ANALYSIS OF WOOD TRAITS IN *HEVEA* USING INCREMENT CORE

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Introduction

In rubber (*Hevea brasiliensis*), latex productivity is the primary trait for crop improvement. Latex production will continue to be the primary objective of breeding programmes; however, rubber wood is also gaining importance, offering wide scope for selection and genetic improvement. In this context, incorporating genetic materials introduced in 1950s in their breeding programmes, Rubber Research Institute of Malaysia(RRIM)developed new clones with high latex yield as well as high timber production with good secondary characteristics. Thus, fast growing rubber trees producing more timber biomass besides yielding appreciable quantity of latex led to the concept of latex timber clones.

Important wood traits and scope for genetic improvement

Wood specific gravity or density is an important characteristic that is selected by tree geneticists (Zobel and Talbert, 1984). Specific gravity is determined by a complex of characters, each of which contributes to the overall specific gravity and each of which may or may not be genetically independent of the other. Genetically, wood fibre is considered the 'basic unit' usually used to describe wood morphology. Thus, specific gravity is mainly determined by several different 'units' of cell dimensions, such as width of cell, thickness of cell wall and proportions of thick- to thin-walled cells. Each of these 'units' of specific gravity is amenable to genetic improvement. Selection and breeding for growth and wood traits for obtaining high genetic gain require accurate information on genetic parameters of these traits. Studies in several temperate softwoods and few hardwoods have shown that most wood qualities as well as tree form and growth characteristics that affect wood are inherited strongly enough to obtain rapid gains through genetic improvement.

Specific gravity or wood density at given moisture content, is estimated through different steps viz., extraction of the sample, determination of its volume, drying of the sample, and computation. There are different methods for estimation of wood specific gravity. Most of wood specific gravity estimations depend upon destructive sampling where wood discs are extracted from trees for further studies. There are however, few non-destructive methods. In one such method, an instrument called 'Pilodyn' is used and density is directly estimated from the hardness of the wood as indicated by resistance to penetration. This method may be easy for use in the field but will only give an indication of the specific gravity of the surface tissues.

As an alternative method 'increment

borers' have been used for non-destructive sampling of living trees. An increment borer extracts a small cylindrical piece of wood of known diameter, and the length of this piece is measured to calculate the volume of the sample at given moisture content. Specific gravity is then estimated based on green volume of the wood core sample and its oven dry weight.

The increment borer is a useful tool for collecting samples from living trees. An increment borer (Fig. 1)consists of a handle, a borer bit (or threaded auger) and an extractor (or spoon). The borer bit or auger consists of a threaded bit, raised lugs for widening the holed during coring, the main hollow shaft and the square end that falls into the handle. The handle consists of a central connector onto which each individual handle is fastened, a clip used to fasten the borer or auger, an end cap which can be removed for cleaning and an internally-located cork for protecting tip of the borer. The extractor or spoon consists of a serrated tip which is used to grasp the wood core upon insertion into the auger, the main spoon and the cap used for grip while drawing the wood core sample. Increment borers come with borers with different diameters that ultimately determine the thickness of the wood core sample. More the diameter thicker will be the sample but larger the whole in the tree after core sampling. Wood core sampling has to be done very systematically following different steps: (1) selecting the sampling tree, (2) preparing the borer, (3) determining coring height and location, (4) coring the tree, (5) extracting the core, (6) extracting the borer, and (7) proper sealing of core holes.

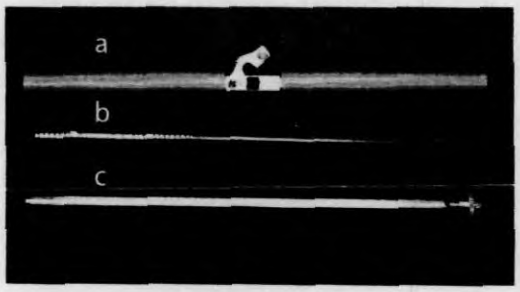

Fig. 1 Increment borer.
a. Handle, b. borer, c. extractor

Analysis of wood traits using wood cores from Hevea clones

Using the increment borer, wood core samples were extracted from seventeen-year-old trees of *Hevea brasiliensis* clones in the genetic analysis trial at CES, Chethackal (Fig. 2). Green volume was calculated from the length of the cylindrical core sample. Based on core length and standard core diameter, core volume was estimated. The wood cores were dried in oven until the weight became constant, and oven dry weight was measured. Wood specific gravity of rubber clones was estimated based on green volume and oven dry weight.

