Contribution to the embryology of *Calamintha umbrosa* Benth.

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Abstract. The anther development confirms to the dicotyledonous type. The tapetal cells are binucleate, glandular and dimorphic. The pollen tetrads are tetrahedral and deccussate. The pollen grains are shed at 2-celled stage. The development of embryo sac is of the polygonum type. A weak hypostase is present. The micropylar haustorium develops lateral diverticulum. The endosperm is *ab initio* cellular and its development conforms to 'stachys type'. The embryo development follows Mentha variation of onagrad type. The seed coat is 1-layered. The pericarp consists of 3 zones. The outer epidermis is non-mucilagenous. At maturity, the hypodermal layer of inner epidermis forms the main protective layer. Seed is endospermic.

Keywords. *Calamintha umbrosa*; sporogenesis; gametogenesis; embryogeny; seed coat; pericarp.

1. Introduction

*Calamintha umbrosa* Benth. belongs to sub-tribe, Melisseae and the tribe Satureineae of the family Lamiaceae. Schnarf (1931) and Davis (1966) have reviewed the earlier embryological work on the family. Casual work on embryology of certain members of the tribe Satureineae has been done by Ruttle (1931 and 1932), Jaitly (1968), Jaitly et al (1968) and Santha Kumari (1976). The present study deals with the embryology and seed coat and pericarp structure of *C. umbrosa*.

2. Materials and methods

The materials were collected from National Botanical Garden, Darjeeling (alt. 7000 ft from sea level) during October, 1978 and fixed in FAA. Customary methods of dehydration, infiltration and embedding were followed. Sections cut at a thickness of 5–10 μm were stained with iron alum-haematoxylin using safranin as counter stain.

3. Observations

3.1 Microsporogenesis and male gametophyte

The anther is tetrasporangiate and develops according to the dicotyledonous type (Davis 1966). The tapetal cells are glandular, binucleate and dimorphic. The endothecium develops fibrous thickenings at binucleate pollen grain stage (figure 1). The meiotic divisions of pollen in mother cells are of simultaneous type. Tetrahedral (86 %) and deccussate (14 %) types of microspore tetrads are formed. The pollen grains are hexasporate and shed at two celled stage (figure 1).

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3.2 Megasporogenesis and female gametophyte

The ovule is anatropous, unitegmic and tenuinucellate. The archesporium is single celled. The megaspore mother cell divides meiotically resulting in the formation of a linear tetrad of megaspores. The chalazal one of which develops into an 8-nucleate embryo sac of the polygonum type (figures 2–4). The endothelium develops at the stage of megaspore mother cell persists up to the late endosperm stage (figures 2–8). An ill developed hypostase is present.

3.3 Endosperm

The first division of the primary endosperm nucleus is accompanied by a transverse wall forming a small chalazal chamber and a large micropylar chamber (figure 5). The nucleus in the chalazal chamber divides once more without any wall formation organising two nucleate chalazal haustorium (figure 7). In a mature fruit the latter extends and establishes contact with conducting strands (figure 8). The division in the micropylar chamber is also transverse forming upper micropylar haustorial and the lower middle chambers (figure 6). The nucleus in the micropylar haustorial chamber divides without wall formation (figure 7). The micropylar haustorium develops lateral diverticulum which extends towards the raphe and starts digesting the integumentary cells (figure 8). The repeated transverse and verticular divisions in the middle chamber result in the formation of the endosperm proper (figures 6–8). The entire gamut of the ontogeny confirms 'stachys type' of endosperm development (Schnarf 1917).

3.4 Embryo development

The zygote divides transversely resulting in a terminal cell ca and a basal cell cb. The former undergoes two successive longitudinal divisions right angles to each other forming a quadrant q (figure 9). The quadrant later on divides transversely to form l and l' tiers (figure 10). The basal cell cb of proembryo divides transversely to form m and ci tiers (figure 10). Shortly after this m and ci divide transversely to give rise to a series of 4 superposed elements d, f, n and n' (figure 11). The further development of embryo corresponds to the Mentha variation of onagrad type (Johansen 1950) or period I, series A₂, Megarche type IV (Souègès 1951).


(Ant, antipodal cell; Ch, chalazal haustorium; Cut, cuticle; Dant, degenerated antipodal cells; Dmg, degenerated megaspore; Dsyn, degenerated synergids; Eg, egg cell; En, endocarp; Ent, endothelium; Eth, endothecium; Fmg, functional megaspore; Mc, micropylar chamber; Me, mesocarp; Mh, micropylar haustorium; Mhn, micropylar haustorial nucleus; Pt, pollen tube; Sc, seed coat; Z, zygote).
3.5 Seed coat and pericarp

In a young ovule the integument consists of 4 or 5 layers of isodiametric cells with large nuclei. After fertilization the seed coat becomes 7 or 8 layered. In a fully mature mericarp the seed coat is formed only by the outer epidermis, where the radial and inner tangential walls are sclerified (figure 12). In megaspore mother cell stage the ovary wall consists of 5 layers of homologous richly cytoplasmic cells. In the mature mericarp the cells of outer epidermal layer are non-mucilaginous. The middle layer cells are empty and thin walled. The hypodermal layer of the inner epidermis becomes highly lignified as a protective layer (figure 12).

4. Discussion

The development of anther wall corresponds to the dicotyledonous type (Davis 1966). The tapetum is secretory, dimorphic and binucleate. Cytokinesis is of simultaneous type.

Anatropous unitegmic tenuinucellar ovule has also been reported for Mentha spp. (Santha Kumari 1976). Ruttle (1931, 1932) reported presence of hypostase in Mentha and Lycopus spp., degeneration of ovule in M. requienii and presence of 6 antipodal in Lycopus europaeus.

The endosperm in present taxa is cellular of stachys type according to Schnarf (1917) while it is of brunella type in Mentha longifolia, Pogostemon plectranthoides (Jaitly 1968) and in Dysophylla quadrifolia (Santha Kumari 1976). In D. quadrifolia the micropylar haustorium and chalazal haustorium are cellular and coenocytic respectively (Santha Kumari 1976). Lateral diverticulum in micropylar haustorium has also been reported by Santha Kumari (1976) in D. quadrifolia.

The embryo development is of onagrad type in the present taxon whereas it is of capsella type in Mentha viridis and M. aquatica (Schnarf 1931; Jaitly 1968).

The seed coat is single layered. The pericarp structure is differentiated into lignified endocarp, thin walled mesocarp and non-mucilaginous epicarp. Seed is endospermic.

References

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