

Taylor & Francis
Taylor & Francis Group

Transactions of the Botanical Society of Edinburgh

ISSN: 0374-6607 (Print) (Online) Journal homepage: http://www.tandfonline.com/loi/tped18

Aerial Roots Of Acanthorhiza Aculeata

Miss Bertha Chandler M.A. B.Sc.

To cite this article: Miss Bertha Chandler M.A. B.Sc. (1912) Aerial Roots Of Acanthorhiza Aculeata, Transactions of the Botanical Society of Edinburgh, 24:1-4, 20-24, DOI: 10.1080/03746601209468933

To link to this article: http://dx.doi.org/10.1080/03746601209468933

Published online: 29 Nov 2010.

Submit your article to this journal

Article views: 3

View related articles

Full Terms & Conditions of access and use can be found at
http://www.tandfonline.com/action/journalInformation?journalCode=tped18

Download by: [University of Florida] **Date:** 14 June 2016, At: 13:09

AERIAL ROOTS OF ACANTHORHIZA ACULEATA. By Miss BERTHA CHANDLER, M.A., B.Sc. (Plates I. and II.)

The development of aerial roots is by no means an uncommon occurrence among many plants. We find such plants as *Rhizophora, Monstera, Ficus, Dillenia* and others producing these organs under normal conditions: and, indeed, most plants may be induced to form these structures under conditions of excessive heat and moisture.

Acanthorhiza aculeata, a palm, develops quite normally abundant aerial roots. They differ from normal aerial roots in the fact that at a certain stage of their development they lose their root-cap and become metamorphosed into hard woody structures, literally thorns. This curious fact about these roots was noticed as early as 1880 by Dr. Friedrich.[1] His examination was conducted almost entirely from the structural standpoint, for he deals with the development of tissues in these roots as they pass from normal aerial roots to thorns, and he touches very little on the physiology or function of these structures.

There are two specimens of this plant in the palm-house in the Royal Botanic Garden, Edinburgh. A photo of one of these by Mr. R. Adam, is given (Plate I.). These specimens were studied with the permission of the Regius Keeper, and the results of my examination have made it possible for me to revise Dr. Friedrich's paper, and to add a few further notes, together with figures which were not given by that author. He examined specimens in the Botanic Garden, St. Petersburg, and gives as an average length of a root about 10 cm. In the specimens in the Royal Botanic Garden, Edinburgh, some branched roots reach a length of 40–50 cm., though the unbranched roots rarely attain a length of more than 15 cm.

The external appearance of these aerial roots are readily seen from Plate I. They arise usually at the base of the leaves after the leaves have fallen away. The roots are to be seen in the figure developed roughly in rings round the trunk. Often they are developed, however, before this stage, and on tearing down the sheath covering the base of

[1] "Acta Horti Petropolitani," 1880.

Downloaded by [University of Florida] at 13:09 14 June 2016

the leaf a root can be seen flattened against the trunk. On emerging from the leaf-sheath they become cylindrical in form and branch freely. Some of these flattened roots can be seen in the centre of the figure lower down on the stem.

Three distinct stages may be noticed in the life-history of these aerial roots. The young roots emerge as soft green structures, provided with a root-cap. They lengthen, and the root-cap is loosened, hanging from the tip of the root and easily dislodged by artificial means. This constitutes the second stage in the metamorphosis of these roots. The final stage is reached when the root-cap is lost, and the root becomes completely hardened, forming a thorn.

These stages can all be distinctly seen in the figure. These constitute the changes for unbranched roots, and also for the longer branched roots, the lateral roots of which differ in no respect from the unbranched ones. There are many other aerial roots, however, especially at the base of the tree forming a dense interwoven thicket, which do not harden and become thorns, but, entering the ground, develop as normal roots, and perform much the same function as the prop-roots in *Pandanus*.

The internal features of these aerial roots have been so minutely described that there is very little to add. But a summary may be given of Dr. Friedrich's results, together with one or two interesting points that have been overlooked.

Looking at a longitudinal section of a young aerial root, and comparing it with a typical root-cap, say, for instance, that of barley, the difference will at once be noticed. In the latter case the loose cells are approximately the same size, and there is no differentiation into an outer and an inner root-cap as in the former (see Plate II. fig. 2). "The cells of the outer root-cap," to quote Dr. Friedrich, "are parenchymatous, and arranged in a brick-shaped manner one above the other; their walls are thickened, pitted, and markedly lignified (showing an intensive yellow coloration with aniline sulphate). Between them are distinct intercellular spaces. The inner root-cap is distinguished from the outer by the different shape of its cells, which are smaller, more polyhedric, parenchymatous cells formed by tangential division" (Plate II. figs. 2 and 3).