The wood specific gravity estimated for various clones using increment wood cores was in general agreement with the estimates obtained using wood discs collected through destructive sampling. It may be noted that even minor variation in measurements of moisture content, volume and oven dry weight of wood cores can lead to highly erroneous results. Hence, care should to be taken during collection of wood samples as well as in further steps of their storage and subsequent processing. Data obtained on physical and mechanical properties using increment cores should always be corroborated with the standard wood disc method. However, the wood cores can be easily extracted and used for analysis of traits

Fig 2. Collection of wood core samples from standing rubber trees using increment borer. a) securing increment borer on the tree, b) coring, c) inserting extractor after coring, d) extracting out wood core, e) wood cores from different clones, f) wood core stored in test tube to prevent desiccation, g) application of fungicide paste on the core hole, h) application of rubber coat on core hole.

like length, lumen width and wall thickness of fibres etc. The wood core samples were stored in formalin acetic-acid alcohol (FAA). After removing from FAA solution, about 1 cm long samples were cut from the wood cores for fibre characteristic studies. The 1 cm long wood samples were washed using tap water to remove excess FAA and treated with Jeffrey's solution (equal volumes of 10% aqueous solutions of nitric acid and chromic acid) and kept in oven at 60°C for 48 hours (modified after Johansen, 1940). The softened wood samples were washed thoroughly under tap water and treated with 1% Safranin for 6 hours and then rinsed in tap water to remove excess stain. The stained wood tissues were then manipulated using fine needle and mounted in glycerol on a microscopic slide for observation of fibre characteristics (Fig. 3). Using an image analyser the dimensions of wood fibres were measured under high power objective lenses and documented for further statistical analysis.

Proper use and maintenance

The increment borer is a precision instrument and needs care for better results. The borer tip must be kept sharpened. A blunt tip will shred wood tissues rather than extracting smooth and continuous sample. This will also lead to jamming of the borer and it will be much difficult to remove the borer from the tree sometimes leading to breakage of the borer. For storing, the borer should be smoothly inserted into the handle to prevent excessive contact with the

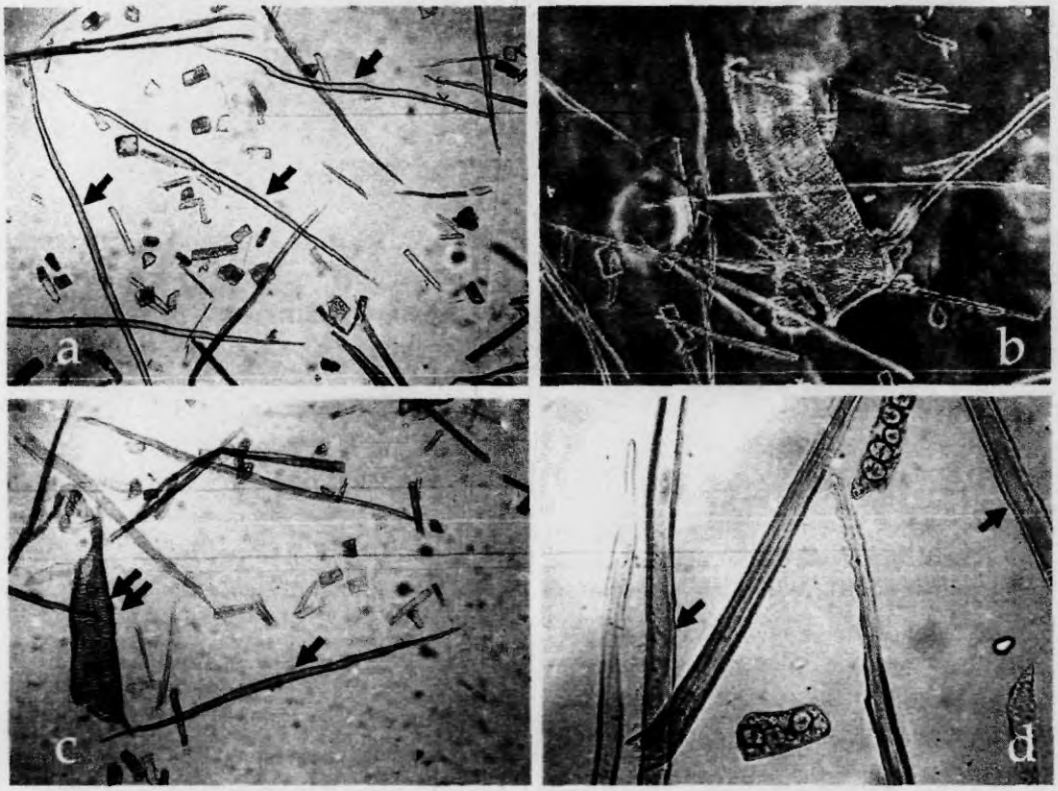

Fig. 3 Cell components of macerated wood core tissue of *Hevea brasiliensis* extracted using increment borer (a) saffranin-stained fibres (arrow) under bright field, (b) fibres and vessel element (under phase contrast), (c) fibres (single arrow) and vessel element (double arrow) (under phase contrast) and (d) Magnified view of fibres (arrow) showing the inner lumen and outer cell wall.

threads of the handle. Utmost care should be taken to prevent damage to borer tip while usage and storage. Being a precious instrument, adequate training is required before use. Improper use will not only damage the instrument but also result in poor sampling.

Applications in analysis of wood traits for quality improvement

This method is simple, easy and inexpensive. Several clones can be rapidly screened for wood trait parameters like specific gravity, fibre characteristics etc. without felling. The wood disc method gives more accurate data on wood specific gravity / density and other physical and mechanical properties, but needs cutting of trees. Using increment borer, more trees can be sampled within a short period, and there is no need to wait until felling. Wood core samples from various *Hevea* clones can be used for rapid assessment of wood traits which is significant for determining wood-trait breeding strategies.

References

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