Structure and development of fruit wall ornamentations in *Pergularia daemia* (Forsk.) Chiov (Asclepiadaceae)

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Abstract. The follicle of *Pergularia daemia* (Forsk.) Chiov is ornamented with large number of branched and unbranched soft spines. The spine initiate before anthesis. It develops from the epidermal and subepidermal (ground tissue) layers of the ovary wall. A mature spine consists of an epidermis enclosing parenchymatous ground tissue with vascular strands and laticifers. Two types of trichomes, uniseriate multicellular and multiseriate multicellular, are present on the spine and fruit surface. The cuticle on the fruit surface is thick with a waxy coating. Stomata present on the fruit surface are slightly raised.

Keywords. *Pergularia daemia*; laticifer; spine; stomata; trichome.

1. Introduction

The use of scanning electron microscope for the surface study of plant organs especially that of fruits and seeds are emphasized by various authors (Heywood 1968; Heywood and Dakshini 1971; Lane 1985; Olowokuduo 1985; Menon and Dave 1988). Studies that used the scanning electron micrograph (SEM) are mostly of epidermal features (Barthlott 1981) and by this the proper identification and differentiation of any a trivial character can be done for the use in systematics or any other descriptions as exploited by Heywood (1968), Cole and Bhenke (1975), Wujek and Menapace (1986) and Bragg and MacMillan (1986).

The outgrowths on the fruit surface of various taxa are interpreted variously as emergences, trichomes, glands, prickles, spines etc. by different authors at different times. For the description of such spiny structures in single fruit itself different confusing terms seem to be used in literature. Morphologically the outgrowths on the follicle of *Pergularia daemia* (Forsk.) Chiov are also described variously in the description of fruits as long soft spines (Hooker 1885), echinate with soft spines (Kirtikar and Basu 1933; Cooke 1958; Santapau and Irani 1960), and softly echinate (Shah 1978; Matthew 1983). Lawrence (1951) defined the term echinate as with stout bluntish prickles and spine as a strong and sharp pointed woody body mostly arising from the wood of stems. Thus it appears very ambiguous to confirm the same structure as spine or prickle (echinate) without any detailed histological investigations. Dave et al (1980) and Rao et al (1985) emphasized that such interpretations on the same structure are due to the lack of morphohistogenic studies and can be rectified only by morphohistogenetical observations. In the present paper surface ornamentations of *P. daemia* follicle are observed under SEM and their ontogeny and structure are studied with light microscope.

2. Materials and methods

Flowers and fruits of *P. daemia* at their sequential developmental stages were
collected and fixed in FAA. The fixed materials were dehydrated, embedded and microtomed as per the usual methods of Johansen (1940). Safranin and fast green were used for staining. Photomicrographs were taken using Carl-Zeiss photomicroscope-I. For SEM studies fresh materials were mounted on specimen stubs using ‘Fevicol’ adhesive. The mounted materials were coated with a thin conducting film of gold-palladium and observed with Cambridge Stereoscan S4–10 microscope at ‘ATIRA’, Ahmedabad.

3. Results

The fruit of *P. daemia* is a pair of follicles ornamented with large number of branched and unbranched spines (figures 1–3). The mature fruit is covered by a thick wax coated cuticle (figure 4). The waxy coating on the fruit surface makes it powdery white in appearance. Stomata present on the mature fruit wall are slightly raised over the surface, but due to the development of thick cuticle with the powdery (waxy) coating they appear to be in surface level (figure 4). In the ovary stage when there is no thick cuticle the stomata appear highly raised above the surface (figure 5). Large number of trichomes develop on the epidermis of the spine and fruit (figures 6–8). The trichomes are of two types, uniseriate and multiseriate. The uniseriate trichome is 2–3 celled (figure 7). The multicylindrical multiseriate trichome is formed of a central column of cells surrounded by 3 or 4 vertical rows of cells (figure 8). It always terminates in a single cell, which is the continuation of the central row of cells. This terminal cell has a broad base and narrow blunt end (figures 8, 9).

The spines start their development at the ovary stage. In the ovary wall 2–4 epidermal and the underlying hypodermal (subepidermal) cells become slightly protruded over the surface (figure 10). These cells are denser with prominent central nuclei. Later these protruded cells and the underlying ground cells divide several times and form a mound (figure 11). The epidermal initials divide only anticlinally, but the hypodermal and underlying layers divide both anticlinally and periclinally. The cells of the mound after fertilization of the ovary divide and elongate rapidly and the spines increase in size (figures 12, 13). The branching of the spine can be observed in the early stages of its development (figure 13). The epidermal spine initials develop into the spine epidermis by anticlinal divisions and cell elongation. The inner cells of the spine are derived from the ground tissue layers by anticlinal and periclinal divisions. In the course of spine development the branches of the fruit vasculature enter into the spine (figure 14). Laticifers are also seen in the spine.

A mature spine measure 4–7 mm in length and 0.5–1 mm in thickness. The spines at the basal and terminal parts of the fruits are smaller than those in the middle region. The mature spine consists of an epidermis enclosing parenchymatous ground tissue with vascular strands and laticifers (figures 14, 15). The epidermal cells are elongated parallel to the long axis of the spine covered by cuticle. Both the uniseriate and multiseriate trichomes are present on the spine (see figure 6). The trichomes are more on the spine than in the fruit surface. The central cells of the spine are polygonal to rounded in shape and the vascular strand passes through the centre of the ground tissue (figures 14, 15). The non-articulated laticifers are found close to the vascular strands (figure 15). These spiny outgrowths never fall off from the fruit, even after the drying of the fruit wall tissues.