

ROOT APICAL MERISTEM IN SOME APOCYNACEAE

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A closed type of organisation was seen in the radicular and well-established root apices in all the species studied. No quiescent centre was observed.

Key Words : Korper - Kappe, closed-configuration.

The root apical organisation was described in some primitive families like Ranunculaceae and also in some advanced families like Gentianaceae, Scrophulariaceae and Compositae (Pillai *et al.*, 1965, a, b). Satija (1982) studied root-apical organisation in some members of Asclepiadiaceae. The investigations presented here deal with the study of root apical organisation in some genera of family Apocynaceae.

MATERIALS AND METHODS

Root apices of the following genera belonging to family Apocynaceae were investigated : *Carissa carandas* Linn., *Nerium odorum* Linn., *Tabernaemontana divaricata* Linn. R. Br., *Thevetia nerifolia* Jun exstend and *Wrightia tinctoria* R. Br. Seeds of *Carissa*, *Nerium* and *Wrightia* were soaked in water and the radicular apices were collected by dissecting the embryos. Root apices from well-established plants except in *Tabernaemontana* were obtained from plants raised by germinating seeds in papertowels and polythene bags containing soil. Mature roots of *Tabernaemontana* were collected from well-established plants developed by cuttings.

Materials collected were fixed in FAA, washed thoroughly in 70% alcohol, dehydrated through TBA series and embedded in paraffin. Serial longitudinal sections were cut on a rotary-microtome at 4-6 μ m and stained with safranin and light green in combination with tannic acid and ferric chloride (Johansen, 1940).

OBSERVATIONS

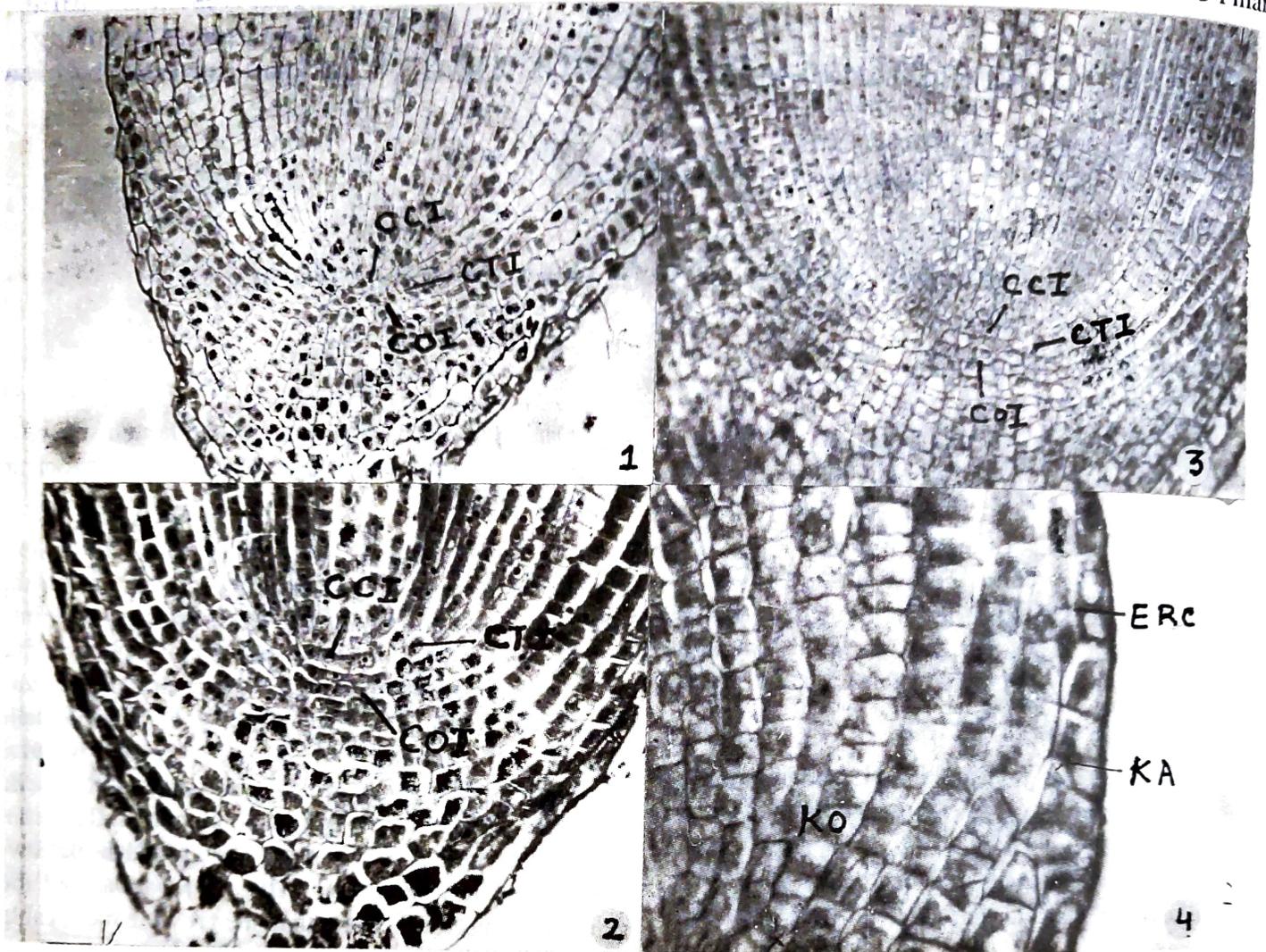
The radicular as well as root apices from well-established plants of all the species studied, showed a closed type of organisation with three superposed tiers of initials at the root-pole, one each aligned with the

