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CAMBIUM IN THE ROOTS OF *ENSETE SUPERBUM* (ROXB.) CHEESMAN

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ABSTRACT

The paper gives an account of the secondary growth due to cambium noticed in the larger roots of *Ensete superbum* Cheesman, previously known as *Musa superba* Roxb., a member of the Musaceae found growing wild on the upper slopes and ravines of the Western Ghats — the Sahyadris.

Key-words — *Ensete*, *Musa*, Secondary growth, Western Ghats (India).

सारांश

ऐन्सेटि सुपरबम् (रॉक्सबर्ग) चीज़मैन की मूलों में एधा – त्रयंबक शंकर महाबले

प्रस्तुत शोध-पत्र में ऐन्सेटि सुपरबम् चीज़मैन की बड़ी मूलों में प्रेक्षित एधा के कारण द्वितीयक वृद्धि का वर्णन किया गया है। पहले यह जाति म्यूज़ेसी कुल के म्यूज़ा सुपरबा (रॉक्सबर्ग) के नाम से विदित थी तथा पश्चिमी घाटों – सह्याद्रियों, के ऊपरी ढलानों एवं कन्द्राओं में जंगली उगती पाई जाती है।

ENSETE SUPERBUM is a lofty handsome plant, often growing on the slopes and in deep ravines of Western Ghats — the Sahyadris. It belongs to the family Musaceae. In Hooker's *Flora of British India* (Vol. VI, pp. 261-264), J.G. Baker described six species of the genus *Musa* and two of *Lowia* from India. Of these, *M. superba* Roxb. (= *M. textilis* Grah.) is now considered to be *Ensete superbum* (Roxb.) Cheesman. The plants grow in Ghats at higher altitudes of Sahyadris and also in shady places. They grow sporadically, old and young ones together, in the vicinity of running water streams. Fully grown plants have huge rhizome about 45 cm or more at the base. But the young plants have a small round rhizome hardly 7-10 cm broad. The leaf sheaths are persistent at the base and leave closely set scars on the rhizome. Small and large numerous roots grow from the rhizome radiating in all directions. They are the first ones to be activated soon after the rains and supply water to the growing point of the rhizome, which proliferates into activity and forms plant rapidly. Larger roots arise from the periphery of the lower part of rhizome and run a long distance and the smaller ones arise from below the growing point and radiate round the pseudostem. Both are endogenous and have piliferous layer. The smaller roots are whitish in colour and ramify in the vicinity of the trunk. The older roots are larger, flabby and dark grey in colour. Root hairs on them often fall away. A giant massive floral stalk or peduncle arises from midst of a rosette of leaves. It is 15-18 cm broad at the base close to rhizome, but only 5-10 cm above, as it emerges from the midst of leaves. It bears numerous spathaceous bluish red bracts in the axils of which the flowers are borne. The female flowers are mostly in the basal bracts and the male ones are borne in the axils of bracts above them. The female flowers thus preceed the male ones. This sequence, however, may vary in different species of *Musa*. Sometimes there is even a second row of female flowers with intervening deciduous bracts. The large floral stalk is often persistent and continues for more than a year. The fruits are 12-15 cm long, more or less triangular, green and have very little or no pulp. They have

large, black oblong, subcoriaceous seeds which germinate in the vicinity of the old parent plant. The plant is propagated also by the vegetative buds on the rhizome. It is perennial. When the mud in the ledges of rocks in which it grows dries up, it remains dormant in the soil during summer months. Quite often the soil in ledges of precarious slopes is held together by its tuft of roots; when it gives way it is washed down into the valley to the lower heights.

