EMBRYOLOGY AND SEED DEVELOPMENT IN *CYPHOMENDRA BETACEA* SENDT (SOLANACEAE)

T. PRASAD,* K. PRASAD and D. SINGH**
Department of Botany, College of Science, Sukhadia University, Udaipur, India.
* Department of Botany, Govt. Meera Girls College, Udaipur, India.
** Department of Botany, University of Rajasthan Jaipur, India.

The embryology and seed development in *Cyphomendra betacea* is described and discussed. The anther wall development was basic type and glandular tapetum as dual in origin. Ubisch granules were not observed. The endothecium lacked fibrous thickenings. A resorption tissue was organised in the septal region. Microsporogenesis, microgametogenesis and megagametogenesis were almost normal and like other Solanaceous species. The ovule was anacampylotropous, unitegmic and tenuinucellate. The megagametophyte was Allium type. The endosperm was cellular. Post-fertilization differentiation in developing seed coat created four distinct zones viz., epidermis, two middle layers and endothelium. In maturing seed coat, two median zones disappear by lytic activity. Characteristic structural changes were observed in the persisting seed coat layers.

Keywords : Embryology; Seed development; *Cyphomendra betacea*.

Introduction

Commonly known as tree-tomato. *Cyphomendra betacea* sendt. is a Central and South American genus of woody tree like shrubs of solanaceae. The plant is considered to be congeneric or very closely related to *Solanum*. The only exomorphic character to separate it from the *Solanum* was humped stamens and thickened connective. The present study is an attempt to find out the characters of the embryology and seed coat, helpful in the taxonomy of the genus and identification of seed samples.

Materials and Methods

The material was collected from Darjeeling Hills (India). Methods of fixation, tissue preparations and histochemistry were followed Jensen (1962).

Observations

Structure and development of anther : The male archesporium was hypodermal and formed a uniseriate sheath of cells (Fig. 1 A, B). The anther wall development was of basic type (Fig. 1 C–I). The anther wall thus comprised of an epidermis, endothecium, two rows of middle layers and tapetum (Fig. 1 I). The tapetum has dual origin as continuity of tapetum on antiseptal side was made through the connective. The structure and behaviour of the tapetal cells was of glandular type. No Ubisch granules were observed. The endothecium cells lacked fibrous thickenings (Fig. 1 J). The epidermis was cutinized.

Microsporogenesis and Microgametogenesis : The sporogenous tissue were arc-shaped and comprised of 4 to 5 cell layers (Fig. 1 H). Meiosis was normal and resulting tetrads were tetrahedral and isobilateral (Fig. 1 I). The microgametogenesis was also like other solanaceous species. The pollen grains were tricolpate with smooth exine (Fig 1 J). Their shedding stage was recorded as 2-celled.

Dehiscence of anther : The dehiscence of anther was helped by differentiation of a 'multicellular' resorption tissue in the septum (Fig. 1 K, L). This tissue originated in hypodermal position and its constituent cells were narrow palisade like (Fig. 1 L. M). During maturation of anther the cells of resorption tissue underwent differentiation through cell enlargement and increasingly dense cytoplasmic contents (Fig. 1 N). Concurrently, the epidermis in this region became multi-layered due to periclinal divisions (Fig. 1 O). In the mature anthers, the partition walls of the constituent cells of the resorption tissue gradually degenerated and produced a resorption cavity (Fig. 1 O). The degenerated process was later extended to the adjoining cells, so as to create a resorption passage between the two microsporangia of the anther lobe. Thus anther dehiscence was facilitated by an apical pore. Another interesting aspect of this species was the formation of a prominent hump in the connective cells towards abaxial side (Fig. 1 P, Q). The hump cells showed an increasingly higher density of cytoplasmic contents.

