

I 506
I 295
V. 61
no. 2
C. 2

STUDIES ON THE LATICIFER SYSTEM IN *EUPHORBIA MARGINATA*:

I. LIGHT MICROSCOPIC OBSERVATIONS ON THE DISTRIBUTION OF LATEX VESSELS IN THE EMBRYO

ROBERT C. SCOTT

Department of Biological Sciences; Chicago City College, Chicago

ABSTRACT.—The distribution of the laticifer system in the embryo of *Euphorbia marginata* is described as a plexus with two components: a stelar component and a cortical-mesophyll component. All the portions of the plexus develop from the laticiferous initials and the branches of these initials located at the periphery of the incipient procambium in the cotyledonary node of the embryo. An earlier researcher, Cameron (1936), concluded that the laticifers of *E. marginata* had an ontogenetic pattern distinct from other members of the Euphorbiaceae studied was in error. His suggestion that two separate latex systems: a stelar and cortical system, exist in the embryo, is corrected and is found to be a single system with the stelar component branching at the cotyledonary node to give rise to the cortical-mesophyll component. The nature of the growth habit and branching of the laticifer plexus of the embryo of *E. marginata* is discussed and illustrated.

Laticifers are cells or series of fused cells that contain latex (Esau, 1965). The latex vessel system found in *Euphorbia marginata* is composed of coenocytic, non-articulated laticifers. This type of multinucleate laticifer originates as a single cell in the embryo and follows the growth of the plant by penetrating into newly formed tissues intrusively between the adjacent cells into various organs of the plant. The non-articulated laticifer cell was ob-

served to become profusely branched at nodal regions during the growth of the plant. Milanez (1952) and Milanez and Neto (1956) reinvestigated the ontogeny of the non-articulated laticifer in *E. phosphorea* and *E. pulcherrima* and concluded from histological studies that the laticifer system was formed from the coalescence of adjacent cells and fusion of their protoplasts to form vesicles. However, Mahlberg (1959) using proliferated embryos of *E. marginata* grown *in vitro* noted that the non-articulated laticifers were not formed by the fusion of cells. The comparison of the three species of *Euphorbia* is valid, but there may be a slight degree of variation in ontogeny of the latex systems.

Cameron (1936) was the first to describe the distribution of the latex system in the embryo of *E. marginata*. He noted that there were two distinct and separate series of latex tubes to be found in these embryos. One, an inner system, was called the stelar latex system and was composed of wide tubes which lie between the vascular bundles in the hypocotyl and radicle. The other system, the outer system, consists of much narrower tubes in the cortex.

These cortical laticifers were found to be unbranched in the hypocotyl and radicle. The stelar and cortical latex systems were found to be connected in the region of the cotyledonary node by a single channel formed by fused cells passing from the stelar latex tubes to the cortical tubes.

Mahlberg (1967) added more information when he noted that in *E. marginata* approximately 12 laticifer initials arose at the periphery of the incipient procambium in the cotyledonary node of the embryo. They appeared at the time of initiation of the cotyledons, and during the subsequent development of the embryo the growing extensions of these cells penetrated along the hypocotyl toward the root meristem and into the enlarging cotyledons. The growing tips, all of which grow between adjacent cells, appear delicate and somewhat pointed, while back from the tip the cells attained a diameter comparable to that of the adjacent cells.

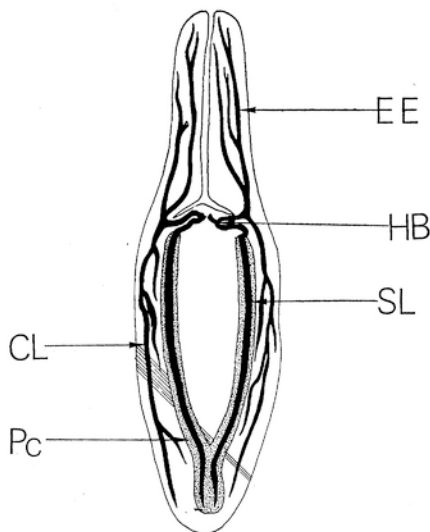
In the present study tissue sections were employed to reexamine and clarify the anatomical distribution of the latex vessels of the embryo of *Euphorbia marginata* and the relationship between the stelar and cortical latex vessels.

