DEVELOPMENT AND STRUCTURE OF SEEDS IN *TREWIA NUDIFLORA* LINN.

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Abstract

Development and structure of seeds in *Trewia nudiflora* Linn. have been investigated. The ovary is superior and consists of 3 to 5 chambers. Each chamber contains a single bitegmic, crassinucellate ovule which is fused with the placenta almost throughout its length. The micropyle is formed by both the integuments. A massive obturator is present above the funicle. Development of female gametophyte follows the *Polygonum* pattern. Endosperm development is of the nuclear type and it finally becomes cellular. Mature embryo is of the Spatulate type. Seminal roots are present in the hypocotyl-root-axis. Polyembryo has been recorded in a few cases. Seeds are excarunculate but the outer integument forms the sarcotesta. The cells of the outer epidermis of the inner integument develop into the stony layer of the seed-coat while the remaining layers of this integument are crushed.

Introduction

Banerji and Dutt (1944) investigated the development of female gametophyte in *Trewia nudiflora* and gave a brief account of the ovule and obturator. Rao and Rao (1974) reported presence of druses in the integuments of this taxon. Seed development has not been investigated in detail so far and the present paper, therefore, deals with this aspect in *Trewia nudiflora*.

Material and method

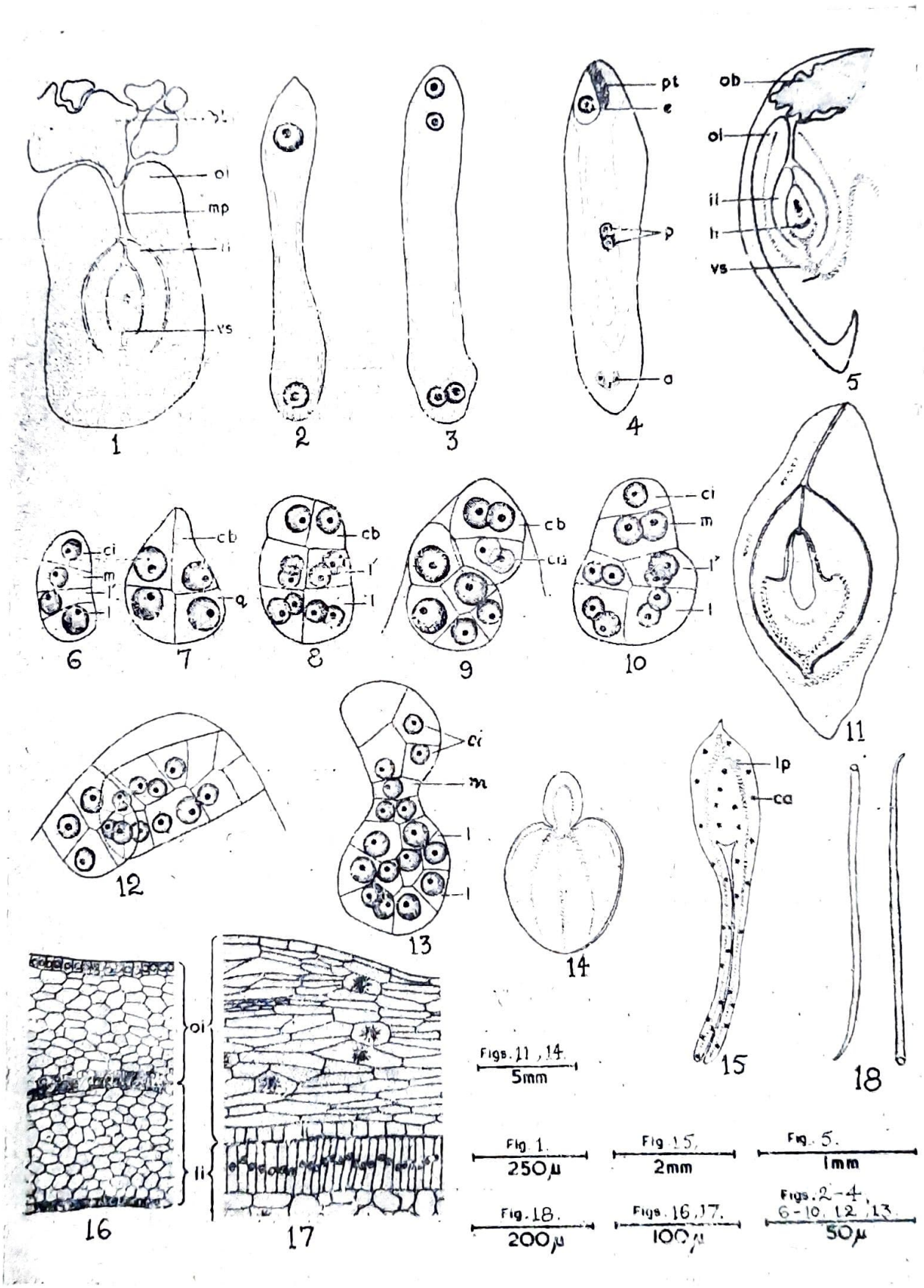
Flowers and fruits of *Trewia nudiflora* at different stages of growth were collected from Dehradun, as well as locally and were fixed in formalin-acetic acid-alcohol. Usual methods of dehydration in tertiary butyl alcohol series and embedding in paraffin wax were employed (Sass, 1958). Serial microtome sections, cut between 12 to 15 μm thickness, were stained in safranin-fast green combination.

