EMBRYOLOGY OF *SENECIO TENUIFOLIUS* BURM. F. (ASTERACEAE)

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Abstract: Anthers are tetrasporangiate and anther tapetum is of the Periplasmodial type. Pollen tetrads are tetrahedral and decussate. Pollen grains are 3-celled when shed. Ovule is anatropous, unitegmic and tenuinucellate. Endothelium is uniseriate. Embryo sac development is of the Polygonum type. Antipodal cells increase up to 4 and their nuclei become polyploid. Fertilisation is porogamous. Endosperm is *ab initio* cellular and embryo development follows Senecio variation of Asterad type.

INTRODUCTION

Senecio, a large genus of about 1500 species is cosmopolitan in distribution. Embryological studies in this genus are quite extensive and these include Guignard (1882), Mottier (1893), Small (1919), Souèges (1920a, b), Dahlgren (1920), Afzelius (1924) and Banchetti (1961). In all these works *Senecio tenuifolius* has not figured for embryological studies.

MATERIAL AND METHODS

Material for the present study was collected from Kalasamudram reserve forest in Anantapur district of Andhra Pradesh and fixed in formalin-acetic acid-alcohol (F. A. A.). Usual procedures of dehydration, paraffin embedding and sectioning were followed. Sections were stained in Delafield's haematoxylin. Voucher specimen No. 2855 has been deposited in the Herbarium of Sri Krishnadevaraya University.

OBSERVATIONS

Microsporangium, microsporogenesis and male gametophyte

The anther is tetrasporangiate (Fig. 1 A). The youngest stage in the available material showed a primary parietal layer and a primary sporogenous layer (Fig. 1 B). The former divides periclinally to form an inner and an outer parietal layers (Fig. 1 A, C). Meanwhile the primary sporogenous cells undergo vertical division to give rise to two rows of secondary sporo genous cells (Fig. 1 C) which function as pollen mother cells later. The inner parietal layer directly acts as tapetum whereas the outer divides periclinally to give rise a hypodermal layer and a middle layer (Fig. 1 D). This type of wall development according to Davis (1966) is known as Dicotyledonous type.

The hypodermal layer develops fibrous thickenings to form fibrous endothecium (Fig. 1 F). Tapetum is of the Periplasmodial type and its cells become binucleate and polyploid. At one-nucleate stage of the pollen grains, the tapetal cell walls breakdown and

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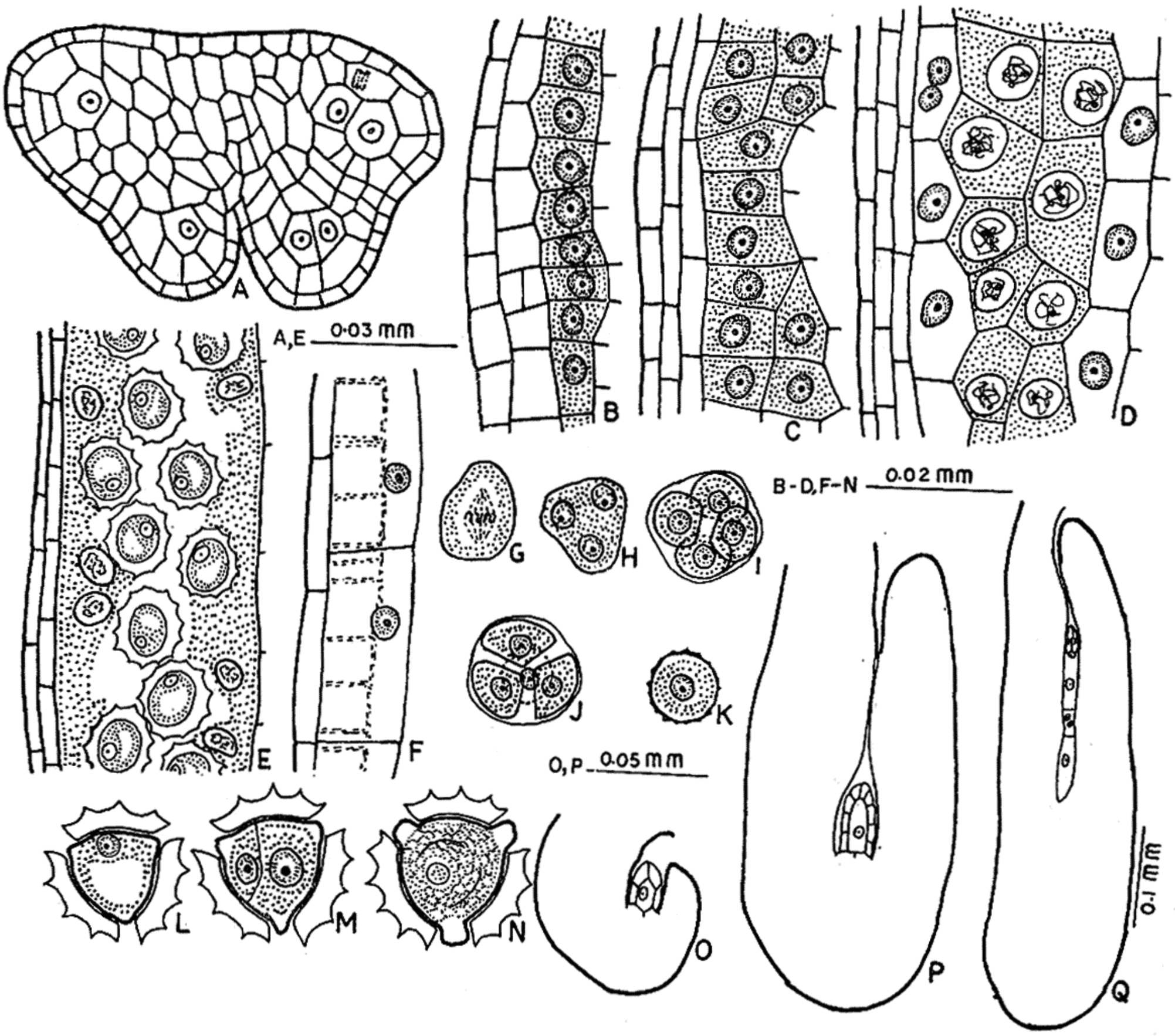

