Shoot Apical Organization in Ipomoea pentaphyllaand Ipomoea pulchella

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Abstract:

The vegetative apices have tunica- corpus organisation and no cytohistologicalzonation. The corpus is divided into central mother cell (CMZ), peripheralzone (PZ) and pith meristem (PM) based on analysis of cell net. The tunica is two layered.The clarity of the layers, depending on the plastochronic stage. The CMZ shows a decrease in depth from the minimal to maximal stage of the plastochron. The inflorescence and floret apices show a mantle - core organisation. In the young reproductive apex the axial cells of the mantle are lightly stained, the complete inflorescence apex is used up in the production of bracts and florets.

Keywords: Plastochron, Meristems, Florets, Primordial and shoot apex.

Introduction

The past few decades witnessed significant advances in our knowledge of the orgin, organisation and behaviour of apical meristems (Cross,1939;Gifford,1943;Hara,1963; Smith, 1963; England &Tolbert, 1964;Agarwal& Puri,1977;Swamy& Krishnamurthy,1978; Kavathekar&Pillai,1980 and Pillai& Chacko,1980). This work represents a report on seasonal study of the shoot apical organisation in *Ipomoea pentaphylla* and *Ipomoea pulchella*.

Materials and Methods

The shoot apices were collected from mature plants which were developed in the botanical garden, Department of Botany, U.O.R. Jaipur. The collected material for experimental work was fixed in Formalin-Acetic Acid –Alcohol (FAA) consisting of formalin, acetic acid and 70% ethanol in a proportion of 1: 1: 18. For about 48 hours and preserved in 70% ethyl alcohol till required for further processing. Specimens were washed thoroughly in 70% alcohol, dehydrated through tertiary butyl alcohol (TBA) series and embedded in paraffin. Serial longitudinal sections were cut at 7-8 µm. Sections were then stained with Tannic Acid-Ferric Chloride, saffranin and light green combinations.(Johansen, 1940).

Observations

Thevegetative shoot apex at three plastochronic stages viz., minimal, mid and maximal stages and reproductive apex at inflorescence and floral stages are reported in the plants studied here.The apex during vegetative phase showed a tunica-corpus organization with (a faint) or without cytohistological zonation. In both the species the apex is a low to high dome depending upon the plastochron and size of dome also increases during the plastochron. The axillary buds becoming reproductive shoots (inflorescence or flower) showed an enlarged apex with mantle-core organization and a high and squared dome. The floral apex is a low dome with decreased size.(Figs.1,2,3&4)

The Minimal Stage

In *Ipomoea pulchella* the axially located cells are slightly lesser cytoplasmic as compared to the peripheral ones (Fig. 6). The corpus can be demarcated into peripheral, central mother cells and pith meristem zones based on pattern of divisions and their functions. Subjacent to the axial tunica is present an irregular

group of lighter stained cells. It constitutes the central mother cells zone (Fig. 6). A group of broader and lightly cytoplasmic cell just below the central mother cells zone represents the pith meristem. It contributes cells to differentiating pith proximally procambial cells arranged in longitudinal cell file are seen closer to the leafprimordia(Fig. 6).

The Mid Stage

In *Ipomoea pentaphylla*the apex height and diameter are increased with the increase in height of leaf primordia. The tunica is two layered and contributes anticlinally dividing rectangular cells (Fig. 1&2). The peripheral zone becomes clear on either sides (in L.S) and is represented by 3-4 regularly arranged and densely stained cells (Fig. 1). Subjacent to the central mother cell zone is present the small group of cells, the pith meristems. Proximal derivatives of this zone contribute cells to the pith (Fig. 1).

The Maximal Stage

The maximal stage was established in *Ipomoea pentaphylla*the size of apex is increased further. The youngest leaf primordium reaches to its highest height (Fig. 3,). The two layered tunica and pith meristem showed similar features as those at mid stage. 1-2 cells in the peripheral region of second tunica layer on the side opposite to the youngest leaf primordium showed periclinal division indicating the site of new leaf primordium. These divisions also disturb the regularity of the peripheral zone on this side. The corpus including central mother cells zone becomes more regularly arranged.

The Reproductive Apex

The axillary buds during flowering phase change to single flower or simple cymose inflorescence. The inflorescence as well as floral apex showed a mantle-core organization (Fig.8).The axillary bud meristem destined to form a reproductive apex aquires a squared shape with layered superficial meristem covering a comparatively lesser organized group of cells. Both the meristematic regions are uniformly densely stained with the onset of bract or floral organ primordia initiation, the meristem becomes organized into a mantle, the superficial 4-5 layered densely stained zone, and a lighter stained subjacent core. This produces floral organs in an acropetal order. The reproductive apex produces cymes form a terminal flower and axillant meristem than form lateral flowers. The whole meristem is consumed in flowers or floral organs (Figs. 5,6,7,8&9).

