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MICROSPOROGENESIS AND DEVELOPMENT OF MALE GAMETOPHYTE IN *Aristida adescensionis Linn.*

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ABSTRACT:
The paper deals with the embryological investigations on Aristida adescensionis. The specimen submitted in Botany department of RTM Nagpur university (Voucher specimen: N-1). The development of microsporogenesis and male gametophyte described in details. The anther wall is four layered, typical in the Poaceae. The papillose epidermis, binucleate tapetum cell are characteristics. The fibrous endothecium restricted to stomium region at mature stage. Meiosis I & Meisosis II normal resulting in isobilateral microspere tetrads. At maturity the pollen grains are three celled.Some Pollen grain are non-viable due to persistent tapetum may lead to the degeneration of PMCs.

Keywords: Poaceae, Pooideae, Papillose epidermis,Binucleate tapetum,Isobilateral tetrads,Mature pollen grain.

INTRODUCTION:
The family Poaceae is known for its structural diversity both in vegetative & reproductive morphology. The division of the Poaceae into two sub-families viz., Pooideae & Panicoideae as proposed by Brown (1814) is maintained even today. Microsporogenesis & Development of Male Gametophyte mostly follows the uniform pattern as studied by (Narayanswami, 1955a,b,c. 1956; Koul,1970 a,b; Raju 1980; Bhanwara et al.,1991; Deshpande & Makde,1994;Nikhade & Makde 1997).

MATERIAL & METHODS:
Materials was collected from Nawargaon (M.S) & fixed in F.A.A.(70% ethanol). Customary methods dehydration, clearing & embedding were followed(Johansen,1940). Sections were cut at 8-12m thick & stained with Delafield hematoxylin. Erythrosin or fast green was used as counter stain. The sections were mounted in canada balsam. Diagrams were drawn with the help of camera lucida.

Microsporogenesis And Development Of Male Gametophyte
The anthers are bithecous and tetralocular. However, adjoining locules from the same theca become confluent due to dissolution of septum prior to anthesis (Fig. 1W). The young microsporangium rather rectangular in transaction consists of a homogenous mass of parenchymatous cell surrounded by a single layered epidermis. It soon becomes slightly four lobed. Simultaneously, the male archesporium diflerentiates at the four corners of a young anther. The male archesporium always arises hypodermally and consists of single row of cells. (Fig. 1B).

The archesporium extends vertically over the entire length of the anther. Archesporial cells are characterised by high staining capacity because of dense cytoplasm and a prominent nucleus.

The male archesporium divides periclinally and forms the primary parietal cell and a primary sporogenous cell, towards the outer and inner sides respectively. The primary parietal cell further divides periclinally and gives rise to two secondary parietal layers. (Fig. 1C) The outer one does not divide and functions directly as the endothecial layer,

The cells of the inner secondary parietal layer, again divide periclinally to form a single middle layer on the outer side and the tapatum towards the inner side (Fig. 1C). The mature anther thus, consists of four wall layers viz, the outer epidermis, a hypodermal layer constituting an endothecium, a single middle layer and the inner most tapetum that surrounds the central sporogenous mass(Fig.1D). The development of anther wall thus, corresponds to monocotyledons type (Davis, 1966).

The epidermal cell more or less rectangular undergoes repeated anticlinal divisions, during subsequent development and enlargement of anther these cells get stretched and become highly flattened. The outer tangential wall of epidermal cells shows a tendency to become papillose at some places thus, epidermis shows a way appearance. The cytoplasmic contents of

epidermal cells start degenerating during organization of microspore and deposition of tannin granules of varied shapes observed (Fig. 1R). The anther epidermis remains persistent upto anthesis (Fig.1W). The endothecial cell enlarge radially and on their inner tangential walls develop fibrous thickening.

The Fibrous bands which arise chiefly along the inner tangential walls, extend outward and upward terminating near the outer tangential wall. It is observed that the endothecial cells get disintegrated all over the inner surface except near the stomium region where the intact endothecial cells show fibrous bonds. The distinct Ubisch granules are noticed on the inner tangential wall of endothecium. (Fig 1W). The ephemeral middle layer starts degenerating prior to the onset of meiosis in pollen mother cells (Fig. 1J)

The tapetum is the innermost parietal layer that completely surrounds the central sporogenous tissue. The tapetal cell distinctly binucleate (Fig.1D). During meiosis II, tapetal cells start falling apart and become vacuolate. Their nuclei also eventually degenerate. These cells finally degenerate in situ thus tapetum describe as secretory or glandular type (Fig.1R). The middle part of anther showing degenerating middle layer, persistant tapetum and degenerating pollen mother cells (Fig. 1GH).

The pollen mother cells are very prominent and appear polygonal in outline. These cells are densely cytoplasmic with centrally located nucleus (Fig.1D). Prior to onset of reduction divisions, PMCs usually fall apart and round off. The cytoplasm recedes from the wall and accumulates around the nucleus (Fig.1J). Meiotic divisions are normal. At close of Meiosis I wall is laid which results in dyads (Fig. 1O). Meiosis II in both dyad cells is accompanied by septum formation (Fig.1P). Since at close at meiosis I and II walls are laid down, thus cytokinesis is of successive type, the resultant microspore tetrads are thus invariably of the isobilateral type (Fig.1Q).