The Ovule : The ovules were unitegmic, tenuinuceliate and anacampylotropous (Fig. 1 U). Numerous ovules were borne on each placenta in a 2-chambered overy (Fig. 1 R). The structure and development was like other Solanaceous species. The nucellus cells towards chalazal end underwent differentation by cell enlargement and deposition of cellulosic thickenings on their walls. These later transformed into a prominent hypostase. The process of megasporogenesis and megagametogenesis were also normal. The hypodermal female archesporium (Fig. 1 S) constituted a large megaspore mother cell (Fig. 1 T,V). Rarely, the megapore mother cell contained a deeply stained body simulating its

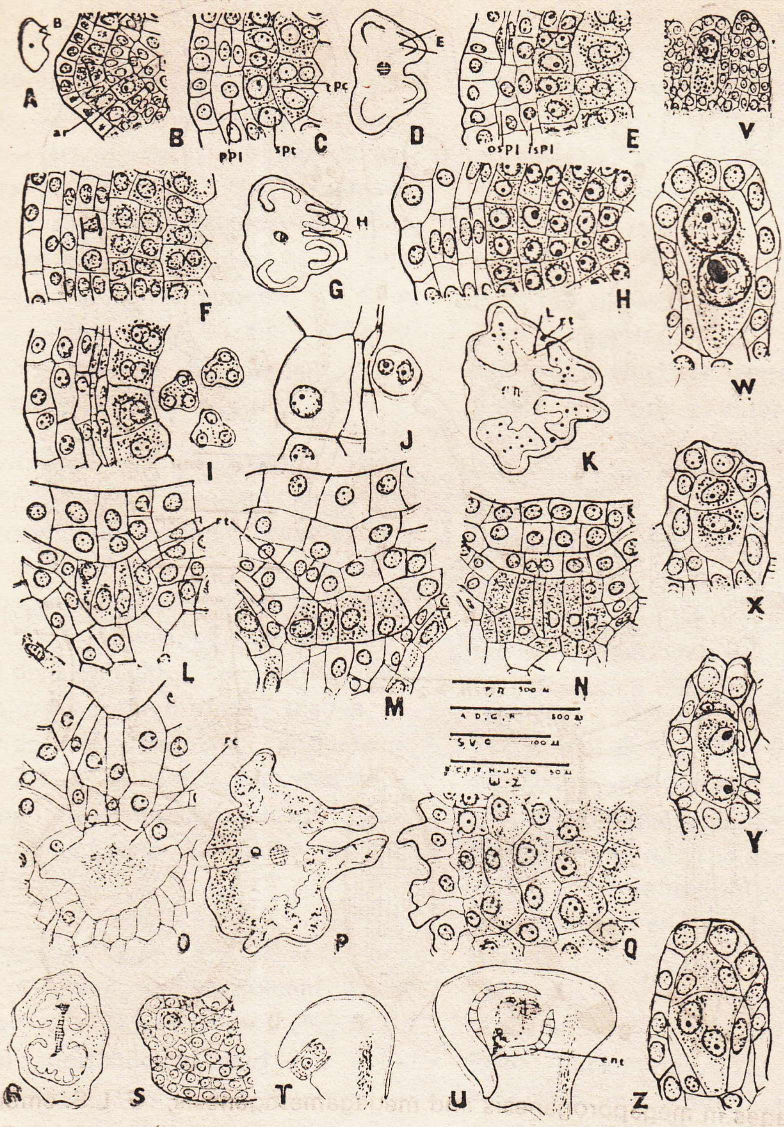
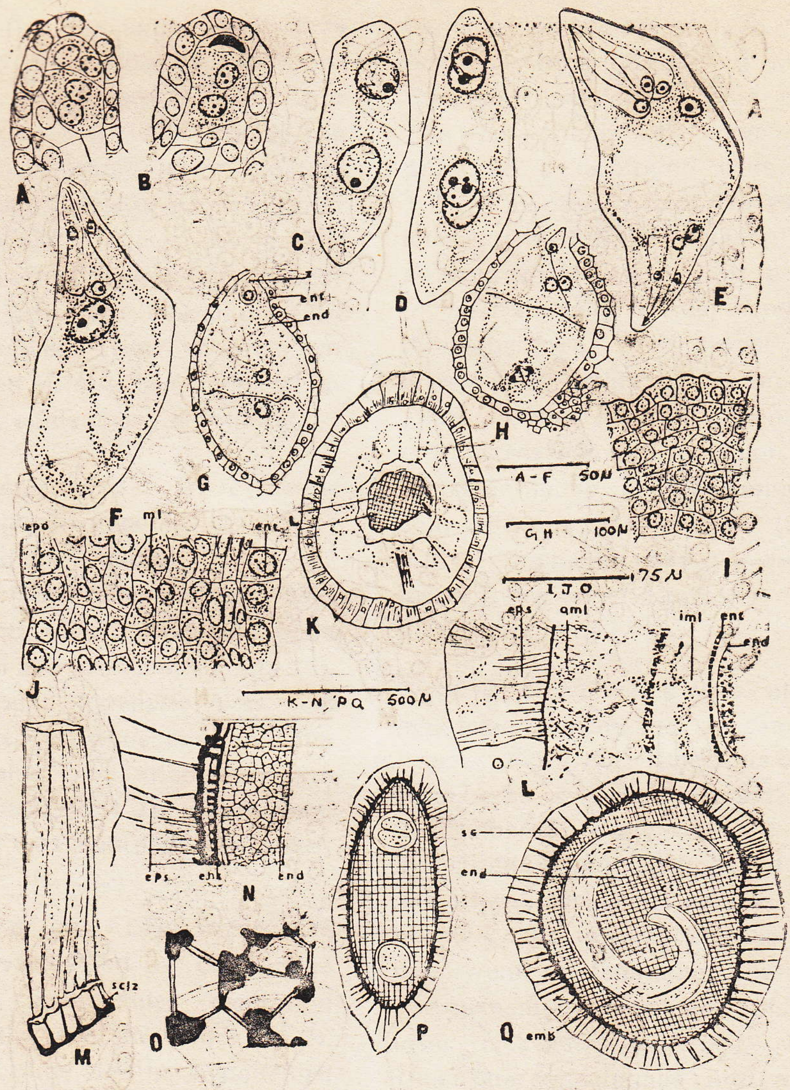