DISCUSSION

The vegetative apex is a low to high and broad dome in boththe species under investigation. Earlier Ramji (1960), Tucker (1962), Pillai and Sharma (1983), Pathak (2001) and Negi (2002) also found this type of vegetative apex in some shrub and tree species. The size of apex is increased during a plastochron. This may be attributed to the changes in the apical meristem prior to new leaf primordium formation as the size is decreased with the formation of new primordium and reaches to maximum prior to initiation of new primordium.

Apart from the size, structure of the apex also changes during a plastochron. The two layered tunica is simulated during the plastochron due to stratification of the corpus. The peripheral zone is seen only on the side opposite to the youngest leaf primordium. The data are in agreement with Shah and Jani (1964) and Pillai and Sharma(1982) who also reported fluctuations in the number of tunica layers and peripheral and central meristem during a plastochron.

The vegetative apex showed a tunica-corpus organization with a faint cytohistological zonation having

lesser cytoplasmic cells at axial tunica and distal central mother cells and this demarcation of staining behaviour between different zones persists throughout the plastochron. Gifford (1950), Tolbert and Johnson (1966), Agarwal and Puri (1977) and others also reported cytohistological zonation pattern in vegetative shoot apices. Though reports denying cytohistological zonation are also present. It seems presence or absence of cytohistological zonation is species specific. Buvat (1950a,b&1951a,b), Camefort (1956) and Lance (1952, 1953&1957) were of the opinion that the central lightly stained region of apex, the meristem d'attente has no organogenetic or hitogenic role during vegetative growth. This region however becomes active during reproductive phase. The data seems to support the view that the lateral meristem or anneau initial region is the most active region of the apex as indicated by most densely stained cells in it (Sharma, 1981;Sharma and Pillai, 1985).

The tunica-corpus organization of vegetative apex changes to mantle-core organization in the reproductive apex. The faint cytohistological zonation disappears and the mantle becomes uniformly densely stained in the axial as well as peripheral regions. This is in agreement with the observations of Gifford (1954), Pillai and Sharma (1983) and Sharma and Sharma (1988) that during transition to reproductive phase the entire apex becomes active and a mantle-core organization is established. Plantefol (1947) also related the presence or absence of zonation in inflorescence apices bearing a terminal flower or not. The species reported here had a cymose pattern of inflorescence with a terminal flower or a single axillary flower and the reproductive apex is without cytohitological zonation.

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References

- **Agarwal, R.M. and Puri, V. 1977**. Ontogenetic studies in some important timber trees of India. I. shoot apex organization and leaf development in *Dalbergiasissoo*. Phytomorphology**27**:296-302.
- **Buvat, R. 1950a**. Observations cytologiquessurl'évolutionetlèfonctionnement du point végétatif de la Giroflee (*Cherianthuscheiri*L., Crucifères). C.R. Acad. des Sci. (Paris) **230** : 1968-1969.
- **Buvat, R. 1950b**. Influence des conditions du milieu extérieursurl'évolutioncytologique du point végétatif de Lupinusalbus (Papilionacées). Compt. Rend. Acad. Sci. (Paris) **231 :**66-68.
- **Buvat, R. 1951a**. Évolutionhistologique du point végétatif de *Myosurusminimus* L. Compt. Rend. Acad. Sci. (Paris) **232 :**1011-1013.
- **Buvat, R. 1951b**. Évolutioncytologique du méristème apical de *Myosurusminimus*L. au cours de la phase végétative. Compt. Rend. Acad. Sci. (Paris) **232 :**1232-1234.
- **Camefort, H. 1956**. Étude de la structure du point végétatifet des variations phyllotaxiques chez quelquesGymnospermes. Ann. Sci. Nat. Bot. **11**, 17 : 1-185.
- **Cross, G.L. 1939.** The structure and development of the apical meristem in the shoots of *Taxodiumdistichum*. Bull. Torrey bot. Club **66**: 431-452.
- **England, W.H. and Tolbert, R.J. 1964**. A seasonal study of the vegetative shoot apex of *Myriophyllumheterophyllum.* Am. J. Bot. **51** : 349-353.
- **Gifford, E.M. Jr. 1943**. The structure and development of the shoot apex of *Ephedra altissima*Desf.Bull.Torreybot.Club.**70** :15-25.