MATERIALS AND METHODS

Seeds of *Euphorbia marginata* were soaked overnight following which the intact embryos were removed and fixed for 48 hours in Craf IV. The embryos were dehydrated in a tertiary butyl-ethyl alcohol series (Johansen, 1940) and embedded in paraffin. Longitudinal and transverse sections were cut at a thickness of 6 μ . The sections were stained in Heidenhain's hematoxylin and counterstained with 1% safranin in 50% ethyl alcohol.

Observations

The distribution of the laticifers in the embryo (Fig. 1) can be described as a complex system of branched non-articulated latex vessels forming a single system of latex vessels all of which arose from the 12 laticiferous initials found at the periphery of the procambium in the cotyledonary node of the embryo. During subsequent development the growing extensions of these initials illustrated a bidirectional elongation. At one end the initial penetrated along the long axis of the hypocotyl toward the root meristem and at the other end of the initial the penetration is into the enlarged cotyledons. These tubes which comprise the major stelar components of the laticifer send out numerous horizontal branches.



1

FIGURE 1. Camera lucida drawing of the embryo of *Euphorbia marginata* to show distribution of the latex system resulting from the development of two of the 12 laticiferous initials.

C.L. cortical latex component of the hypocotyl

S.L. stelar latex component of the hypocotyl

Pc procambium in hypocotyl

H.B. horizontal latex tubes and branches in the cotyledonary node.

E.E. laticifer extensions in the mesophyll of the epicotyl

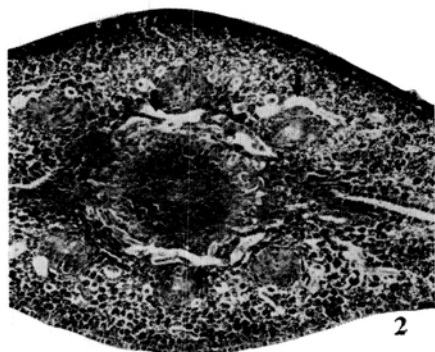


FIGURE 2. Transverse section through region of cotyledonary node showing horizontal branching of latex vessels.

These horizontal branches appear in the cotyledonary nodal region (Fig. 2) and some of these branches are trans-stelar. The laticifer branches at the cotyledonary node bifurcate repeatedly sending out a network of branches into the mesophyll of the cotyledons and other branches into the cortical region of the hypocotyl (Fig. 3). This network of tubes found in the mesophyll of the cotyledons and the cortex of the hypocotyl are narrower than the stelar component of the laticifer system.

In the embryo the laticifers were easily detected; starch grains were not seen in the laticifers under the light microscope as in the other cell types of the embryo, protein and lipid inclusions are abundant. In the seedling the opposite is observed: a large number of starch grains are seen in the latex vessels whereas protein and lipid inclusions disappear.

In a transverse section of the hypocotyl six vascular bundles are observed. The stelar and cortical elements of the latex system are distinct in this region (Fig. 4). The cortical elements appear as a number of isolated cells occurring below the epidermis up to a depth of about five cells and are absent from the remaining cell layers of the inner cortex. The stelar latex system consists of about 12 fairly wide cells two or three of which are present on either side of each vascular bundle. As the hypocotyl is examined there is relatively little change in the positions of the 12 stelar vessels. As the hypocotyl tapers off and has a narrower cortex, the stelar and cortical components are brought closer

together, but they remain distinct; no anastomoses between any of the latex vessels was observed. The latex vessels terminate as pointed tips just above the root apex.