The genus *Musa* is an ancient one in India and has persisted from the Tertiary period (Mahabale, 1966). It occurs in the Deccan Intertrappean Series at Mohgaon Kalan in Madhya Pradesh (Jain, 1963). But the present wild species *Ensete superbum* (*M. superba*) is different from the early Tertiary species in the Deccan Intertrappeans. In Mysore Ghats the plant grows loftier as the rain and humidity there are greater than those in the Western Ghats in Maharashtra. But at both places the plant has small and large roots of a similar kind. The larger roots, as they become older, form periderm and lose root hair. They appear to give mechanical strength to the plant and hold the plant in its position. The larger roots appear to be formed only once in a season but the smaller ones are produced continuously. They arise from the pericycle and have a structure typical of a monocot root. The outermost layer is generally piliferous layer or periderm. Both have similar structure with lot of variations. Cambium was observed in the larger roots which form the subject matter of this paper.

SMALLER ROOTS

Plate 1, figures 1 and 2 illustrate the general structure of this root. In younger stages the root is having a typical monocot root structure, having a wide cortex, small pith and stele made up of radially elongated linear xylem strands. In a medium sized root there are 20-25 xylem strands and 4-5 medullary bundles in the central pith. The medullary bundles have large metaxylem cells with hardly a layer or two of conjunctive parenchyma. In a younger root 4-8 large medullary bundles and about 20 primary xylem strands are present. There are only 2-3 cells of xylem on a radius with exarch protoxylem (Pl. 1, figs 3, 4). The stele is thus polyarch with exarch bundles in young roots. There is no cambium; but the pericycle and endodermis are visible. Pericycle becomes multilayered and metaxylem cells in the pith form large cavities. They do not have protoxylem rows on them. Their number goes on increasing. As the root grows older one notices as many as 20-25 large cavities of metaxylem in the pith which gets slowly compressed or crushed (Pl. 1, fig. 3). A few mucilage cells are also seen in the central pith as well as cortex. With further growth of the root, endodermis becomes distorted and lateral roots arise from the pericycle pushing their way through the endodermis and cortex.

As the width increases, parenchyma layers in the cortex also widen and the outer layer of cells becomes lacunar by the formation of schizogenous cavities (Pl. 1, fig. 1). They are irregular and get crushed later. About 4-5 parenchymatous layers and periderm lie outside this circle of schizogenous cavities and the cortex follows schizogenous cavity layer. A few layers of parenchyma and periderm constitute the outer cortex. The stele goes on expanding further and the structure of the root completely changes in the older root.

OLDER ROOT

The structure of older root is shown in Pl. 1, figs 2 and 4. It has been observed that the pith is full of 20-30 metaxylem cavities, due to which hardly any pith is seen in the centre. Primary xylem strands are not visible as they are pushed to the periphery of the stele. Pericycle gets activated and by repeated division becomes multilayered (Pl. 1, fig. 2). The endodermis is broken and the cortex gets considerably expanded by the formation of several layers of parenchyma. Phloem lies outside the cambium forming a continuous ring (Pl. 1, fig. 4), sometimes even 2 rings of cambium are formed (Pl. 1, fig. 3). The shape, method of division and position here is typical of cambium as in the case of dicot roots. It is a regular feature of older roots in this plant. Obviously it is due to the irregular secondary growth.

Examples of such irregular cambium are known to occur in some other monocots also, e.g. we had noticed it in the roots

of *Aloe barbadense* and in the suckers of a species of *Commelina*. How it develops from the meristem of the roots and how it gets connected to the structure of the older roots is not yet clear and will be described later. It is being investigated by Shri Govind Raj Rao and Mrs Shaila Lugade. Generally new roots are formed below the meristem of stem or rhizome, immediately after the rains, as the plant begins to rejuvenate.

Further work on the origin of these roots and their relation to stem meristem are under investigation.

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EXPLANATION OF PLATE

PLATE 1

Ensete superbum Cheesman showing secondary growth in the root.

1. T. S. of a young root without secondary growth. × 10.
2. T. S. of a young root magnified to show the inner cortical region. × 600.
3. T. S. of old root with secondary growth. × 8.
4. A portion of root in fig. 3 enlarged to show secondary vascular tissues. × 120.

