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Patterns of amyloplast distribution during microsporogenesis in *Tradescantia*, *Impatiens* and *Larix*

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Abstract

During the meiotic prophase I in *Tradescantia* and *Impatiens* microsporocyte becomes temporarily asymmetric, with excentrically situated nucleus and all amyloplasts gathered in a dense group close to the nuclear envelope. Further microsporogenesis in *Impatiens* differs in amyloplast distribution from that in *Tradescantia* and *Larix*. In *Impatiens* at the telophase I amyloplasts are assembled in a dense equatorial plate. At the late telophase II this plate reshapes and separates a meiocyte into four areas (a tetrad) until cell plates are formed in simultaneous cytokinesis. Similar assemblages of amyloplasts do not occur in telophase meiocytes of *Tradescantia* and *Larix* where cytokinesis is of a successive type.

Key words: amyloplasts in microsporogenesis, microsporogenesis

INTRODUCTION

Before the introduction of electron microscopy it was difficult to distinguish mitochondria from proplastids in the meiotic cells. There were, however, observations of some regular changes in localization of cytoplasmic organoids during microsporogenesis in seed plants and sporogenesis in *Pteridophyta*. These organoids referred usually as mitochondria were distributed in consecutive stages of meiosis according to certain patterns, and the term chondriokinesis was introduced to describe their movements. Several types of chondriokinesis characteristic of various species were distinguished (Bąkowski 1938).

Very clear pictures of plastid and mitochondrion distribution in microsporogenesis in *Ginkgo biloba* have been seen by means of light and electron microscopes (Wolniak 1976). Both types of organoids are

randomly situated in first prophase meiocytes, but after the first telophase they form a dense and thick layer dividing the cell into two mononucleate spaces. The layer persists until the second telophase and the organoids are apportioned during the simultaneous cytokinesis. A similiar layer of mitochondria and plastids occurs at the first telophase in *Equisetum* meiocytes (Bednara and Rodkiewicz 1984). It persists until the second telophase and then it is reshaped to separate four arising spores. Along the middle of this four-lobed layer the cell plates of a tatrad are set up.

MATERIAL AND METHODS

Anthers of about two hundred angiospermous species of several dozen genera were surveyed in order to find starch grains in the meiotic cells. The starch was found in meiocytes of *Tradescantia (Commelinaceae)* and *Impatiens* (*Balsaminaceae*).

Anthers of *Tradescantia virginica* L., *Tradescantia viridis* hort., *Impatiens balsamina* L. and *Larix decidua* Mill. fixed in a 3 : 1 mixture of ethyl alcohol and acetic acid were stained *in toto* with PAS (periodic acid, Schiff) for polysaccharides. Red starch grains in amyloplasts were observed in squash preparations.

RESULTS

Amyloplasts due to their starch grains were very distinctly visible after PAS or iodine staining; therfore, the distribution of amyloplasts during microsporogenesis could be easily followed. We discerned two different patterns of amyloplast distribution: 1) characteristic of *Impatiens* (Fig. 1), 2) characteristic of *Tradescantia* and *Larix* (Fig. 2).

During the first meiotic prophase the distribution of amyloplasts was similar in both patterns. Amyloplasts of early meiotic cells were distributed randomly. This distribution changed with the advancement of prophase and all amyloplasts gathered in one dense group close to the nuclear envelope (Figs. 1b, 2b), but we failed to find such groups in meiocytes of *Larix*. At this stage a meiocyte was somewhat elongated

PLATE I

Fig. 1. Microsporogenesis in *Impatiens balsamina*, starch grains after PAS staining (× 1200)

a— first meiotic prophase; b — later stage, group of amyloplasts in a prophase meiocyte; c — late prophase I; d — meiocyte after the telophase I, heavily squashed; e — a similar stage, slightly squashed; f — telophase II; g — tetrad; h — microspores in a heavily squashed tetrad; i — young microspore