As the cotyledons expand and mature, laticiferous vessels follow the vascular bundles and branch profusely (Fig. 5) sending out numerous branches into the mesophyll of the cotyledons. No branches appeared in the pith region of the hypocotyl.

DISCUSSION

In *Euphorbia marginata* the distribution of the latex vessels is similar to the pattern in other members of the Euphorbiaceae (Chauveaud, 1891). However, there is no evidence to substantiate the claim of Cameron (1936) that two separate systems: a stelar system and a cortical laticifer system exists. Rather this researcher has found that a single initial gives rise to branches at the cotyledonary node which profusely branch and grow into the cortex of the hypocotyl and mesophyll of the cotyledons.

This research effort provided still more evidence to support the interpretation of non-articulated laticifers as distinct and individual cells (Chauveaud, 1891). The interpretation of the origin of the non-articulated laticiferous system within the young embryo ascribed to occurrence of cellular fusion (Cameron, 1936; Milanez and Neto, 1956) was refuted by Mahlberg (1959) and is supported by this work.

Utilizing ultrastructural techniques it may be possible to obtain considerable data on cellular growth and development on specialized cells such as the non-articulated laticifers. Such studies on the laticifers of *E. marginata* are in progress.

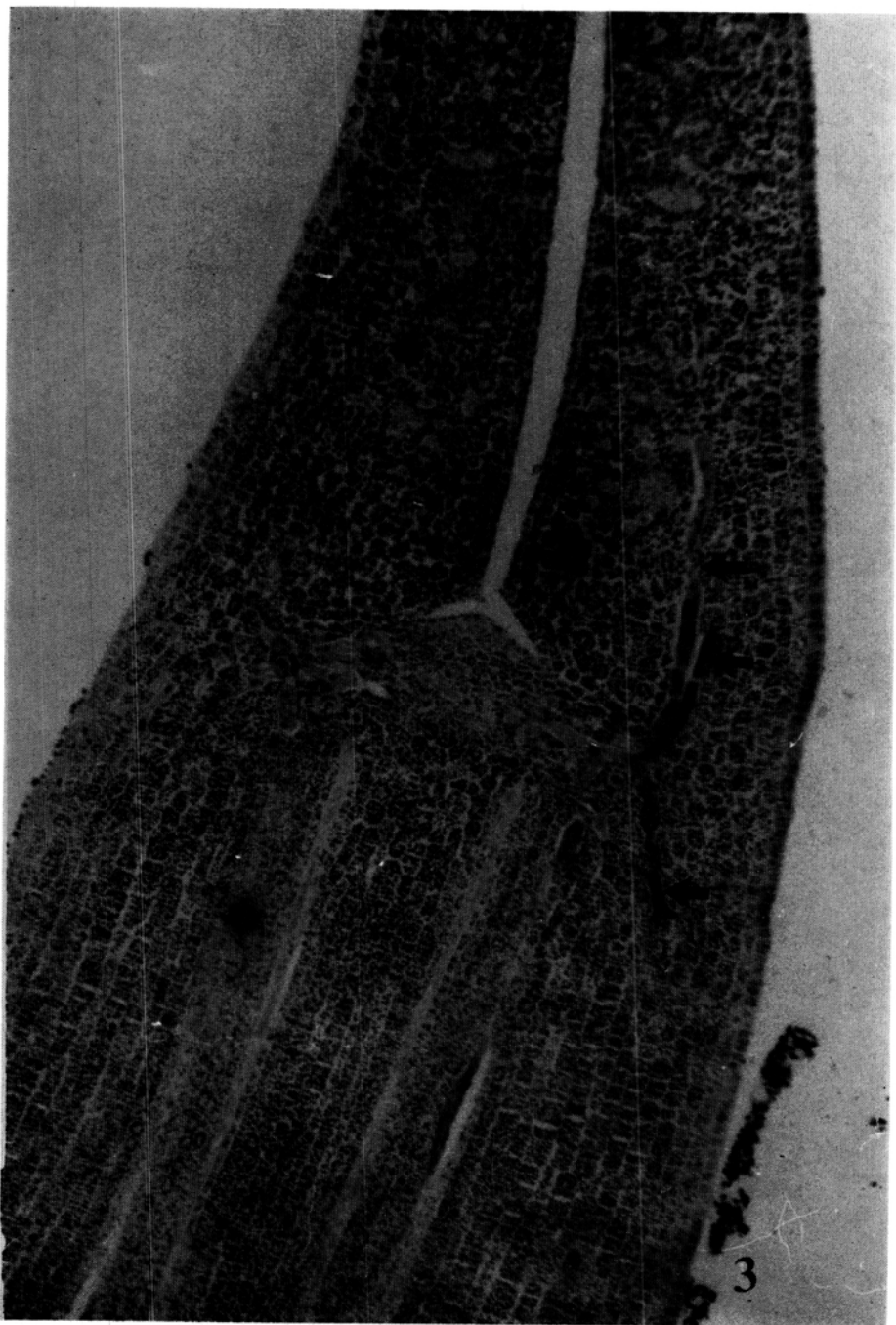


FIGURE 3. Longitudinal section of embryo showing branches from cotyledonary node oriented to form the cortical-mesophyll component of the latex system.

