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Short Communication
Some approaches to reduce tediousness in growth analysis of rubber and banana

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ABSTRACT

Being large in size, growth analysis of rubber and banana demands suitable sub-sampling systems. Also, there are practical difficulties in measuring the area of large banana leaves. In the study conducted to solve above problems, 40 percent in fresh weight of total biomass was identified as the suitable sub-sample size for different plant components of both crops. The area of banana leaves can be successfully estimated from the product of length and maximum width of the leaf with a correction factor of 0.755.

Keywords: Banana, growth analysis, rubber, sample size

Growth analyses, though tedious, are essential in agronomic research. Growth of plants as a whole or with reference to different organs is assessed under different environments. Relative Growth Rate (RGR), Leaf Area Ratio (LAR), Leaf Area Index (LAI) and Net Assimilation Rate (NAR) are some of the commonly used indices in growth analyses. Depending on the requirement, growth studies may be either destructive or non destructive. Most researches prefer to use the latter due to small plot size required in experiments and the possibility of repeated measurements on same plants, but necessity of the former cannot be totally ignored. Perhaps, hi-tech instruments, if available, may facilitate to overcome some difficulties in growth analyses. For instance, digital weighing machines save time in sample weighing. Infrared gas analyzers allow to estimate instantaneous dry matter production of a crop by measuring photosynthesis and respiration with no damage to the plants. In addition, indirect methods, such as empirical or mechanistic models, could be used to estimate dry matter productivity. However, accuracy of indirect estimates need to be tested using direct methods.

Being large in size, growth analysis of rubber and banana plants is not easy. Few, if any, total biomass studies on these crops have been done. Eckstein *et al.* (1995) have conducted above ground biomass studies on banana with ca. 15% sub-samples drawn from different plant components. However, adequacy of that sub-sample size is not known. Moreover, a standard size oven may not be sufficient to conduct whole plant analyses on dry matter of these plants. Therefore, effective sub-sampling systems are required for such a task. Although modern leaf area meters are available for fast and accurate measurements of leaf area, there are practical difficulties to use such instruments for banana since its leaves are too large for these instruments. The aim of this study was to identify suitable sub-sampling sizes to conduct whole plant dry matter analysis of both rubber and banana and to device an indirect method to estimate the area of banana leaves, particularly for indigenous Sri Lankan varieties.

Sub-sampling for dry matter analysis

Since composition of each plant component, *i.e.* leaves, stems, roots etc. of both rubber and banana plants may differ and affect required size of sub-sample, the procedure of selecting suitable sub-sample size was adopted separately for each individual component. The fresh weight of each plant component was measured and then divided into several sub-samples. These were measured for fresh weight and dried to a constant weight in a forced draught oven at 80 °C for more than 12 hours. Fresh and dry weights of the series of sub samples were added one by one to make a series of cumulative fresh and dry weights and proportion of total component weight was calculated. With the fresh and dry weights of cumulative sub-samples and total fresh weight of the component, the total dry weight of the component was estimated (Equation 1) and then its deviation from the actual dry weight determined. The proportion of this deviation from actual (Equation 2), i.e. the error in estimating total component dry weight (Y axis) was plotted against the proportional fresh weight of relevant sample (X axis) as illustrated in Figure 1. Six plants in different sizes each from banana and rubber were harvested for this study.

Equation 1

$$\text{Estimated Dry Wt.} = \frac{\text{Dry Wt. of Subsample}}{\text{Fresh Wt. of Subsample}} \text{ Total Fresh Wt.}$$

Eqiatopn 2

$$\text{Error of Estimation} = \frac{[\text{Estimated Dry Wt.} - \text{Actual Dry Wt.}]}{\text{Actual Dry Wt.}}$$

The deviation of estimates from the actual values (i.e. the error) decreased with the increase in sub-sample size. This decline was more prominent in components of banana than in those of rubber (Fig. 1). This is probably due to greater water content of banana plants, resulting in a greater error in fresh weight measurements due to evaporation during the time lag between separation of plant parts and weighing. However, in general, 40% of the total weight of each component appeared to be sufficient to estimate total dry matter with ca. 5% error. Use of proportions with respect to total biomass avoids the

