Original Research Paper

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DIVERSITY AND EVOLUTION OF POLLEN APERTURE PATTERN IN ANGIOSPERMS

Botany

KEYWORDS: Pollen aperture pattern, evolution, monosulcate, triporate, pantoporate.

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ABSTRACT

The wall of pollen grains particularly outer wall exine shows impressive ornamentations and morphological variation. Diversity of aperture pattern in pollen is one of the main features of pollen morphology. This diversity is due to variation in pollen morphogenesis, which occurs during microsporogenesis. In monocots, pollen in many species is monoporate(monoaperturate), a single aperture located at the distal pole, but the shape of the aperture varies from monosulcate, trichotomosulcate to polychotomosulcate. But in dicots(eudicots), pollen is triporate(triaperturate) and three apertures are arranged in equatorial plane in most of the species and in remaining species di, tetra, penta or hexaaperturate. In Chenopodiaceae, Amaranthaceae, Convolvulaceae, Cucurbitaceae pollen is pantoporate/polyporate i.e. many apertures all around the surface of the pollen. Aperture pattern with reference to Borassus spp. belongs to Arecaceae of Monocotyledons and Phyllanthus spp. belongs to Leguminosae of Dicotyledons is shown.

INTRODUCTION

Pollen grains are produced from the anthers of the flower. Pollen is the male gametophyte of the plant. In the anther sporogenous tissue divide to form pollen mother cells. Pollen mother cell undergoes meiosis to produce four haploid pollen grains in the form of tetrad. Each tetrad may dissociate to form monads(single), rarely remain in the form of dyads(two), octads(eight) and polyads(many) or pollinia(aggregated). Each pollen grain is covered by a wall with two layers outer exine and inner intine. Exine is made up of sporopollen which is the most resistant and durable. Pollen grains differ in their symmetry, shape and particularly in their aperture pattern. Aperture is the opening or thinning of the exine where the intine is usually thick. It is the germination site, where the germination tube comes out.

APERTURE PATTERN IN POLLEN GRAINS

Erdtman classified pollen grains based on the number, position and character of the apertures. Aperture(s) play an important role in the identification of the plants. In Bryophytes, Pteridophytes and primitive extinct gymnosperms apertures are proximal trilete or monolete. In all extant gymnosperms the pollen grains are distal aperturate or inaperturate. In angiosperms the most primitive pollen grain is boat shaped monosulcate(Fig.1) type(Walker&Doyle, 1975; Hickery&Doyle, 1975; Hughes&McDougall,1987). This character of primitive angiosperms is continued from Cycas of Cycadales, Pinus, Abies and Cedrus of Coniferales, Ginko of Ginkgoales and in many primitive dicotyledonous angiosperms like Magnolia, Degeneria. Boat shaped monosulcate character has been preserved in many monocotyledons like Arecaceae and in some dicotyledons like Canellaceae(K.Bhattacharya, 2006).

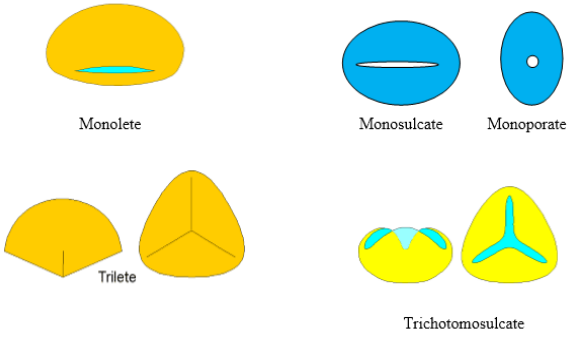
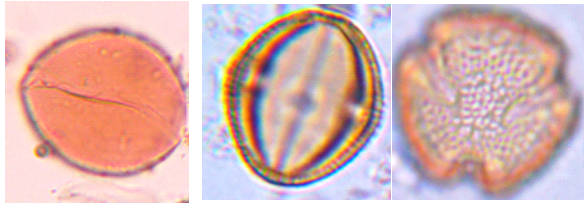


Figure 1: Aperture character in primitive angiosperms and monocots

EVOLUTION IN APERTURE FORMATION

The main trend of evolution of pollen aperture is the transformation of the distal monosulcus into tricolpate form. Tricolpate condition according to Takhtajan(1980) led to tricolporate or triporate condition. According to Chanda and Ghosh (1979), in early dicotyledons evolutionary changes occurred in two ways 1. From monosulcate to bisulculate(Calycanthaceae, Amaryllidaceae) to biporate(Trimeniaceae) to pantoporate. 2. From monosulcate to non-aperturate to tricolpate(Nelumbonaceae etc.).