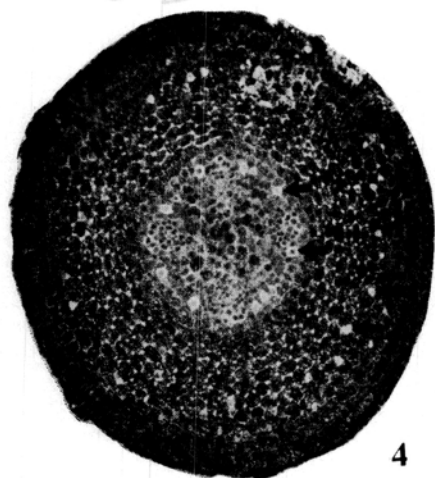


FIGURE 4. Transverse section through the hypocotyl showing the outer cortical component and the inner stelar components of the latex system.

LITERATURE CITED

- CAMERON, D. 1936. An investigation of the latex systems in *Euphorbia marginata*, with particular attention to the distribution of latex in the embryo. Bot. Soc. Edinb. Trans. and Proc. 32:187-194. 5 figs.
- CHAUVEAUD, M. 1891. Recherches embryogeniques sur l'appareil laticifère des Euphorbiacées, Urticacées, Apocynées et Asclopiadées. Ann. Sci. Nat. Bot., ser 7, 14:1-161.
- ESAU, K. 1965. Plant Anatomy. 2nd Ed. John Wiley and Sons. New York. XX + 767pp.
- JOHANSEN, D. 1940. Plant Microtechnique. McGraw-Hill. New York. XI + 523pp.
- MAHLBERG, P. G. 1959. Development of the non-articulated laticifer in proliferated embryos of *Euphorbia marginata* purch. Phyllomorphology 9: 156-162, 10 figs.
- MAHLBERG, P. G. 1967. Mitosis in the non-articulated laticifer of *Euphorbia marginata*. Amer. J. Bot. 54 (4): 465-472, 13 figs.
- MILANEZ, F. R. 1952. Ontogenese dos laticiferos do caule de *Euphorbia phosphorea* Mart. Arch. Jard. Bot., Rio. de J. 12:17-35.
- and NERO, H. M. 1956. Origem dos laticiferos do embrião do *Euphorbia pulcherriam*. Rodriguesia 18-19: 351-396.

Manuscript received August 2, 1967.



FIGURE 5. Longitudinal section through the cotyledon showing the branched latex vessels in close proximity to the branches of the vascular tissue.