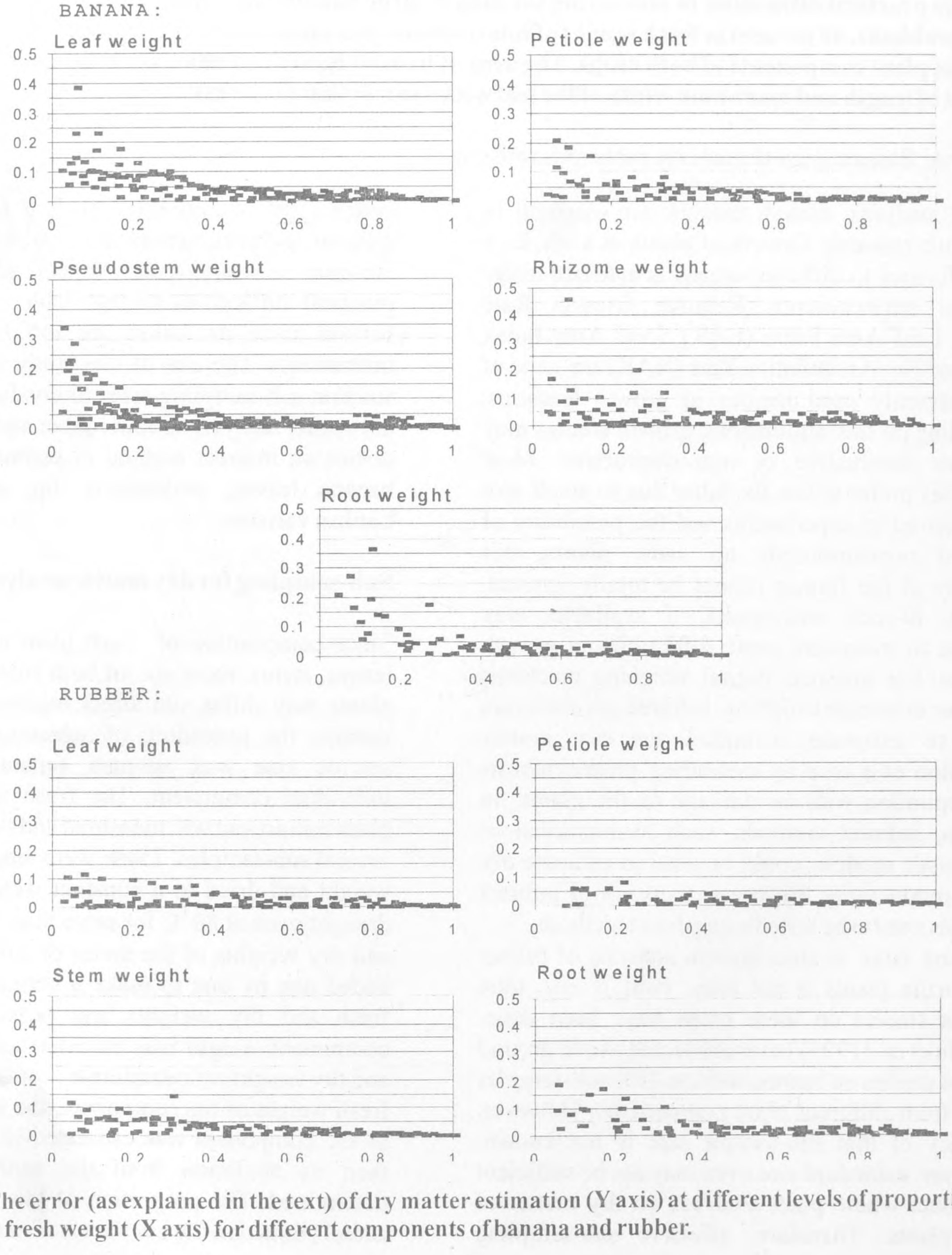

Figure 1. The error (as explained in the text) of dry matter estimation (Y axis) at different levels of proportional fresh weight (X axis) for different components of banana and rubber.

problem of using absolute sample size which shows increase in error in total biomass estimation with increase in component size. However, as observed in two crops and also among the components of each crop, there will be slight deviation of the results of this analysis, if done for different environmental conditions. In general, as rule of thumb, 40% of total fresh weight could be considered as the suitable size for sub-sampling.

Estimation of banana leaf area

Fifty banana leaves (from variety Kolikuttu) were measured for length and maximum width, then split into narrow strips and measured for leaf area (Li-Cor, LI3050A, USA). Leaf area was plotted against the product of leaf length and maximum width as shown in Figure 2. The regression line fitted to values showed a very high correlation (r^2=0.9328) and can be explained as,

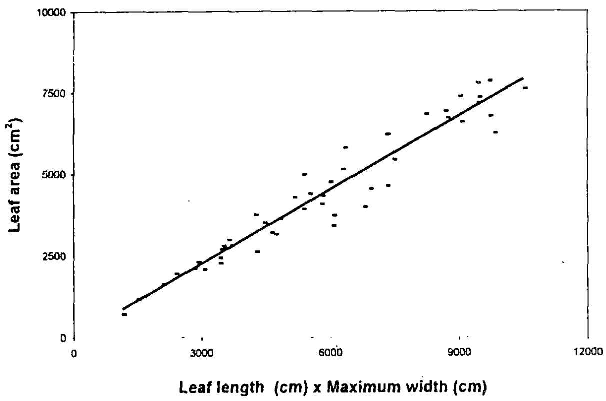

Figure 2: The relationship between leaf area and the product of leaf length and maximum width.

leaf area = leaf length x maximum width x 0.755(±0.0115)

Thus, using the equation, area of banana leaves can be measured simply with a measuring tape. Also, destructive sampling is not essential for this technique, hence it provides an added advantage in leaf area measurements in small plots which have not been designed for removing leaves. Although the model developed is rather empirical, leaves of different sizes were used for the analysis. Therefore, above model could be used for area prediction of banana leaves in a wide range of sizes. Moreover, the model is in agreement with that developed by Robinson and Nel (1985) and used by Eckstein *et al.* (1995). Nevertheless, some changes in the correction factor (i.e. 0.755), may be required for different varieties of banana, as the correction factor developed by Robinson and Nel (1985) for the variety Cavendish was 0.83, deviating by 0.01 from the value of this study.

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