 to 91) and 55.1/year (range: 11 to 109), respectively. This gives an average of 5.57 nodes and 6.72 nodes produced over the two years of data recording, indicating that the rate of leaves produced increases with time.

The total stem length of manau could be determined for different age periods using regression technique. The regression equations are as follows:

**Age 7.2 years:**

\[ Y = -1.644930 + 0.2129709 \times X \quad (R = 0.9840) \]

**Age 8.2 years:**

\[ Y = -1.680985 + 0.2125395 \times X \quad (R = 0.9853) \]

(Note: Y = Stem Length (m); X = No. of Internodes; R = correlation coefficient)

There was a strong positive correlation between stem length and the number of internodes in both ages. By using T-test as comparison, no significant differences were observed between the correlations at ages 7.2 and 8.2 years. The data of stem length and number of internodes for the different ages were combined and the following equation was derived:

**Both ages:**

\[ Y = -1.648476 + 0.2124169 \times X \quad (R = 0.9859) \]

Note:

This equation can be used to determine the stem length of manau. However, the values for the first ten internodes close to the base are not reliable and should not be used. During the initial growth of manau or rattan generally, leaves are produced at a closer distance, and the basal internodes are thus shorter.

The mean stem diameter at 10 cm, 20 cm, 30 cm and 100 cm from the root collar were 34.7 mm, 28.0 mm, 24.7 mm and 22.9 mm, respectively. No linear relationship was observed between diameter and stem lengths. Only 40 plants were used in the analysis. Further investigation with more plants should be carried out to determine the correlation between these parameters. If the growth of manau in terms of stem length could be determined by stem diameter, plants of superior genotype can be easily determined.

Estimated Yield

The mean length of dried parts at age 7.2 and 8.2 years was 3.35 m (range: 0.78 m - 7.70 m) and 4.59 m (range: 0.60 m - 13.30 m). The length of dried parts is considered mature and is usable in furniture making. However, from preliminary analysis, it was learnt that the part above this length can also be used (Abdul Latif Mohmod pers. comm). Research on the length of usable parts is still being conducted at FRIM. In practice, rattan collectors only collect canes which have "hard" outer skin (epidermis), irrespective of whether their leaf sheaths are dried or still green.

Uncollected parts have epidermis of whitish or lighter creamy yellow that could easily be peeled off or cut through by a knife. A study by Nur Supardi and Wan Razali Mohd (1989) showed that matured part of manau could be determined by the equation:

\[ Y = -1.12567 + 0.4239466 \times X_2 - 1.439984 + 0.08904229 \times X \]

(where \( Y \) = estimated length of matured cane in meters; \( X_1 \) = total length of rattan in meters; and \( X_2 \) = the number of inter-
nodes). In the study, the length of dried parts was taken as the estimated length of matured cane. The estimated values were actually underestimated figures for matured cane as it is believed that the matured cane covers not only the dried parts but also where leaf sheaths are still green or slightly yellow.

The conservative values of matured cane for the plot at Dengkil could be derived from the following regression equations:

**Age 7.2 years**

\[
Y = -0.6154685 + 0.2779506 \times X_1 \\
(R = 0.7847)
\]

\[
Y = 0.07927656 + 0.06385926 \times X_2 \\
(R = 0.8101)
\]

**Age 8.2 years**

\[
Y = -0.3178492 + 0.4049428 \times X_1 \\
(R = 0.8309)
\]

\[
Y = -1.346057 + 0.09114832 \times X_2 \\
(R = 0.8436)
\]

Analysis using T-test showed that the length of the dried part varies significantly at the two ages. This means that age plays an important role in maturity of the cane. This also means that the plants are still growing actively at this stage.

Using equations (i) and (ii), the estimated yield of the plot at age 7.2 and 8.2 years are shown in Table 4. It is assumed that the usable parts is 1.5 times the length of the dried parts. The average price of raw (green) ranon manau is $1.00/m.

From the data collected, the total dried parts and usable parts at age 8.2 is 1543.80 m/ha and 2315.70 m/ha, respectively.