PLATE I

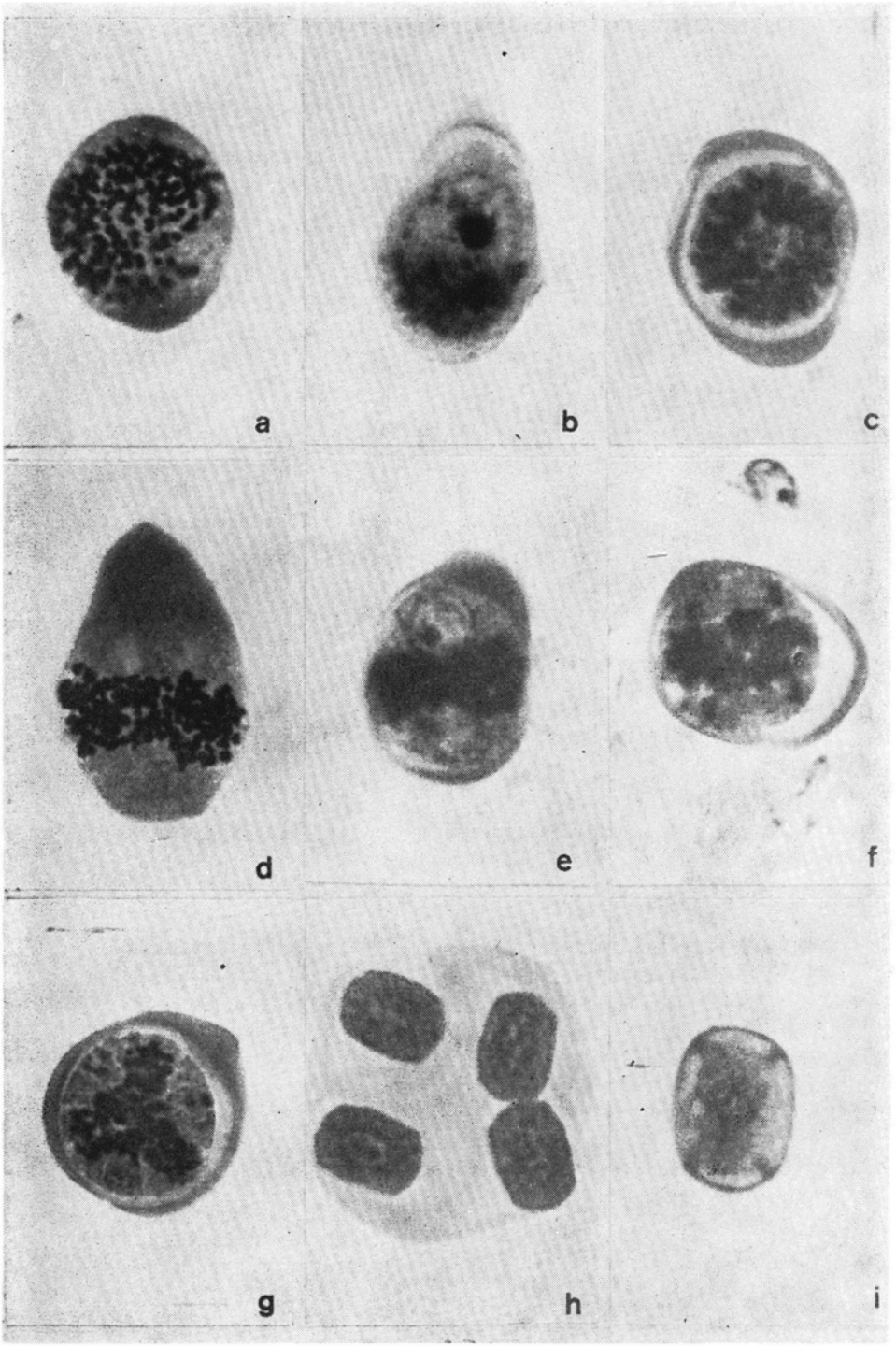
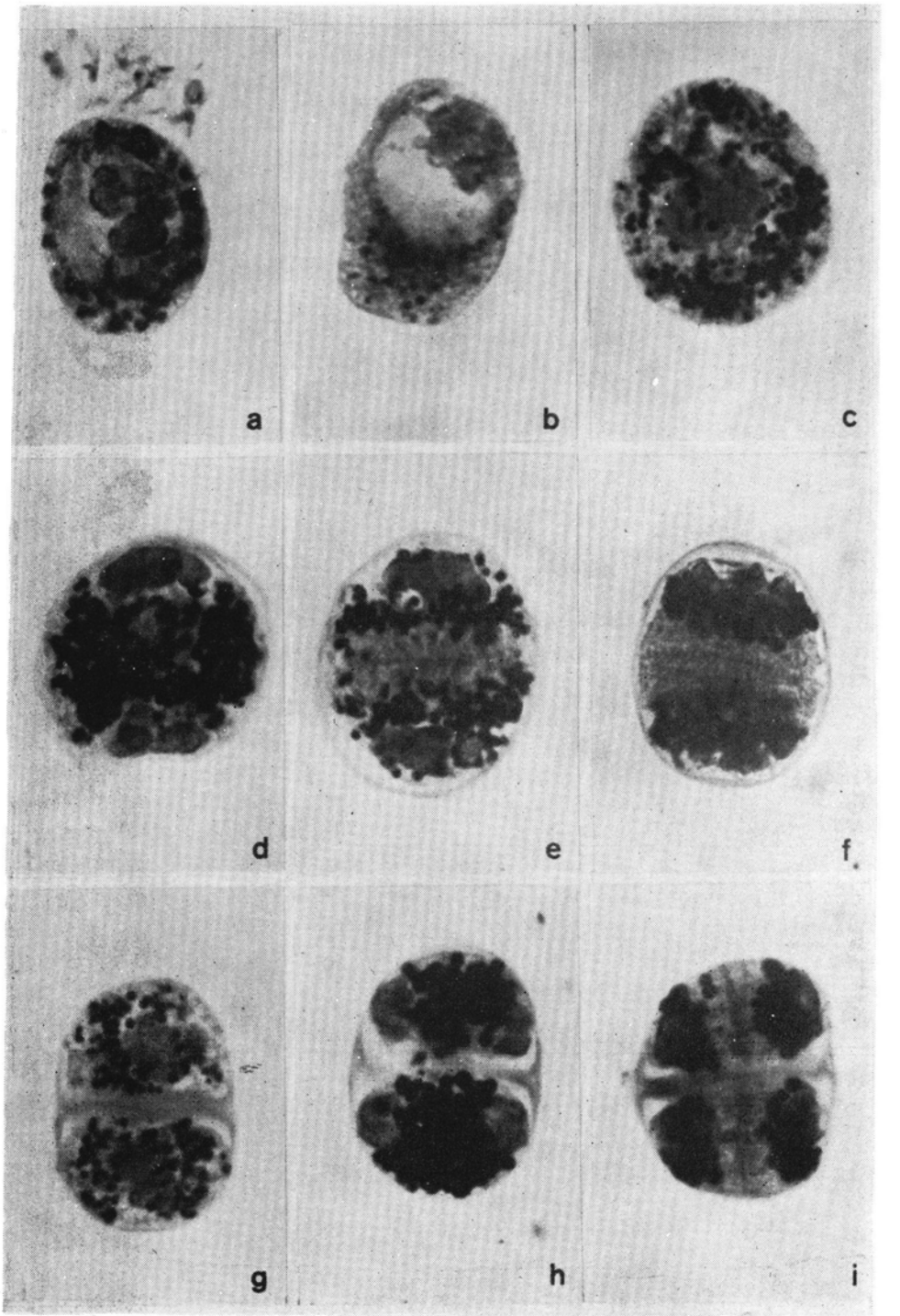