Fig. 1. A. T. s. of anther. B–D. Stages in the development of anther wall. E. Periplasmodial. tapetum. F. Fibrous endothecium. G, H. Pollen mother cell in meiosis. I, J. Microspore tetrads. K, L. One-nucleate pollen grains. M. 2-celled pollen grain. N. 3-celled pollen grain. O–Q. Stages in the development of ovule.

the cytoplasm protrudes in to the anther locule forming periplasmodium (Fig. 1 F), which is short lived.

The pollen mother cells round off and undergo meiotic divisions followed by simultaneous cytokinesis resulting in tetrahedral and decussate pollen tetrads (Fig. 1 G–J). The microspores after their release from the tetrad enlarge, become spherical and develop thick wall (Fig. 1 K, L). The nucleus after mitotic division gives rise to a small generative cell and a large vegetative cell (Fig. 1 M). The generative cell moves to the centre of the pollen grain where it divides to form two sperms. At the shedding stage the pollen grains are three-celled with three germ pores (Fig. 1 N).

Ovary and Ovule

The ovary is bicarpellary, syncarpous and unilocular with a basal anatropous, unitegmic and tenuinucellate ovule (Fig. 1 O–Q). At the megaspore tetrad stage, the inner layer of the integument becomes differentiated as the endothelium (Fig. 2 B). It remains uniseriate with uninucleate cells (Fig. 2 G) throughout its further growth till it is absorbed by the growing embryo.

Megasporogenesis and female gametophyte

A hypodermal single-celled female archesporium directly functions as the megaspore mother cell (Fig. 2 A). The megaspore mother cell undergoes two meiotic divisions resulting in a linear tetrad of megaspores (Fig. 2 B). The chalazal megaspore is functional while the micropylar three megaspores degenerate (Fig. 2 C, D). The functional megaspore undergoes mitotic division resulting in 2-nucleate embryo sac (Fig. 2 E, F). The embryo sac pierces the nucellar epidermis which is already in degenerating condition. The two nuclei undergo two more mitotic divisions resulting in an 8-nucleate, 7-celled embryo sac of the Polygonum type (Fig. 2 G). The synergids are hooked. Antipodal cells are