Fig. 1 (A–Z) *Cyphomendra betacea*

A. T.S. Young anther. *B.* male archesporial cells. *C–I,* development of anther wall. *J,* mature anther wall. *K,* T.S. anther showing resorption tissue. *L,* a portion enlarged. *M, N,* resorption tissue in the sub-hypodermal layers. *O,* same, with cavity. *P,* T.S. mature anther. *Q,* a portion enlarged. *R,* T.S ovary *S.* L.S. ovular primordium showing one-celled female archesporium. *T, U,* L S. ovule at megaspore mother cell and organised embryo sac stages, respectively. *W,* L.S. ovule showing megaspore mother cell. Note a dark pigmented body simulating nucleus. *X–Z,* stages in megasporogenesis.

ar, male archesporium: *ispl,* inner secondary parietal layer, *ospal;* outer secondary parietal layer; *ppl,* primary parietal layer; *rc,* resorption cavity; *rt,* resorption tissue; *spt,* sporogenous tissue; *tpe* tapeal cells of connective side.



A–F, stages in megaporogenesis and megagametogenesis, *G*, L.S. embryo sac showing 2-celled endosperm. *H*, showing second division. *I J*. L.S. part of the integument *K*, L.S. seed at young globular embryo stage. *L*, a portion enlarged *M*, single epidermal cell showing basal sclerotic thickenings. *N*, T.S. mature seed coat. *O*, endothelial cells in surface v ew *P*, *Q*, T.S. and L.S. of mature seed, respectively,

emb, embryo; *end*; endosperm; *ent*, endothelium; *epo*, outer epidermis of the integument; *eps*. epidermal cells of seed; *ml*, middle layers, *I* integument; *sc* seed coat; *sclz*, sclerotic Zone; *Z*, zygote.

nucleus (Fig. 1 W). Meiotic division in the mother cell produced a binucleate dyad. The lower functional dyad by mitotic divisions formed bisporic, 8-nucleate, *Allium* type of embryo sac (Figs. 1 X; 2, A, E). The organised embryo sac (Fig. 2 E) appeared broad sac-like with a micropylar neck. The egg-apparatus constituents were large. The antipodals rarely differed in shape and size. The polar nuclei fuse before fertilization (Fig. 2 E,F).