PLATE II



with the cell nucleus in an asymmetrical position at the apex of the cell. The group of amyloplasts dispersed before the first prophase was concluded. Amyloplasts were again randomly distributed around the nucleus which has shifted to the centre of the cell.

Two patterns of amyloplast distribution were noticeable since the late first telophase. In *Impatiens* at that stage all amyloplasts occupied the equatorial plane, forming there a dense plate or layer separating the cell into two areas (Figs. 1d, e). This plate persisted during the second meiotic cycle of both nuclei which divided synchronously. At the end of the second telophase the layer was reshaped and formed four--lobed structure (Fig. 1g). Two of its lobes lay between the nuclei of second posttelophase pairs. Then the cell plates appeared and amyloplasts were grouped at the proximal side of each tetrad cell, while the nucleus lay close to the distal wall.

Amyloplasts of *Tradescantia* and *Larix* meiocytes at the late first telophase were loosely placed in a large space between the nuclei (Fig. 2d). At the beginning of cytokinesis this loose group was divided in two parts separated by a wide space of cytoplasm where a cell plate was built (Figs. 2e, f). In a diad amyloplasts encircled the nuclei and at the end of the second meiotic telophase again occupied a middle zone of each cell. In the early tetrad stage amyloplasts were at proximal walls, nuclei at distal ones.

DISCUSSION

All amyloplasts of *Impatiens* microsporocyte after the first meiotic telophase gather in a layer along the equatorial plane thus dividing the cell into two mononucleate parts. We may assume, though we have not yet made electron microscopic investigations, that mitochondria were included in this layer, as they are present together with plastids in similar arrangements of organoids described in meiocytes of the homosporous ferns: *Onoclea sensibilis* (Marengo 1977) and *Pteris aquilina* (Sheffield and Bell 1979), in microsporogenesis in the gymnosperms: *Podocarpus macrophylla* (Vasil and Aldrich 1970) and *Ginkgo biloba* (Wolniak 1976), *Equisetum hyemale* (Bednara and Rod-

PLATE II

Fig. 2. Microsporogenesis in *Tradescantia virginica*, starch grains after PAS staining (× 1200)
a — first meiotic prophase; b — later stage, group of amyloplasts at the nuclear envelope; c — late prophase I; d — meiocyte after the telophase I; e — beginning of cell plate formation; f — a cell plate separates diad cells; g — prophase II in a diad; h — after the telophase II; i — cell plates formation in a diad

kiewicz 1984). Only the organoid band or layer described in a moss *Rhynchostegium serrulatum* differs in that it does not involve plastids. In *Rhynchostegium* the four plastids respond to an earlier quadripolarity of the sporocyte and are regularly distributed one to each of the future second telophase poles early in prophase of the first meiotic division (Brown and Lemmon 1982).

