LEAF AREA STUDIES ON FOUR VARIETIES OF CASSAVA WITH DIFFERENT LEAF FORMS AND BRANCHING HABITS AND THEIR RELATIONS WITH YIELD

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Keywords: Cassava, Leaf area index, Leaf form, Branching habit, Yield.

INTRODUCTION

Cassava varieties are known to differ considerably in their leaf area and yield (SINHA and NAIR, 1971). Root yield is determined by the total production of dry matter and its distribution, while the total dry matter is mainly determined by LAI, and its distribution appears to be governed by a preference for top or root growth (COCK et al., 1979). Thus, one of the major factors determining the yield of cassava is LAI.

Local cassava clones show variation in plant type, and in this experiment four varieties of cassava with different leaf forms and branching habits were studied. Black Twig, a high yielder and a variety with wide adaptability, was used for comparison with the other three varieties.

MATERIALS AND METHODS

Four varieties of cassava, viz. Black Twig unbranched, normal leaf lobe; Melaka branched, normal leaf lobe; Peranchis unbranched, narrow leaf lobe; and Buluh branched, narrow leaf lobe, were planted on clayey loam soil at the farm of MARDI's headquarters in Serdang, Selangor on the fifth and sixth of March, 1980. Length of cutting and planting distance were 20 cm and 1 m x 1 m, respectively. The plants were harvested at monthly intervals starting at two months after planting till 12 months. For this purpose there were four replications with 11 plots per variety, consisting of eight plants per plot for each harvest. Fertilizer application was carried out at planting using a straight NPK fertilizer at a rate of 60:30:110 kg/ha. At each harvest, data on total leaf fresh weight, leaf dry weight, branches and suckers were recorded. Primary and secondary branches indicate the branches associated with the first and second inflorescences, and suckers indicate other lateral branches on the main stem. Root number, total root fresh weight and dry weight were also recorded.

Leaf area was determined by using a sample of 40 leaves for each variety at each harvest, and determining the area minus the petiole by using a leaf area meter model Li-cor 3100. An equation of the relationship between the area of 40 leaves (cm²) and their fresh weight (g) was established for each variety: in Black Twig, y = 3975.00 + 22.85 x, in Melaka, y = 3360.19 + 25.46 x, in Peranchis, y = 3447.86 + 18.12 x, and in Buluh, y = 3215.65 + 29.11 x. Subsequently, total leaf area was calculated from total fresh weight of leaves per plot. Total dry weight of roots was calculated from a sample of two kg fresh weight of roots oven-dried at 70°C till constant weight.

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Leaf life was measured at three-and-a-half months and seven months after planting by tagging a fully expanded leaf and recording the date when it fell. The trial was clean — weeded for the first three months by using fluometuron (2.0 kg/ha) and alachlor (2 l/ha) as a preemergence herbicide mixture, followed by two rounds of manual weeding.

RESULTS AND DISCUSSION

Leaf area indices (LAI's) for all the varieties irrespective of leaf lobe and branching habit increased rapidly from two months after planting. This follows the normal plant growth pattern. Melaka reached maximum LAI at four months and the rest by the fifth month (Figure 1). After reaching maximum LAI, there was gradual drop till the eight month, followed by a slight increase at the ninth month and subsequently a further drop up to the 12th month. This slight increase in LAI's could be due to the availability of moisture in the form of rainfall in the latter part of the season (Figure 2). Black Twig with normal leaf lobe and unbranched habit (Figures 3a, 3b and 4) attained the highest LAI of 3.7 at the fifth month, and Buluh, branched with narrow lobed leaf, an LAI of 3.3. The lowest LAI of 2.0 was that of Peranchis with narrow lobe and unbranched habit which means fewer total leaves per plant. Work at CIAT had indicated that optimum LAI for cassava root yield is about 3.0 – 3.5 (ANON, 1979). In this experiment, although Buluh retained an LAI of more than 3.0 for more than two months, its root yield is the lowest (Figure 5); whereas Black Twig having a higher LAI but for a shorter period gave the highest yield.

![Graph](image_url)
Figure 2: Rainfall pattern during a leaf area study on four varieties of cassava with different leaf forms and branching habits over time of harvest.

Figure 3a: Number of primary branches and suckers per plant (PBS) during a leaf area study on four varieties of cassava (Melaka and Black Twig) with different leaf forms and branching habits over time of harvest.
Figure 3b: Number of primary branches and suckers per plant (PBS) during a leaf area study on four varieties of cassava (Buluh and Peranchis) with different leaf forms and branching habits over time of harvest.

Figure 4: Number of secondary branches per plant (SB) during a leaf area study on four varieties of cassava with different leaf forms and branching habits over time of harvest.