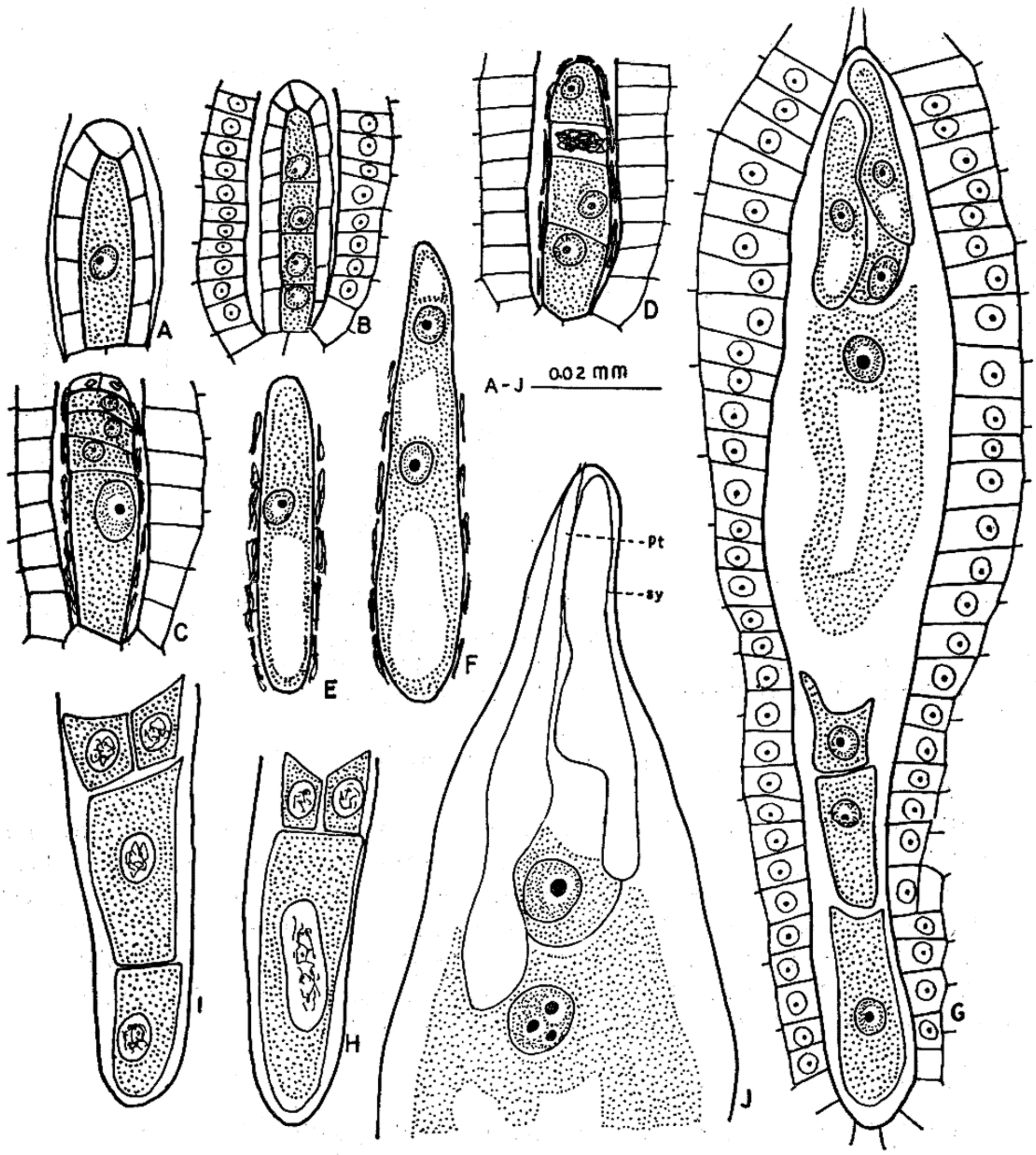

Fig. 2. A. Megaspore mother cell. B-D. Megaspore tetrads. E. One-nucleate embryo sac. F. Two-nucleate embryo sac. G. Organised embryo sac. H, I. Antipodal cells. J. Micropylar part of embryo sac showing zygote and triple fusion nucleus. (pt, pollen tube; sy, synergid).