In *Impatiens* (Fig. 1) and *Equisetum* (Bednara and Rodkiewicz 1984) the equatorial organoid layer persists until the second meiotic telophase and than spreads between the posttelophase nuclei. Similar organoid layers seem to occur in meiocytes of widely different species. In all these meiocytes meiosis concludes in formation of a tetrad after simultaneous cytokinesis. In contrast during microsporogenesis in *Tradescantia* (Fig. 2) and *Larix* there is a successive cytokinesis, and the organoid layer is not formed. Therefore, it appears that the organoid layer primarily plays the role of a barrier which separates cytoplasmic areas of diad and tetrad cells before the cell plates and cell walls are built.

The cell plates grow along through the middle of the organoid layers. Thus, this type of organoid arrangement may insure to some extent equal apportionment of organoids among postmeiotic cells as suggested by Wolniak (1976), Brown and Lemmon (1982) and Dupuis (1978) in *Impatiens*.

The early prophase I gathering of all amyloplasts in one group at the nuclear envelope (Figs. 1b, 2b) is not obviously related to the formation of an organoid layer in the later stage. Amyloplasts are grouping in the meiocytes of both *Tradescantia* and *Impatiens*, but only in the latter is the organoid layer formed. Formation of the organoid group at the prophase I nucelus seems to be inexplicable but perhaps not restricted to these species; it has been observed in *Equisetum* sporocytes (Bednara and Rodkiewicz 1984), polarized microsporocytes have been seen in *Pinus* (Walles and Rowley 1982).

REFERENCES

Bąkowski Z., 1938. Versuch einer Klassifizierung der Chondriokinese bei Kormophyten. Acta Soc. Bot. Pol. 15: 323-368.

Bednara J., Rodkiewicz B., 1984. Distribtution of plastids and mitochondria during sporogenesis in *Equisetum*. (in press).

Brown R. C., Lemmon B. E., 1982. Ultrastructural aspects of moss meiosis: cytokinesis and organelle apportionment in *Rhynchostegium serrulatum*. J. Hattori Bot. Lab. 53: 41-50.

Dupuis F., 1978. Etude ultrastructurale de la microgamétogenèse chez l'*Impatiens balsamina* L.: de la diade à la tetrade. Bul. Soc. Bot. Fr. 25: Acta Bot. 19-25.

Marengo N. P., 1977. Ultrastructural features of the dividing meiocyte of *Onoclea sensibilis*. Amer. J. Bot. 64: 600-601.

Sheffield E., Bell P. R., 1979. Ultrastructural aspects of sporogenesis in a fern *Pteridium aquilinum* (L) Kuhn. Ann. Bot. 44: 393-405.

Vasil I. K., Aldrich H. C., 1970. A histochemical and ultrastructural study of the ontogeny and differentiation of pollen in *Podocarpus macrophyllus* D. Don. Protoplasma 71: 1-37.

Walles B., Rowley J. R., 1982. Cell differentiation in microsporangia of *Pinus sylvestris* with special attention to the tapetum. I. The pre- and early-meiotic periods. Nord. J. Bot. 2: 53-70.

Wolniak S. M., 1976. Organelle distribution and apportionment during meiosis in the microsporocyte of *Ginkgo biloba*. Amer. J. Bot. 63: 251-258.

Wzory rozmieszczenia amyloplastów podczas mikrosporogenezy u Tradescantia, Impatiens i Larix

Streszczenie

Podczas pierwszej mejotycznej profazy mikrosporocyty w pylnikach *Tradescantia* i *Impatiens* przybierają na krótki czas asymetryczną budowę. Jądro komórkowe przesuwa się w pobliże ściany, a przy błonie jądrowej gromadzą się wszystkie amyloplasty układające się w jedną zwartą grupę. Dalsza mikrosporogeneza w pylniku *Impatines* różni się sposobem rozmieszczenia amyloplastów od mikrosporogenezy u *Tradescantia* i *Larix*. W pierwszej telofazie amyloplasty *Impatiens* zbierają się w zwartą równikową płytkę lub warstwę. Podczas później, drugiej telofazy warstwa amyloplastów zmienia kształt tak, że rozdziela tetradę na cztery obszary aż do czasu kiedy w równoczesnej cytokinezie utworzą się przegrody pierwotne. Podobnych warstw amyloplastów nie ma w telofazie mikrosporocytów *Tradescantia* i *Larix*, gdzie zachodzi cytokineza sukcesywna.