Observations

Ovule—The gynoecium contains a syncarpous, tri-to penta-locular superior ovary. A single ovule is present in each loculus and is fused with the placenta almost throughout its length (Fig. 5). Above the ovular attachment is also present a massive obturator. The lobes of the obturator are elongated and some of them enter the micropyle. The cells of the obturator lie in continuation with the transmitting tissue of the style.

An ovule, at the organised female gametophyte stage, possesses a massive nucellus and two integuments. The micropyle is formed by both the integuments, and the conical apex of the nucellus reaches the base of the endostome. The nucellus is parenchymatous and the embryo sac is deepseated.

Megasporogenesis and megagametogenesis—The earliest sign of megaspore mother cell is noticeable in an ovule with well-developed integuments. This cell is found to be deepseated (Fig. 1). Functional megaspore undergoes three mitotic divisions forming two,



Text-figs. 1-18

four and finally an eight-nucleate emgryo sac (Figs. 2, 3, 4) Development of the female gametophyte follows the *Polygonum* pattern.

Endosperm—Development of endosperm is of the Nuclear type. After the globular stage of embryo, the endosperm starts becoming cellular and in a mature seed it persists as a massive tissue. The cells of the endosperm are filled with reserve food material and druses of calcium oxalate are also present in many cells.

Embryo—Zygote divides by a transverse wall into an apical cell, *ca* and the basal cell, *cb*. The cell *ca* generally divides by a vertical wall into 2 juxtaposed cells designated as q (Fig. 7). Rarely, it may also divide transversely into l and l′ (Fig. 6). Both the cells of q divide by vertical walls giving rise to a quadrant (Fig. 9) and soon octant stage is reached (Figs. 8, 10). A globular proembryo arises by further divisions in the octant cells (Fig. 13). During these developmental stages, the cell *cb* may divide either by a transverse wall into *ci* and *m* (Fig. 6) or it may show vertical partition (Fig. 7). Daughter cells of *cb* divide further to form a suspensor of limited number of cells (Fig. 13). Twin embryos are also observed in this taxon (Figs. 9, 12). However, only one embryo ultimately reaches maturity. Mature embryo is of the spatulate type (Fig. 14) and is differentiated into a root-cap, a hypocotylroot-axis, two broad cotyledons and an epicotyl (Figs. 14, 15). The hypocotyl-root-axis shows seminal roots (Figs. 15). The cells of the embryo are filled with reserve food material and many of them possess druses of calcium oxalate. The vascular supply of embryo is much branched in cotyledons and at places possess spirally thickened xylem elements.

