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EMBRYOLOGICAL STUDIES OF *STIPAGROSTIS PLUMOSA* (L.) MUNRO EX T. ANDERSON

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Abstract

Embryological studies of *Stipagrostis plumosa* (L.) Munro ex Anderson have been made. The development of anther wall is Monocotyledonous type. The tapetal cell is uni-nucleate and glandular. Middle layer is ephemeral and endothecial cells develop fibrous thickenings. The microspore mother cells undergo successive meiotic divisions and result in the formation of isobilateral microspore tetrads. The pollen grains are triporate and shed at 3-celled stage. The ovule is anatropous and bitegmic. The chalazal megaspore of a linear tetrad develops into Polygonum type of embryosac. Sometimes, the antipodal cells vary from 3-7 in number.

Introduction

The genus *Stipagrostis* is of maximum diversity in North American desert. It consists of about 50 species Cope, (1982), Mabberley (1997). Some of the species belonging to this genus are important from forage point of view. Among them *S. plumose* (L.) T. Anders is considered highly variable. The interspecific hybridization is suggested to be the reason for this variation (Scholz, 1972; Faruqi, 1980). *Stipagrostis ciliata* is the only species which is studied embryologically so far (Inamuddin & Maghboub, 1990) in which facultative type of embryosacs were reported. Embryological studies of *S. plumosa* (L.) Munro ex Anderson is described herein.

Material and Methods

The flower buds of *Stipagrostis plumosa* at different stages of development were collected from Nalut, Libya. The material was fixed in 3:1 ethyl acetic mixture. The dissected material was treated with 20% hydrofluoric acid for 24-hours to dissolve silica. The silica free material was then dehydrated in alcohol-xylol series and embedded in paraffin wax. The sections were cut at 7-9µ thickness and these were stained in safranin-fast green combination.