Downloaded by [University of Florida] at 13:09 14 June 2016

The epidermis is interesting. The cells are markedly thickened to the outside, at the point where they touch the root-cap, while the other sides of the walls remain unthickened (fig. 3, *a* and *b*). These epidermal cells are concave to the outside, but gradually take on a more regular, flat-shaped form. Owing to the direction in which the epidermal cells lie, a longitudinal section of the root shows a transverse view of the epidermal cells; a transverse section shows a longitudinal view of the cells. A special median section would show the epidermis as a layer quite distinct from the rest of the meristem tissue right to the apex, thus dividing the root-cap from the root itself. The cells of the epidermis increase through radial division, and the thickening of the outer part of the walls can be watched from very early stages upwards.

In the second stage of the life-history of these aerial roots internal changes have also taken place. In a longitudinal section the root-cap is seen to be only slightly adhering to the root (fig. 4). The outer thicker layer has noticeably peeled off in layers, forming the tufted mass round the root, which can easily be detected with the naked eye (fig. 1, *b*). The inner layer, too, gradually loosens from the epidermis, the cells of which become gradually thickened to the outside (fig. 4, *a*).

In the final or thorn stage the metamorphosis is complete; the root-cap, if present at all, is so loose that it is more like a thimble on the root, like the root-pocket of the Lemnaceæ, and can easily be detached, leaving behind a bristle or thorn (fig. 1, *c*). The transverse sections of aerial roots at various stages in their life-history show more distinctly the process of hardening (figs. 5–9). The essential features shown in a transverse section are, the epidermis, the protective sheath (*Schützhülle*), consisting of thick cells (Dr. Friedrich says that he has observed this tissue in no other aerial root, but it is observable to some extent in palm pneumathodes, roots of Bromeliads, etc.), an outer cork tissue, an inner cork tissue with larger cells to the outside, small to the inside, a distinct endodermis, a typically palm vascular system xylem alternating with the phloem, and the pith. Transverse sections of the upper portion of the axis of the thorns show well-marked aerenchyma in the inner cortex. The figures

Downloaded by [University of Florida] at 13:09 14 June 2016

show that as the sections approach the tip of the thorn the wood tissue is considerably increased and the aerenchyma gradually lost (figs. 6, 7, 8). A section near the tip shows practically all hardened tissue except phloem. As Dr. Friedrich puts it, with the whole change of the aerial root into thorns nothing is altered in the anatomical arrangement of the inside tissues; the cells of all the tissues, with the exception of the phloem become thickened and lignified. The flattened bases of some of these aerial roots (fig. 9) exhibit the same essential features as the circular roots themselves, but with a much more marked woody development.

Mention was made of the roots which are found, on tearing down the leaf-sheath, flattening themselves against the trunk. The point is interesting, for they resemble in this respect the intracortical roots of the Bromeliaceæ; for example in *Puya* and *Kingia*. These roots, one will remember, are developed inside the cortex, and on emerging lose their root-cap, a further point of resemblance to a stage in the development of the aerial roots in *Acanthorhiza*. The flattened roots may be simply explained as the pressure of the leaf-sheaths, since on emerging they become cylindrical in form; but the striking resemblance in habit to the intracortical roots of the Bromeliads, and the tendency of the roots to lie parallel with the stem, suggests another cause, that of atavism, that is to say, that the memory of a former habit similar to the roots of the Bromeliads still clings to them.

The interesting point to notice about these aerial roots is their function; there is no doubt that in their early existence they function as pneumathodes or breathing roots, an inference drawn from the presence of much aerenchyma. This function persists even in the thorn stage, where aerenchyma are found at the base of the structures, but with the loss of the root-cap and aerenchyma the function becomes largely that of protection. The fact that many of these roots do not proceed as far as the thorn stage, but on entering the ground develop as normal roots, adds a third function to those already mentioned—one similar to that of the prop-roots of the Pandanaceæ.

Downloaded by [University of Florida] at 13:09 14 June 2016

EXPLANATION OF PLATES.

PLATE I.

Photo of a specimen of *Acanthorhiza aculeata* at the Royal Botanic Garden, Edinburgh. (By Mr. Robt. Adam.)

PLATE II.

Fig. 1. Various stages in the life-history of aerial roots of *Acanthorhiza aculeata.*
- *a.* youngest stage—root-cap firmly adhering.
- *b.* 2nd stage—root-cap a loose tuft.
- *c.* complete metamorphosis into a thorn.
- *d.* a branched root.
- *e.* an aerial root flattened in its upper portion.

,, 2. L.S. of young aerial root.
- *a.* epidermis (thickened on outer walls).
- *b.* epidermis under the root-cap.
- *c.* inner root-cap.
- *d.* outer root-cap.

,, 3. Enlarged portion of fig. 2. (Lettering as in fig. 2.)

,, 4. L.S. of an older root showing the peeling off of both outer and inner root-caps in layers.