central-cylinder, cortex and columella and separate-initials for the epidermis-peripheral part of the rootcap (Figs. 1-3).

Rootcap : It covers the root body for a considerable distance behind the meristematic region and on the basis of cell orientation, can be distinguished into central columella and the peripheral region. The columella initials are 5-6 cells wide in radicular and older root apices of *Carissa* and *Wrightia* and 3-4 cells wide in *Nerium* (Fig. 1, 3). The regular vertical columella files are formed by division of columella initials. The columella cylinder is broadest in *Thevetia*, next in breadth is *Wrightia* and *Carissa* and the narrowest being in *Nerium* and *Tabernaemontana* and the radicular apex is broader than the growing root (Table 1). The peripheral part of the cap is distinguished from the central columella by the files of cells which curve from the flanks towards the columella. The origin of these files can be traced proximally to the epidermis-rootcap initials-showing repeated Kappe divisions to form the peripheral part of the rootcap (Fig. 4).

Cortical initials : Just distal to the initials of the Central cylinder in the root-body, are the cortical initials. These are 3-4 cells wide in *Carissa*, *Tabernaemontana* and *Wrightia* and 4-5 cells wide in *Nerium* and *Thevetia* in radicular as well as in root-apices of well-established plants as seen in median longitudinal sections (Figs. 1-3). The peripheral cells of this tier show Korper divisions and differentiate into the cortex proximally (Fig. 4).

Central Cylinder initials : A group of 3-4 cells at the root pole immediately proximal to the cortical initials represents these initials. The initials are almost isodiametric, densely cytoplasmic and show promi-



Figures 1-4 Median longitudinal sections of the root apex.

Fig. 1. *Carissa carandas* - radicular apex (x 400). Fig. 2. *Nerium odorum* - older root apex (x 400). Fig. 3. *Thevetia merifolia* - older root apex (x 400). Fig. 4. *Nerium odorum* - part of the section enlarged to show the epidermal rootcap-complex (x 800).

nent nuclei. Korper divisions take place in these initials to form the central cylinder (Fig. 4).

There is no ontogenetic change in the organisation of the apical meristem in radicular and mature roots.