The deposition of thick callose wall, along the wall of pollen mother cells and also in between the developing microspore, occurs early during meiosis. Male sterility is common but observed at different stages of development. Degeneration observed in microspere mother cells and pollen grains at uninucleate or binucleate stage.

Pollen grain: The young microsopere is spherical with dense cytoplasm and centrally placed prominent nucleus (Fig.1S). The uninucleate microspores are spherical, contain a granular cytoplasm with well developed exine and intine. The first mitotic division of the microspore nucleus takes place near the well results in smaller generative nucleus (Cell) and larger vegetative nucleus (Cell). The two nuclei lie side by side in alveolar cytoplasm with few starch grains (Fig. 1T). The shape of male gametes may be crescent shaped or elongated. The mature pollen grain 3- celled (Fig. 1U).

RESULT AND DISCUSSION

The family Poaceae characterised by Tetrasporangiate anthers, four layered anther wall, glandular tapetum, successive type of cytokinesis, isobilateral types of microsphere tetrads, & 3-celled pollen grains at anthesis.

The male archesporium is hypodermal and unicellular in A. adscensionis. But earlier embryologists (Narayanswami, 1952 ; Chandra, 1963, 1970; Venkateshwarlu & Devi, 1964: Koul, 1970, a,b) have failed to observe this character. However, Untawale et. al. (1986) ; Raju (1980) ; Bhanwra and Choda (1986) reported unicellular Archesporium in members of poaceae. Similar condition is also reported by (Ghaisas,1991); Bhuskute 1990;Nikhade & Makde(1997). Multicellular archesporium reported by Rangaswami (1935) ; Raju (1980) and Bhuskute (1900). Brunkener (1975) suggested that the development of early anther need not be so specific and may show some flexibility particuiarly in the differentiation of archesporium. Present investigation also favours occurrence of variability in the archesporium condition.

Though 4-layered anther wall seems to be the characteristic feature of taxa belonging to poaceae, Seshavatharam and Satyamurti (1976) reported it to be 5-layered in forage grasses studied by them. Epidermis is a single layered remains intact at anthesis. The epidermal cells may become papillose and show the deposition of tannin in the form of granules. Bhandari and Khosla (1982) reported cuticular fibrillar projection in Triticale, such projectios are also reported by Gawali (1977) in the taxa studied by him.

The hypodermal endothecium develops fibrous thickening. However, sterile anthers do not show

such thickenings. A review by Gerenday and French (1988) reveals that whenever the dehiscence of anther is porate , the fibrous thickening are absent. The "Ubisch" granules reported by many workers, Bhanwara (1985,1988) however, did not mention about these granules in the plants studied by him. The single middle layer is ephemeral and be completely crushed or obliterated even before the microsporangium is fully mature and ready to dehisce (Swamy and Krishnamurthy 1980). This is also true in present investigation .

In the present investigation binucleate tapetum has been reported in A. adscensionis. Such a binucleate condition is also reported by Artschwager and Me Guire (1949), Bennett et. al (1973). The male sterility is related to the abnormal behavior of tapetum in anthers (Zenkteler, 1962: Chauhan and Singh 1966). The sporogenous cells are less which speaks at low output of pollen grains. (Bhanwra 1988 and Bhanwra et. Al,. 1991).

The successive cytokinesis results in isobilateral tetrads of microspores which is the uniform character in Poaceae. This is also substantiated by the present work.

The variation in the shape of male gametes has been reported by Kihara and Heri (1966) and Raju (1980) while working on the species of Triticum, Author feels that these observation are based upon sectioned material and variable shapes may be due to plane of sectioning. The mature pollen grains are 3-celled at the time of dehiscence of anther. Multinucleate pollen grains have been reported in Eleusine coracana, Pennisetum typhoideum and Panicum miliare (Narayanswami, 1952. 1953,1955 a). Sorghum vulgare (Darlington and Thomas, 1941); Artschweger and Mc guire 1949). Coix aquatica (Koul, 1970 a), in Brachiaria, Paspalidium, Sporobolus and Eleusine (Gawali, 1977).