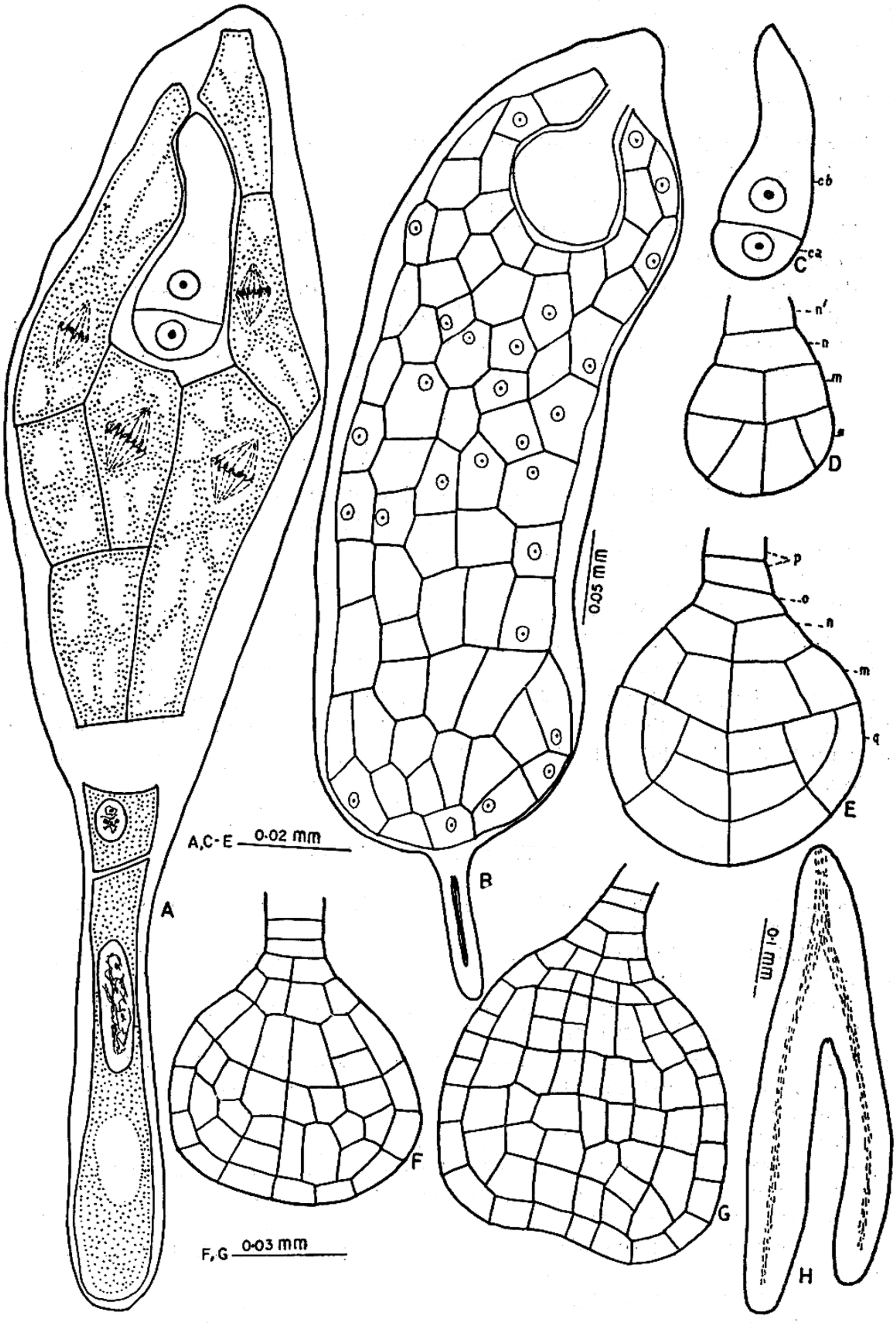

Fig. 3. A, B. Stages in the development of endosperm. C–H. Stages in in the development of embryo.

initially two or three in number (Fig. 2G) but may increase up to 4 cells (Fig. 2I). The cells show nuclear divisions and fusions resulting in polyploid nuclei (Fig. 2H, I). The antipodal cells are persistent (Fig. 3A).

Fertilisation, endosperm and embryo

The entry of pollen tube is porogamous (Fig. 2J). Syngamy and triple fusion occur more or less simultaneously.

The primary endosperm nucleus divides earlier than the zygote. The endosperm formation is *ab initio* cellular (Fig. 3A, B). Endosperm is consumed by the growing embryo but for one or two layers.

Embryo development in *Senecio tenuifolius* reembles those studies earlier (see Pullaiah 1984) and hence a detailed description is omitted. Embryo development follows Senecio variation of Asterad type of Johansen (1950) and Grand period I, Megarchetype II, series A, subseries A_2 in the first embryonic group according to Souèges (1939) (Fig. 3C–H).

DISCUSSION

The results obtained here are in accordance with those on other members of the tribe Senecioneae. However, Prakasa Rao *et al.* (1979) reported Glandular tapetum in *Emilia flammea* and this appears doubtful since Periplasmodial tapetum is a characteristic feature of the family Asteraceae (see also Pullaiah 1984). Sundara Rajan (1968) reported that in *Emilia sonchifolia* the endothecium shows no fibrillar thickenings even at the time of pollen shedding. Pullaiah (1983) reinvestigated and showed that fibrous endothecium is neverthless present in *Emilia sonchifolia.* Occurrence of Polygonum type of embryo sac in the present species is in conformity with other members of the tribe Senecioneae so far investigated. The antipodal cells in *Senecio tenuifolius* (present study) increase up to 4 only while Afzelius (1924) recorded as many as 40 antipodals in *Senecio erucifolius.*

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菊科黃菀植物的胚形成

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花藥具四孢子囊，營養層爲周邊營養質體型。四分孢子呈四面體形及交叉十字形，花粉粒散出時具三細胞。胚珠倒生，具單層珠被，爲單壁珠心型。花粉囊內殼亦爲單層，胚囊發育隸屬於蓼型。反足細胞四個，核爲多倍體。受精時花粉管自珠孔進入。胚乳自早期卽具細胞壁，胚的發育屬於紫菀型的黃菀變型。