Nuclear area/Cytoplasmic area ratio in the radicular as well as in root apex of well-established plants was calculated. In the radicular and older apices of *Carissa*, the value for nuclear/cytoplasmic ratio is equal in central cylinder initials and cortical initials whereas the ratio is highest in the columella initials of the radicular apex. The value is the highest for the central cylinder initials in radicular and older root apices of *Nerium*, *Thevetia* and *Wrightia* and for the columella initials in the older root apices of *Tabernaemontana* (Fig. 5). The immediate derivatives of these initials show lower values.

Quiescent centre characterised by lightly stained

cells was not observed at any developmental stage in any species.

DISCUSSION

The type of structure reported in this study is referred to as "the most precise organisation of the meristem in the dicotyledons" by Esau (1953, 1965). The closed type of organisation has also been reported in the members of family Asclepiadaceae (Satija, 1982) and in *Solanum melongena* (Jethwani and Pillai, 1989). Among the various theories put forward, the Korper-Kappe concept of Schiepp (1926) seems to be the most suitable for root apical meristems. In addition to the Korper and Kappe patterns of growth, the rib meristem pattern has been described by many investigators in the columella of the rootcap. The columella initials have been termed as "columellogen" by Pillai and Pillai (1961 a). Structurally and ontogenetically the colu-

Table 1: Root measurements

Species	Age of the root	Diameter of the root	Width of the peripheral zone (µm)	Width of the Columella (µm)
<i>Carissa</i>	Radicular apex	304	122	60
	Older root apex	202	69	64
<i>Nerium</i>	Radicular apex	306	109	68
	Older root apex	265	103	59
<i>Tabernaemontana</i>	Older root apex	274	86	98
<i>Thevetia</i>	Older root apex	439	111	207
<i>Wrightia</i>	Radicular apex	352	88	176
	Older root	169	52	61

Armstrong and Heimsch (1976) relate the pattern of meristem to root length and Bansal (1983) suggested a correlation between the age of the root and apical organisation in *Embllica*. The data presented here do not support either of the above, as the structure of the root meristem remains unchanged in young and old roots as well as in short and long roots.

No quiescent centre has been observed at any developmental stage in the roots of all genera.

Comparison of the nuclear/cytoplasmic ratios in the different regions of the radicular and older root apices indicates that the initials have more meristematic activity as compared to their immediate derivatives. This is as expected in roots with no quiescent centre.

Root apex with discrete initials is supported to be advanced hence Apocynaceae is considered as an advanced family and the root apical-organisation with tiered initials support this.

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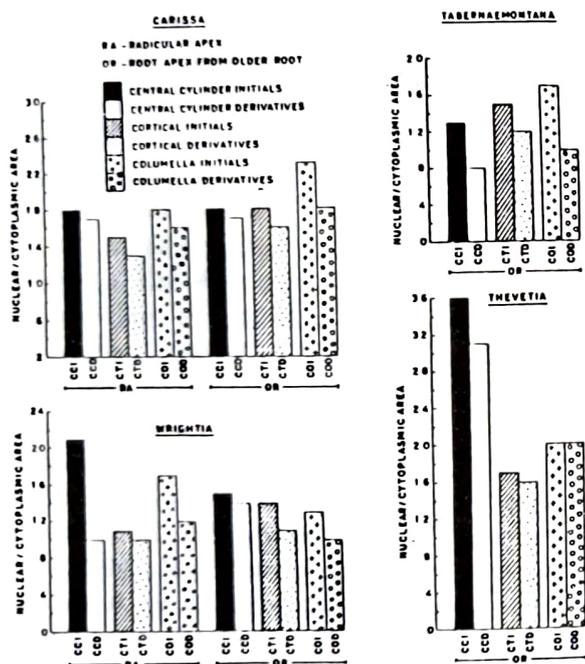


Figure 5 Histogram depicting nuclear/cytoplasmic ratios in the various zones of the radicular and older root apices.

- CCI - Central cylinder initials
- COI - Columella initials
- CTI - Cortical initials
- ERC - epidermis rootcap-complex
- KA - Kappe division
- KO - Korper division
- PR - Peripheral part of the rootcap.

mella differs from the peripheral region of the rootcap. This suggestion is in agreement with earlier studies (Pillai, 1964).