- **Gifford, E.M. Jr. 1950**. The structure and development of the shoot apex in certain woody Ranales. Am. J. Bot. **37** : 595-611.
- **Gifford, E.M. Jr. 1954**. The shoot apex in angiosperms. Bot. Rev. **20** : 477-529.
- **Hara, N. 1963**.Structure of the shoot apex with special reference to chimera formation Gamma field symposia, Japan.**12** : 97-112.
- **Johansen, D.A. 1940**. *Plant Microtechnique*.McGraw Hill Co., New York.
- **Kavathekar, K.Y. and Pillai, A. 1980**.Studies on the developmental anatomy of Ranales. VII. Shoot apical organization in some members of Annonaceae. Flora **169** : 245-253.
- **Lance, A. 1952**. Sur la structure et le fonctionnement du point végétatif de *Viciafaba* L. Ann. Sci. nat. Bot. 11, **13** : 301-339.
- **Lance, A. 1953.** Sur 1' absence d' initialesapicales et 1a configuration de 1' anneau initial chez *viciafaba* L.C.R. Acad. des sci. (Paris) **26** : 510-512.
- **Lance, A. 1957**. Recherchescytologiquessurl'evolution de quelquesméristèmsapicauxetsurses variations provquées par des traitementsphotopériodiques. Ann. Sci. nat. Bot. ll, **18** : 91-422.
- **Negi, R.S. 2002**. Morphogenetic studies in some Caesalpiniaceae. Ph.D. Thesis, Univ. of Raj., Jaipur.
- **Pathak, R. 2001**. Morphogenetic studies in some *Cassia* spp. Thesis. Univ. of Raj.Jaipur.
- **Pillai, S.K. and Chacko, B. 1978**.Growth periodicity and structure of the shoot apex of *Piccasmithiana* (wall.)Boiss.An anatomical and histochemical study. Flora**167** :515-524.
- **Pillai, A. and Sharma, K.C. 1982**. Developmental anatomy of *Albizialebbek*(Linn.) Benth. I. The shoot apex. Acta Bot. Indica.**10** : 79-84.
- **Pillai, A. and Sharma, K.C. 1983**. Shoot apical organisation in *Acacia nilotica*(L.) DELILE. Flora **174 :**467-473
- **Plantefol, L. 1947**. Hélicesfoliaires point végétatifetstèle chez les Dicotylédones. La notion d' anneau initial. Rev. Gén. Bot. **54** : 49-80.
- **Ramji, M.V. 1960**. The structure of the shoot apex and leaf initiation in *Polyalthialongifolia*. Proc. Indian Acad. Sci. **51B** : 227-241.
- **Shah, J.J. and Jani, P.M. 1964**. Shoot apex of *Euphorbia nerifolia*L. Proc. Natl. Inst. Sci. India **30B** : 81-91.
- **Sharma, K.C. and Sharma, M. 1988**. Root apical organization in some Mimosoideae. Flora **180 :**251-257.
- **Sharma, K.C. 1981**. Developmental anatomy of some Mimosoideae Ph.D. Thesis, Uni. of Raj., Jaipur.
- **Sharma, K.C. and Pillai, A. 1985**.Stem-Node-Leaf Continuum in *Acacia*.FeddesRepertorium96 : 279-284.
- **Smith, C.A. 1963**. Shoot apices in the family Moraceae with a seasonal study of *Maclurapomifera*(Raf) Schneid. Bull. Torrey bot. Club.**90** : 237-258.
- **Swamy,B.G.L. and Krishnamurthy, K.V.1978. C**ertain conceptual aspects of meristems.III.A model of phytomorphology.**28**: 1-7.
- **Tolbert, R.J. and Johnson, M.A. 1966**. A survey of the vegetative shoot apices in the family Malvaceae.

Am. J. Bot. **53** : 961-970.

- **Tucker, S.C. 1962**. Ontogeny and Phyllotaxis of the terminal vagetative shoots of *Micheliafuscata.* Am. J. Bot. **49 :**722-737.