### Effect of Rattan on Rubber Trees

Most of the rattans were found to hang on a tree or a couple of trees for support. Each rubber tree was observed to support at most two rattans. Through out the area, only one rubber tree was observed to support four manau plants. The occurrence was due to the absence of available trees for support in the immediate vicinity, resulting in the four manau clinging onto the single tree. On the lower slopes, where growth is very good, the presence of rattan was observed to cause problems of access along the planting rows of rubber. However, this could be overcome if the lower fronds of mature rattans are cut. Dried leaf sheaths could also be peeled to prevent discomfort to rubber tappers.

A wider planting distance of rattan could also be used to allow more space for passage. The planting distance of rattan will, however, depend on the spacing of rubber trees and the crown area of rattan. The crown area of manau growing under rubber was observed to range from 4 m² (when it climbs through dense branches of rubber) to 16 m² (when it is on top of the tree canopy). Normally, the crown area is 9 m² (3 x 3 in). If the distance between rubber rows are 6m or less, as at Dengkil, rattan should be planted in every alternate rubber row and planted at a closer distance within the planting rows (e.g 2 m). If the rows of rubber are spaced wider, rattan should be planted in all the inter-rows.

Except for a few fallen dried twigs, no branch was observed to break due to the weight of manau. The weight of an average diameter size manau of 15m stem length (inclusive of leaf sheaths and leaves) was calculated to be in the average of 2 kg/m. This weight force is spread out to the many twigs and branches.

It could not be said if the presence of rattan affected latex production of the rubber trees. A study at Felda Serting Hilir 3 is still in progress to study the effect on latex production.

### Effect of Rubber on Rattan

Growth performance of manau seemed not to be affected by rubber. The growth of manau under rubber is however, better than those planted in the forest, particularly in the early growth stages, as

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**TABLE 4**

The estimated yield and gross income from rattan from a rubber smallholding at Dengkil, Selangor.

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Plants per. ha</th>
<th>Dried parts (m/plant)</th>
<th>Usable parts (m/plant)</th>
<th>Estimated yield (m/ha)</th>
<th>.Estimated Gross Income (e)-(d)*M$l</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2</td>
<td>423</td>
<td>2.51</td>
<td>3.76</td>
<td>1590.48</td>
<td>M$1,590.48</td>
</tr>
<tr>
<td>8.2</td>
<td>415</td>
<td>3.72</td>
<td>5.58</td>
<td>2315.70</td>
<td>M$2,315.70</td>
</tr>
</tbody>
</table>
GROWTH, NODE DEVELOPMENT AND ESTIMATED YIELD OF CALAMUS MANAN

TABLES
Stem length (m) growth of *calamus manan* up to age 3 years after planting

<table>
<thead>
<tr>
<th>Locations</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dengkil (lower slope)</td>
<td>0.15 10.04</td>
<td>0.27 ±0.13</td>
<td>0.83 ±0.38</td>
</tr>
<tr>
<td>Sg.Buloh FR (All treatments)</td>
<td>0.16 ±0.05</td>
<td>0.32 ±0.11</td>
<td>0.58 ±0.30</td>
</tr>
<tr>
<td>Bkt.LagongFR (Field 41)</td>
<td>0.07 ±0.05</td>
<td>0.20 ±0.10</td>
<td>0.29 ±0.21</td>
</tr>
</tbody>
</table>

shown in Table 5. This is attributed to the ideal light and vegetation conditions of the site for the growth of manau. The rubber trees are, however, too old when the rattans were planted. Old rubber trees do not have low branches which are important for support during the initial stage of climbing of the rattans.

The age of rubber trees also plays a part in the growth performance of manau. Two advantages of planting rattan in a younger rubber plantations are (i) there is more light penetration for good growth and (ii) low lying branches of young rubber trees can provide a place for the cirri of manau to hook themselves to.

CONCLUSIONS AND RECOMENDATIONS
From the studies, the stem length (XI) could be determined by the number of internodes (X2) using the formula $XI = -1.648476 + 0.2124169 \times X2$. The length of dried parts (Y), that is a portion of the usable parts of rattan could be derived from the formula $Y = -0.3178492 + 0.4049428 \times XI$.

In terms of growth, manau can perform well when planted under rubber plantations. The provision for spacing should take into consideration the clear passage for rubber tappers and the effect on rubber trees. There is a need for more studies on the effect of rattan on latex production and yields of rattan obtainable from the plantation. The minimum maintenance requirements needed by the rattan plant must be provided for.

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