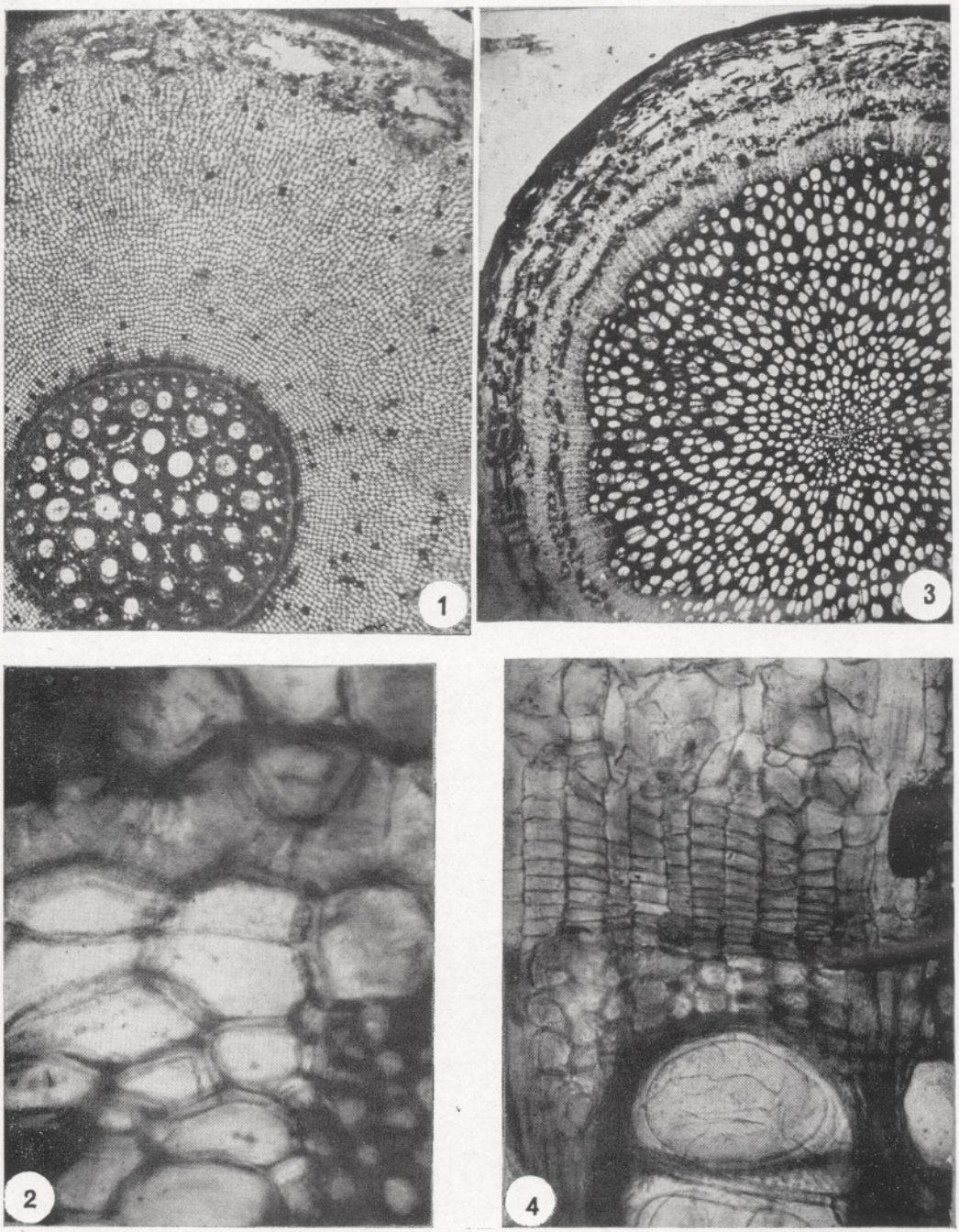

PLATE 1