Fertilization and Endosperm : Triple fusion followed syngamy and the endosperm development was cellular. The first division in the primary endosperm nucleus was horizontal (Fig. 2 G). It was followed by a vertical division (Ffg. 2 H). Subsequent divisions were in both the planes to provide a cellular endosperm (Fig. 2 K). The endosperm was used up during development except a few layers which persi ted in the mature seed.

Development of the seed coat : Prior to fertilization, the integument comprised of 8-10 layers (Fig. 2 I). Fertilization induced rapid cell divisions (Fig. 2 J) and the integument became massive comprising of more than 30 layers of parenchymatous cells. The inner epidermis acquired behaviour of endothelium. During further development, most of the integumentary layers underwent differentiation and apparently demarcated into four zones viz; (a) the outer zone of epidermis, (b & c) the two median zones of parenchymatous layers and. (d) the inner zone of endothelium (Fig. 2 L). The cells of two median zones gradually disintegrated and replaced by lysigenous cavities Fig. 2 K). The epidermal cells too showed radial enlargement and accumulation of thickenings. The wall materials were mainly of lignin and non-cellulosic polysaccharides. The thickenings were extended from the base upward and occupied only about 1/6th of the epidermal cell (Fig. 2 M). The whole epidermis appeared sclerotic (Fig. 2 N). The cells of endothelium on the other hand were small with lignified U-shaped thickenings.

The mature seed : The mature seed was kidney-shaped and enclosed by a coloured mucilaginous envelope of placental origin. The seed coat was very hard. It enclosed several layers of endosperm and a coiled dicotyledonous embryo (Fig. 2 P, Q). The epidermis of endosperm was much prominent due to deposition of cellulosic thickenings. The epidermis was main mechanical layer of the seed coat Its constituent cells were enlongated, palisade-like and sclerotic (Fig. 2 M). The endothelium of small, polygonal cells was also mechanical. Its constituent cells exhibited U-shaped thickenings mainly of lignin (Fig. 2 0).

Discussion

The structure and development of anther wall in *Cyphomendra betacea* was of basic type like other Solanaceous species. The origin of tapetum was dual and structural behaviour as glandular with greater elongation of cells on the septal side. Thus characters of the tapetum closely resembled to the investigations of Smith (1935), Jain (1956), Mohan Ram and Kamini (1964), and Jos and Singh (1968). Besides, Corroborating earlier investigations of Singh and Saxena (1968), Saxena and Singh (1969) and Prasad *et al.* (1985), resorption tissue and resorption passage was also observed in *Cyphomendra betacea.* However, unlike other investigations, the origin of resorptions tissue in *Cyphomendra betacea* was from hypodermal and sub-hypodermal tissues.

The present investigation also envisaged several features of embryology and seed coat development viz; periclinal divisions of anther epidermis opposite to resorption tissue, structure and development of resorption tissue, acquision of dense contents in the anther connective, porous anther dehiscence, 4-5 layered male sporogenous tissue, bisporic *Allium* type of female gametophyte, epidermis with upright cells as mechanical layer and endothelium as subsidiary mechanical layer of the seed coat with specialized thickenings towards cell corners. These features of seed coat, if used judiciously may prove useful aid in the taxonomy of *Cyphomendra betacea.*

Accepted October, 1989.

References

Jain T C 1956· *J. Indian bot. Soc.* **35** 181.

Jensen W A 1962, *Botanical Histochemistry* John willey and Sons, San Francisco.

Jos J S and Singh S P 1968, *J. Indian bot. Soc.* **47** 117.

Prasad T, Singh D and Prasad K 1985, *Proceed, Natl Symposium on Recent advances on the Morphology of crop plants,* Waltair (India).

Mohan Ram H Y and Kamini Isho 1964, *Phytomorphology* **14** 574.

Singh D and Saxena T 1968, *Proc. Indian Sci. Cong. Assoc.* III 338 (Abst.)

Saxena T and Singh D *J. Indian bot. Soc.* **48** 148.

Smith O 1935, *Univ· Agr. Exp. Sta. Memo.* **184** 3.