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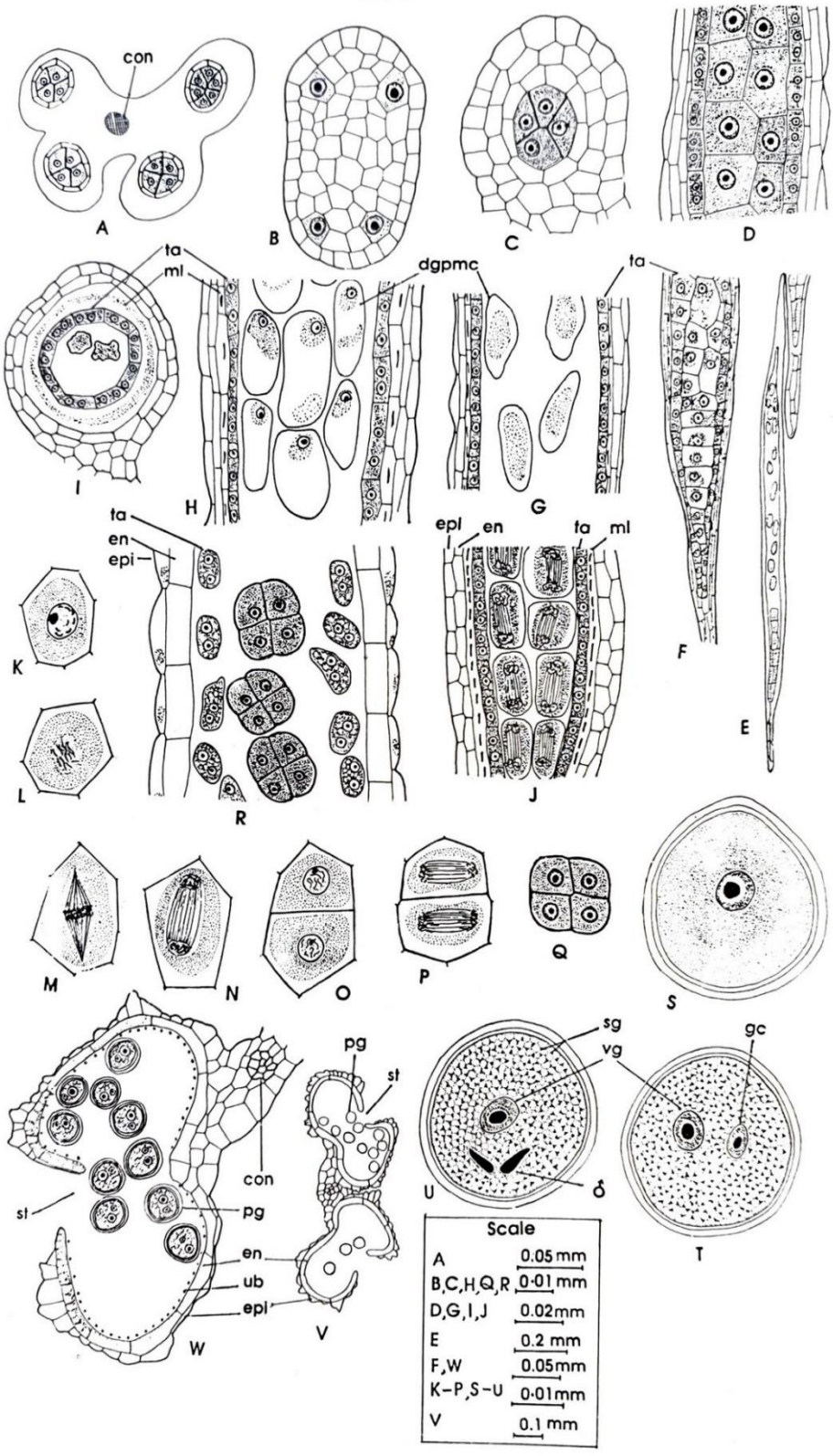
FIGURE 1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Scale
A 0.05 mm
B,C,H,Q,R 0·01 mm
D,G,I,J 0.02mm
E 0.2 mm
F,W 0.05mm
K–P,S–U 0·01mm
V 0.1 mm

EXPLANATION OF FIGURE : 1

A-W :*Aristida adescensionis Linn.*

(Microsporogenesis and Male gametophyte)

A : T.S. anther(diagrammaatic)

B : T.S.young anther showing male archesporium.

C : T.S.anther (part) showing 3 layered anther wall.

D :L.S. Anther(part)showing 4layered anther wall.

E : L.S.anther (diagramatic).

F :L.S. basal part of anther(E) magnified; note degenerating middle layer,Pollen mother cells &

persistent tapetum..

G :Middle part of anther (E) showing degenerating middle layer & persistent tapetum..

H : Apical part of anther(E) showing same stages mentioned in G.

I : T.S.anther (part) note degenerating middle layer and persistent tapetum.

J : L.S.fertile anther(part) showing meiosis I;note synchrony in division.

K-P :Stages in Meiosis I & II.

Q : Isobilateral microspore tetrad ; note callose wall.

R : L.S. anther (part) showing pollen tetrads, glandular tapetum; ; note alveolar cytoplasm in tapetal cells & persisting cytoplasm in epidermal cells.

S : Uninucleate pollen grain ; note psilate exine ,thin intine & dense cytoplasm.

T : 2-celled pollen grain; note alveolar cytoplasm & starch grains.

U : Mature pollen grain ; note male gametes..

V : T.S. mature anther.

W : Part of anther(V); note stomium, papiliose epidermis , fibrous endothecium restricted to stomium region & 'Ubisch' granules.

Abbrevations :

Con – Connective , ta – tapetum , ml – middle layer , dgpmc – degenerating pollen mother cell , en – endodermis , epi – epidermis , st – stomium , pg – pollen grain , ub – ubish , gc – generative cell , vg – vegetative cell ,