,, 5. T.S. of the axis of a branched aerial root. A T.S. of the axis of an unbranched root (fig. 10, *a*) would be similar.
- *a.* epidermis.
- *b.* protective sheath (*Schützhülle*).
- *c.* outer cortex.
- *d.* inner cortex.
- *e.* endodermis.
- *f.* xylem tracheids.
- *g.* phloem.
- *h.* pith.
- *k.* aerenchyma with thickened cells at intervals.

,, 6, 7, 8 (corresponding to figs. 10, *b*, *c*, *d*). Successive stages across metamorphosed aerial root showing loss of aerenchyma and hardening of tissue. (Lettering as in fig. 5).

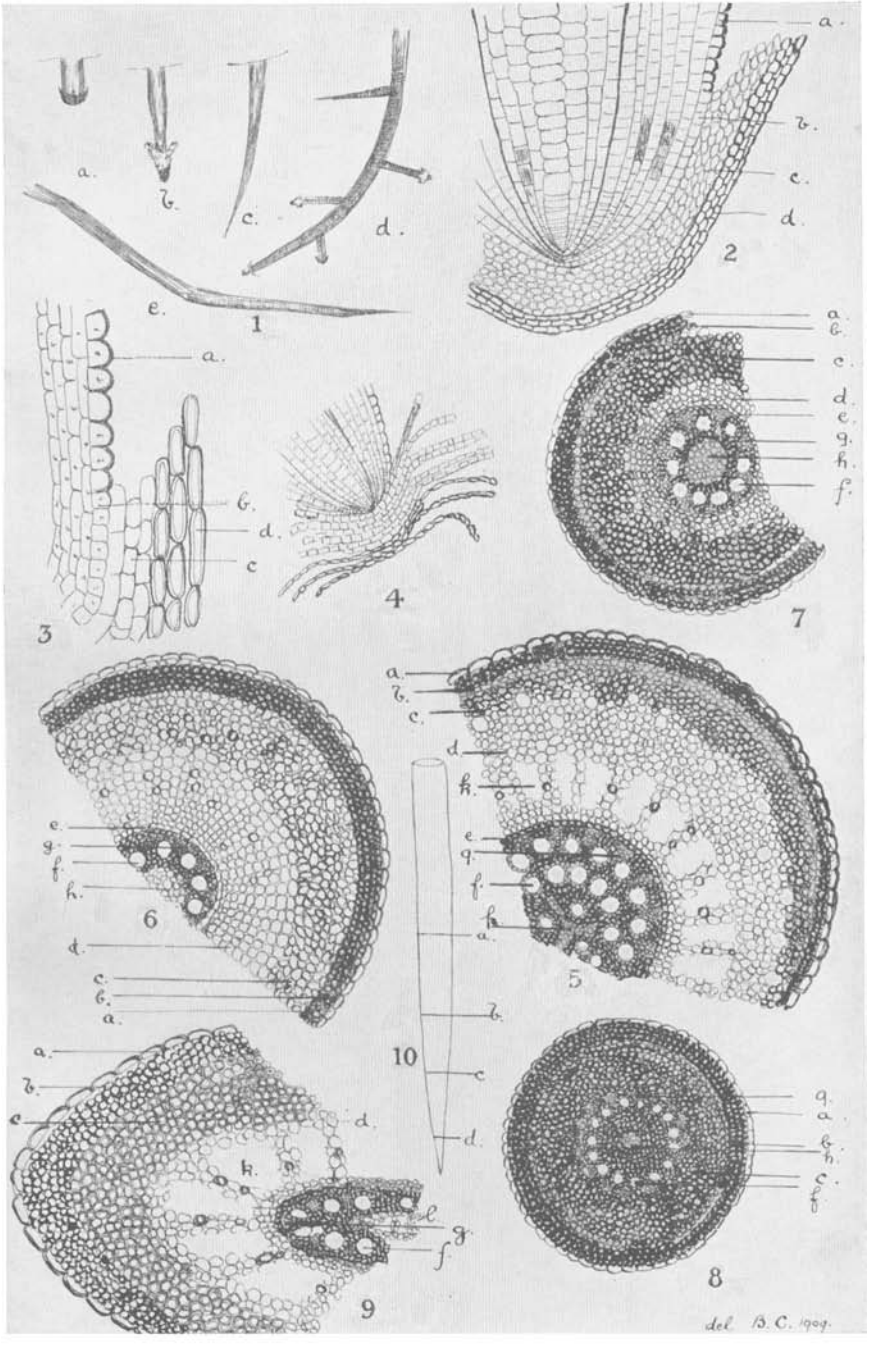
,, 9. T.S. across flattened base of aerial root. (Lettering as in fig. 5.)
- *k.* cortical aerenchyma.
- *l.* pith aerenchyma.

Downloaded by [University of Florida] at 13:09 14 June 2016



Photographed by R. M. Adam.

Downloaded by [University of Florida] at 13:09 14 June 2016



Miss Bertha Chandler.

Downloaded by [University of Florida] at 13:09 14 June 2016