Changes in the nucellus and chalaza—The nucellus increases in size in post-fertilisation stages and shows a number of other changes. A cup-shaped tissue of more or less regualrly arranged slightly thick-walled cells, comparable to hypostase, differentiates below the embryo sac. The cells of the nucellus between the hypostase and the cup-shaped vascular supply show proliferation leading to the increase in distance between the lower limits of both the epidermal layers of the inner integument (compare Fig. 5 with 11). The cells enveloping the vascular cup become thick-walled and take a dark-brown or deep red stain with safranin.

The entire nucellus and its proliferated region is absorbed by the endosperm, while the vascular supply and dark-brown cells surrounding it persist in a crushed condition. The cells of the lower part of the chalaza also divide and contribute to the formation of the fleshy part of the seed-coat in continuation of the outer integument.

Changes in the inner integument—The inner integument is more than 10 cell-layers thick throughout the length of the ovule except at the apex where the number is 3 or 4. The cells are parenchymatous and both the epidermal layers are quite conspicuous (Fig. 16). No vascular supply is present in the inner integument.

The inner integument undergoes marked changes accompanied by cell divisions. The cells of the outer epidermis on account of anticlinal elongation, become palisade-like

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Text-figs. 1-18— **1,** T. L. S. ovule at the megaspore mothercell stage; **2, 3,** 2- and 4-nucleate embryo sac respectively ; **4,** Mature embryo sac at the time of fertilization. Note the pollen tube near the egg: **5,** L. S. ovule at the mature embryo sac stage; **6,** L. S. very young seed at 4-celled pro embryo stage; **7-13,** stages in embryo ; **14,** Mature embryo ; **15,** L. S. mature embryo showing seminal root primordia ; **16,** L. S. part of integuments at organised embryo sac stage ; **17,** L. S. part of integuments at the globular stage of embryo, **18,** Macrosclereids. (**a,** antipodals ; **ca,** crystals of calcium oxalate ; **e, egg ; h,** hypostase ; **ii,** inner integument ; **mp,** micropyle ; **ob,** obtura-**tor ; oi,** outer integument ; **lp** lateral trace of seminal root ; **p,** polars ; **pt,** pollen tube : **vs,** vascular supply).

(Fig. 17). The elongation begins from the micropylar region and extends throughout the length of the developing seed. These cells are ultimately transformed into macrosclereids showing simple pits (Fig. 18). The macrosclereides become dark-brown in a mature seed and form a characteristic layer. The cells of the inner epidermis, as well as those of the intermediary layers, are ultimately crushed by the growing endosperm and appear as a white fuzzy layer. Druses of calcium oxalate are sometimes seen in this crushed tissue.

Changes in the outer integument—The outer integument is also massive. Druses of calcium oxalate are frequent in many cells of the intermediary layers, a feature also reported earlier (Rao and Rao, 1974). The funicular vascular supply travels down into the chalaza where a number of branches are given out to travel into the outer integument (Fig. 5). After giving off these branches it proceeds up to the base of the nucellus where it fans out at the junction of the nucellus and the inner integument. In the outer integument vascular strands travel up to its top.

The outer integument also increases in size by the division of its cells during the development of a seed and becomes massive specially in the micropylar reigon. The entire outer integument persists in a mature seed and forms the fleshy part of the seed-coat.

Mature seed—Mature seeds are light-brown in colour and are approximately 13-15 mm long and 8-10 mm broad. The fleshy covering is formed of the outer integument and the lower part of the chalaza. The raphe ridge is not marked on the ventral side of seed because of its fusion with the placenta. The outer epidermis of the inner integument forms the stony layer of the seed-coat, while the remaining layers of the inner integument are crushed. Surrounded by the seed-coat are present a massive endosperm and a well-developed embryo of the Spatulate type.

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References

Banerji, I. & Dutt, M. K. 1944. The development of the female gametophyte in some members of the Euphorbiaceae. *Proc. Indian Acad. Sci.*, **20B** : 51-60.

Rao, P. R. & Rao, D. S. 1974. Druses in the ovular envelopes of Euphorbiaceae. *Curr. Sci.*, **43** : 793-795.

Sass, J. E. 1958. *Botanical Microtechnique*. The Iowa State College, Press, Ames, Iowa.