(a) (b)

Fig. 2: (a) Monosulcate (*Borassus spp.*) (b) Tricolporate(*Phyllanthus spp.*) equatorial, Polar view

The fossil record strongly suggests that evolution led to increase in aperture number(J.W.Walker et al. 1975, M.Van Campo 1976). Because the aperture is the place where pollen tubes are intiated to interact with stigma, increase in aperture number has higher probability of germination. According to Isabelle Dajoz et al.(2004) pollen grains with four apertures germinated faster than the grains with three apertures. Pollen grains with increased number of apertures have the selective advantage of fertilization.

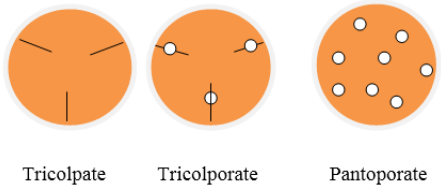


Figure 3: Aperture diversity in dicots

Gunnar Erdtman(1960) proposed two major groups of flowering plants. 1. Monosulcates with a single polar aperture and 2. Tricolpates with three equatorial pollen apertures. It was partially confirmed using DNA sequencing(chloroplast gene rbc L) and molecular phylogenetic reconstructions(combined multigene analysis) (C.A. Furness, 2004). In monocotyledons the dominance of

monocolpate(=monosulcate) pollen grains is seen(Figures 1 and 2), followed by trichotomosulcate and colpate forms. Nair(1970) pointed out the occurrence of monocolpates in 31 out of 46 families of monocots. The colporate form of dicots is totally absent in monocots. Species with tricolpate pollen apertures are now called as **eudicots.** They include about 75% of present day angiosperm species. A single polar aperture is found in basal angiosperms(Piperales), monocots, conifers and Gnetales. In most eudicots microspore tetrads are tetrahedral with three apertures(colpi) arranged equatorially. Eudicot colpi might be reduced to pores and number can increase to many as in the order Caryophyllales in which multiple pores are scattered over the pollen surface(pantoporate). In monoctos and primitive dicots, pollen is monosulcate or monosulcate reduced to monoporate.

CONCLUSION

The evolution of aperture condition from monosulcate to pantoporate is discussed here. In general, Gymnosperms, basal angiosperms and monocots have monosulcate or monoporate pollen. Monosulcus or polar pore is conserved in monocots whereas in eudicots rapid evolution led to equatorial tricolpate to pantoporate pollen diversity, which provide selective advantage of more germination sites in contact with stigma for fertilization.

REFERENCES

1. Carol A. Furness and Paula J. Rudall 2004. Pollen aperture evolution-a crucial factor for eudicot success?. TRENDS in Plant Science. 9: 154-158.
2. Chanda S & Ghosh K. 1979. In: Recent Trends & Contacts between Cytogenetics, Embryology &Morphology :171-185.
3. Erdtman G.(1960) Pollen walls and angiosperm phylogeny. Bot. Not. 113, 41-45.
4. Erdtman G.(1960) Handbook of Palynology. Munksgaard, Copenhagen.
5. Hickery LJ& Doyle JA. 1977. Bot. Rev. 43:3-104.
6. Hughes NF & McDougall AB 1987. Rev. Palaeobot. Palynol. 50: 255-272.
7. I.K. Ferguson and J. Muller, Eds. (Academic Press, New York, 1976),125-138.
8. Isabelle Dajoz, Irene Till-Bottraud, Pierre-Henri Gouyon 1991. Science 253: 66-68.
9. Nair PKK. 1970. Pollen Morphology of Angiosperms. Scholar Publ. House, Lucknow.
10. Takhtajan AL 1980. Bot. Tev. 46: 225-359.
11. Walker JW & Doyle JA 1975. Ann. Missouri Bot. Gard. 65: 664-723.