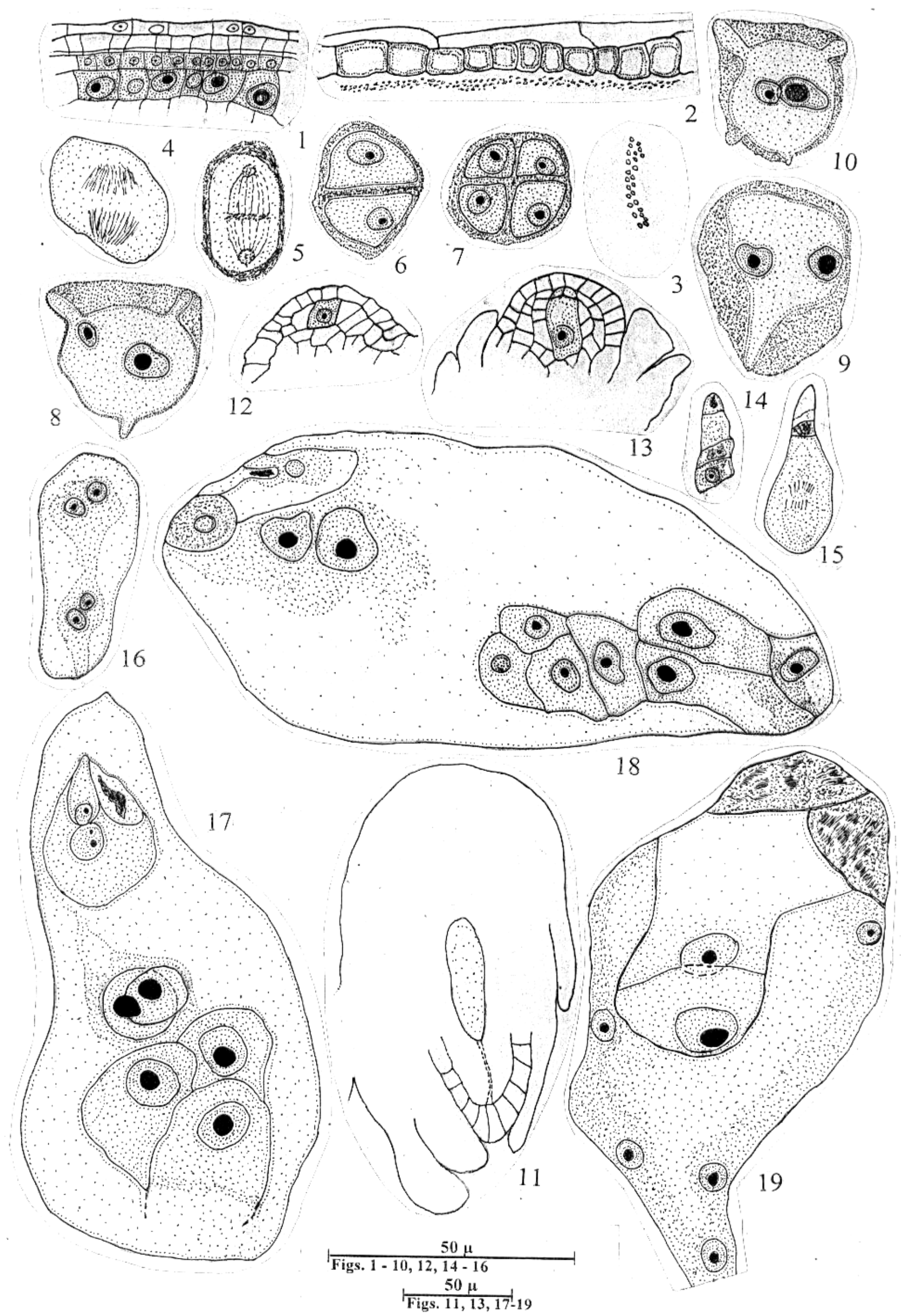
Results

Microsporangium, microsporogenesis and male gametophyte: The young anther of *S. plumosa* is composed of parenchymatous cells, surrounded by an epidermis. The hypodermal archesporial cell starts differentiating very early at four corners of each anther. The archesporial cell is comparatively larger in size and consists of dense cytoplasm with more prominent nucleus. Each cell divides periclinally into an inner and outer primary parietal layers. The inner primary parietal layer cells undergo mitotic divisions in various planes to give rise to sporogenous tissue consisting of two layers of cells towards the centre of the anther. The outer primary parietal layer cells further divide periclinally to give rise to anther walls, conforming to Monocotyledonous type (Davis, 1966) of development. Thus the anther walls consist of one layer of epidermis, endothecium, middle layer and a tapetal layer (Fig. 1). At maturity endothecial cells acquire fibrous thickenings and the middle layer is sandwiched between the enlarged endothecial and tapetal cells. The middle layer cells degenerate at the time of microsporogenesis. The tapetum is single layered, glandular and uni-nucleate (Fig. 1). Sometimes, tapetal cell divides and becomes 2-nucleate. It is interesting to note that after the formation of pollen grains the tapetal cell-wall breaks up and form small spherical granular bodies known as Ubisch's bodies (Figs. 2-3). These bodies remain adpressed to the inner wall of the endothecium. The microspore mother cell undergoes meiosis and successive cytokinesis results in the development of isobilateral microspore tetrads (Figs. 4-7). The young microspores are liberated in the anther locule and become rounded. The pollen grain nucleus divides into large vegetative and small generative nucleus (Fig. 8). The generative nucleus further divides and forms two sperm nuclei. Sometimes both vegetative and generative nuclei are equal in size (Fig. 9). The mature anther dehisces at 3-celled stage of pollen grains. The pollen grains are triporate but occasionally 1-4 pores have also been observed (Figs. 8-10). The mature pollen grains wall consists of outer thick exine and inner thin intine.

Megasporangium, megasporogenesis and female gametophyte: Some of the hypodermal cells of young placenta undergo cell divisions in various planes resulting in the formation of dome-shaped ovule primordia. The nucellus consists of a layer of cells. The inner integument appears first and later it is followed by the outer integument. During development, the ovule undergoes a gradual change of curvature until it becomes anatropous. Thus the mature ovule is anatropous, crassinucellate and bitegmic (Fig. 11). The micropyle is formed by the inner integument. Before initiation of the integuments a single archesporial cell develops immediately behind the nucellus (Fig. 12). It directly functions as megaspore mother cell (Fig. 13). The megaspore mother cell undergoes meiotic divisions resulting in the formation of a linear tetrad (Fig. 14). The upper three miropylar megaspores degenerate while the chalazal one becomes functional (Fig. 15). The functional megaspore undergoes three mitotic divisions resulting in the formation of 8-nucleate embryosac. Such nuclei organize into Polygonum type of embryosac (Figs. 16-17). Sometimes, the number of antipodal cells become 3-7 celled due to mitotic division (Fig. 18).