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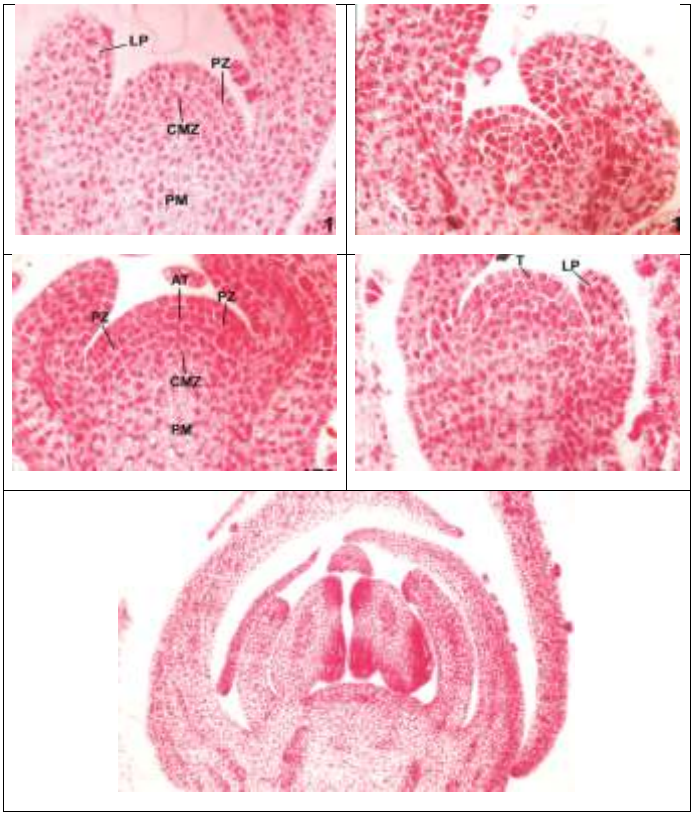


FIGURES : 1-5

Ipomoea pentaphylla – Median longitudinal sections of the vegetative and floret apices.

Fig. 1 : At mid stage X 400.

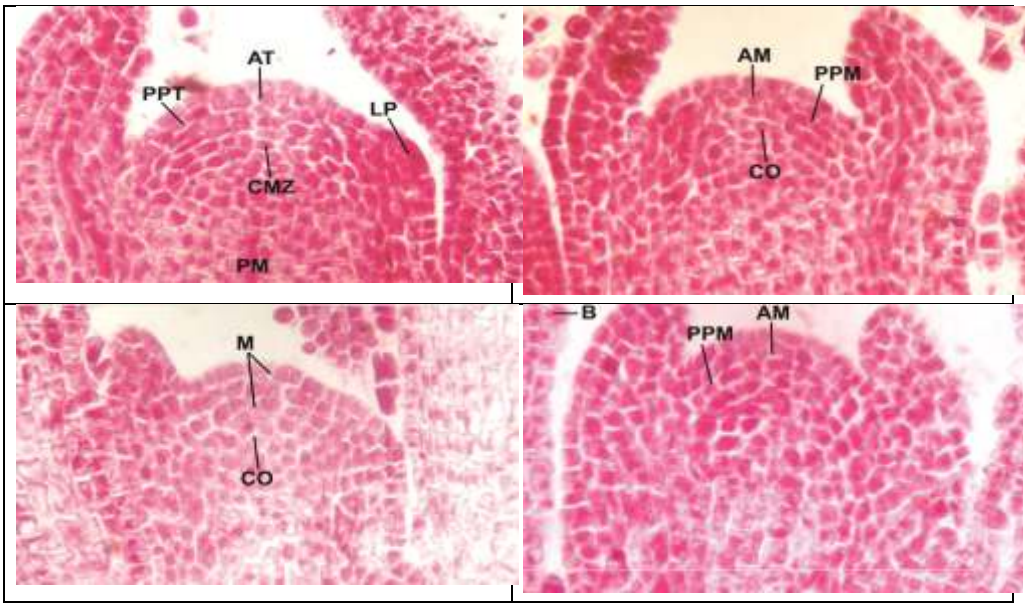
Fig. 2 : Mid stage of the plastochron X 400.

Fig. 3 : Maximal stage of the plastochron showing central mother cell zone and broader cells of axial tunica X 400.

Fig. 4 : The apex showing leaf primordium initiating from near the base of the dome X 400.

Fig. 5 : The floret apex X 100.

AT –Axial tunica, CMZ –Central mother cell zone, **LP**–Leaf primordial, **PM**–Pith meristem, **PZ** – Peripheralzone, **T**– Tunica.



FIGURES: 6-9

Ipomoea pulchella – Median longitudinal sections of the vegetative and reproductive shoot apex.

Fig. 6 : At minimal stage, axial tunica layer is lighter stained X 400.

Fig. 7 : Showing a floral apex X 400.

Fig. 8 : A floral apex showing mantle-core organisation X 400.

Fig. 9 : A floret apex with axial mantle cells broader and darker stained X 400.

AM –Axial mantle, **AT** –Axial tunica, **CMZ** –Central mother cell zone, **CO** –Core, **LP**–Leaf primordial,**M**–Mantle, **PM**–Pith

meristem, **PPM**–Peripheral mantle, **PPT** – Peripheral tunica.