Peranchis: \[ PBS = 4.1909 \left(1-e^{-0.57x}\right) \]
Buluh: \[ PBS = 35.8509 \left(1-e^{-0.03x}\right) \]
Black Twig: \[ SB = 0.08679 \left(1-e^{-0.03x}\right) \]
Melaka: \[ SB = 37.44253 \left(1-e^{-0.03x}\right) \]
Peranchis: \[ SB = 13.50009 \left(1-e^{-0.009x}\right) \]
Buluh: not available
This could be due to several factors. Even though their leaf sizes were similar for the first five months (Figures 6a and 6b), thereafter Buluh's leaf size was significantly smaller than Black Twig. At the same time, LAI for Buluh dropped almost linearly from the fifth month till the eighth month whereas Black Twig’s LAI showed the most gradual drop even when compared to Peranchis or Melaka. Buluh’s LAI reached 3.0 almost a month earlier than Black Twig but this was attained by having a number of branches (Figures 3a, 3b and 4) which by increasing the number of apices and leaves was at the expense of root growth (Figure 5).

In terms of leaf life, Black Twig at both tagging times had the longest leaf life (Table I). At three-and-a-half months of age, Black Twig had the longest leaf life of 65 days while Buluh had the shortest of 44 days. At seven months of age, Black Twig’s leaf life was 41 days and Melaka had the shortest of 17 days, while Buluh’s was 21 days.

Cassava root thickening commences after two months of growth, and root bulking increases with time (WHOLEY and COCK, 1971). In this experiment, Buluh and Melaka had greater number of thickened roots by the second and third months as compared to Peranchis and Black Twig (Figures 7a and 7b). Even with similar average number of thickened roots over harvests for the varieties tested, their root yields were still low. This was probably due to the rate of bulking of the storage roots (Figure 5). In Black Twig, root bulking commenced a month later than the other varieties but the rate of bulking was faster, followed by Melaka, Peranchis and Buluh, and subsequently its yield was higher when compared to the other varieties. Although Melaka was branched and considered a variety with normal leaf lobe, its LAI was below the optimum for root bulking. This confirms that branching reduces leaf size (TAN, 1980) (Figures 6a and 6b) whereas Black Twig which started off with a similar

\[
\text{Black Twig: } RGR = -456.73 + 148.16x \\
\text{Melaka: } RGR = -198.52 + 97.13 \\
\text{Peranchis: } RGR = -104.96 + 68.12x \\
\text{Buluh: } RGR = -96.27 + 38.87x
\]
Figure 6a: Mean single leaf area (LA) of four varieties of cassava with different leaf forms and branching habits over time of harvest.

Figure 6b: Mean single leaf area (LA) of four varieties of cassava with different leaf forms and branching habits over time of harvest.
TABLE 1: LEAF LIFE (NO. OF DAYS) OF FOUR VARIETIES OF CASSAVA WITH DIFFERENT LEAF FORMS AND BRANCHING HABITS AT 3½ AND 7 MONTHS AFTER PLANTING

<table>
<thead>
<tr>
<th>Age after planting</th>
<th>Black Twig</th>
<th>Melaka</th>
<th>Peranchis</th>
<th>Buluh</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3½ months</td>
<td>65.13a+</td>
<td>49.04b</td>
<td>59.44a</td>
<td>43.94b</td>
<td>4.30</td>
</tr>
<tr>
<td>7 months</td>
<td>41.38a</td>
<td>16.66c</td>
<td>29.19b</td>
<td>21.38c</td>
<td>2.91</td>
</tr>
</tbody>
</table>

+ Numbers with the same alphabet in the same row are not significantly different.

![Graph showing number of roots per plant (NR) over time of harvest for Black Twig and Melaka varieties.](Figure 7a: Number of roots per plant (NR) during a leaf area study on four varieties of cassava with different leaf forms and branching habits over time of harvest.)

In conclusion, it seems that Black Twig is a high yielder compared to the other varieties probably because of its ability to retain a relatively high LAI for a longer period of growth. Combining this ability to its relatively longer leaf life it manages to reduce the turnover of assimilates used up in the production of new vegetative growth. Also, its root bulking rate is faster compared to the other varieties. Thus, more assimilates could be channelled for storage in its roots.
SUMMARY

Four varieties of cassava with different branching habits and leaf forms were studied. Black Twig, unbranched and normal leaf lobes, attained the highest LAI of 3.7, while Peranchis which has also an unbranched habit but narrow lobes had the lowest LAI of 2.0. Branched varieties seem to give the lowest yields, while varieties with reasonably high LAI and longer leaf life gave the highest yield.

REFERENCES


Figure 7b: Number of roots per plant (NR) during a leaf area study on four varieties of cassava with different leaf forms and branching habits over time of harvest.

Accepted for publication on 11th May, 1983.