Fertilization and endosperm: The pollen tube passes through the stylar tissue without damaging its cells. Both synergids appear to persist even after the development of 2-celled embryo (Fig. 19). One small nucleus fuses with the egg and the other with secondary nucleus. But the actual discharge of the sperms and their fusion with the egg and secondary nucleus were not seen clearly.

The development of endosperm is nuclear type and it develops more rapidly than the embryo. Later the endosperm becomes cellular. The antipodal cells degenerate after zygote formation.



Figs. 1-19. *Satipagrostis plumosa*.

Fig. 1. L.S. anther showing wall layers and microspore mother cells.

Fig. 2. Mature endothecial layer cells showing fibrous thickenings and Ubisch's bodies.

Fig. 3. Ubisch's bodies in high power.
Figs. 4-6. Successive division of microspore mother cell.
Fig. 7. Isobilateral microspore tetrad.
Figs. 8-9. 2-celled pollen grains.
Fig. 10. 4-porate pollen grain.
Fig. 11. L.S. ovule showing anatropous condition.
Fig. 12. L.S. ovule with archesporial cell.
Fig. 13. L.S. ovule showing megaspore mother cell and nucellus.
Fig. 14. Linear megaspore tetrad.
Fig. 15. Dividing megaspore functional nucleus.
Fig. 16. 4-nucleate embryo sac.
Fig. 17. Mature embryosac.
Fig. 18. 7-celled antipodals.
Fig. 19. 2-celled proembryo and nuclear endosperm.

Discussion

The development of Monocotyledonous type of anther walls in *Stipagrostis plumosa* is essentially similar to other investigated members of the family (Davis, 1966). Conversely uni-nucleate tapetum is rare in the family Poaceae (Davis, 1966). However,presence of uni-nucleate tapetum in *Phalaris minor* (Inamuddin & Niazi,1987); *Panicum turgidum* (Inamuddin & Abdulla, 1990); *Stipagrostis ciliata* (Inamuddin & Maghboub, 1990) and *Stipagrostis plumosa* is an interesting feature. 1-porate pollen grains are common in the investigated members of the family Poaceae (Davis, 1966). However 1-4 porate pollen grains have been studied earlier in *Stipagrostis ciliata* (Inamuddin & Maghboub, 1990) and also in the present material. The presence of Ubisch's bodies in the anther of *S. plumosa* is an interesting feature of the family poaceae. Although such structure has been reported earlier in some other distant families (Bhojwani & Bhatnagar, 1977). The formation of isobilateral microspore tetrad in *S. plumosa* is in conformity with other investigated members of the family (Davis, 1966).

The development of Polygonum type of embryosac in *S .plumosa* is essentially similar to other investigated members of the family (Davis,1966).The presence of normal looking pollen grains and embryosac suggest that sexual reproduction is normal feature in the present taxon. However, in contrast facultative apomixis has been reported earlier in *Stipagrostis ciliata* (Inamuddin & Maghboub, 1990). Thus such observation gives an idea that occurrence of apomixis cannot be considered as characteristic feature of the genus. The presence of multiple antipodals of the present taxon is not a special feature, such type of antipodals have also been reported earlier in *Molenea coerulea* (Shadosky, 1926); *Caltha palustris* (Crafl, 1941); *Anemone nemrosa* (Trela, 1963); *Hordeum* spp., (Erdelska, 1966); *Ammophila arenaria* (Kubien, 1968); *Pennisetum divisum* (Inamuddin & Faruqi, 1982); *Phalaris minor* (Inamuddin & Niazi, 1987) and *Panicum turgidum* (Inamuddin & Abdulla, 1990).

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