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Early stages of embryo development in *Delphinium paniculatum* Host

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Abstract

The zygote in *Delphinium paniculatum* divides transversely like that of *D. staphisagria* and *D. elatum*. As regards the destination of the apical and basal cells this type of embryo development is new in the classification of Souèges (1948) and has been called *Delphinium* type.

INTRODUCTION

The embryo development in *Delphinium paniculatum* is similar to that in *D. staphisagria* and *D. elatum* (Babis 1979). In the latter species the zygote divides transversely and further embryogenesis is dependent on this division. The development of the embryo in the above named 3 species is interesting above all because in other species the zygote division may be oblique, very oblique or longitudinal, and in connection with this embryogenesis in them is different. In *D. staphisagria*, *D. elatum* and *D. paniculatum* the development of the embryo may be classified to the first period of classification (Souèges 1948). The type of this development is new in this classification.

METHODS

The embryos were prepared out from the ovary and fixed in Navashin's modified CrAF fixative: 0.4-0.5-20.0 for 24 h. The material was embedded in paraffin and cut on a microtome along the symmetry plane of the embryo. The preparation were stained with Erlich's haematoxylin.

RESULTS

The first division of the *D. paniculatum* zygote is transverse and perpendicular to the cell axis. Two cells arise, the upper one of which, *ca*, is several times smaller than the lower, one, *cb*, (Plate — fig. 1). It may be assumed, on the basis of the structure of the embryo of several cells in which the wall separating the daughter cells of the apical one from the basal one is distinctly inclined, that sporadically the first

zygote division may also be oblique (Plate — figs. 9, 15). The *cb* cell is the next to divide. The newly formed wall is more or less parallel to the previous one and to the proembryo basis. The third successive division occurs in the apical *ca* cell. This cell divides longitudinally into two daughter cells lying next to one another on one level (Plate — figs 5, 7, 8). In one proembryo the first *ca* division was quite different. The *ca* cell divided transversely forming two upper tiers *l* and l^1 (Plate — fig. 6). In this case a linear tetrad formed. In general a tetrad V_1TT, VTT and TTT may occur in *D. paniculatum*.

Five- and six-cell proembryos may differ in structure in dependence which segment of the tetrad divides earlier or in which cells simultaneous divisions occurred. In a 5-cell proembryo the apical tier is bicellular, whereas the *m* tier may be uni- or bicellular like tier *ci* (Plate — figs 8, 9). A characteristic trait of these two 5-cellular proembryos is that the wall separating *m* from *ci* is transversal-oblique, therefore the upper daughter cells *ci* will probably compensate the middle tier. The latter in such a case would not be homogeneous. Six-cell proembryos may have 3 tiers, although mostly they have four (Plate — figs 10, 11, 12, 13). At this stage of development the *ci* cell is already divided into two daugther cells lying one above the other and forming two tiers, a higher one *n* and *a* basal one n^1. In nearly all cases the *ci* cell divides transversely, although in one case an oblique division was noted (Plate — fig. 11). The newly forming wall, however, joins always to the external walls of the embryo. As the result of so highly oblique a division, the upper daughter cells n^1 will compensate the higher lying tier *n* and in this connection this tier will in the future become nonhomogeneous.

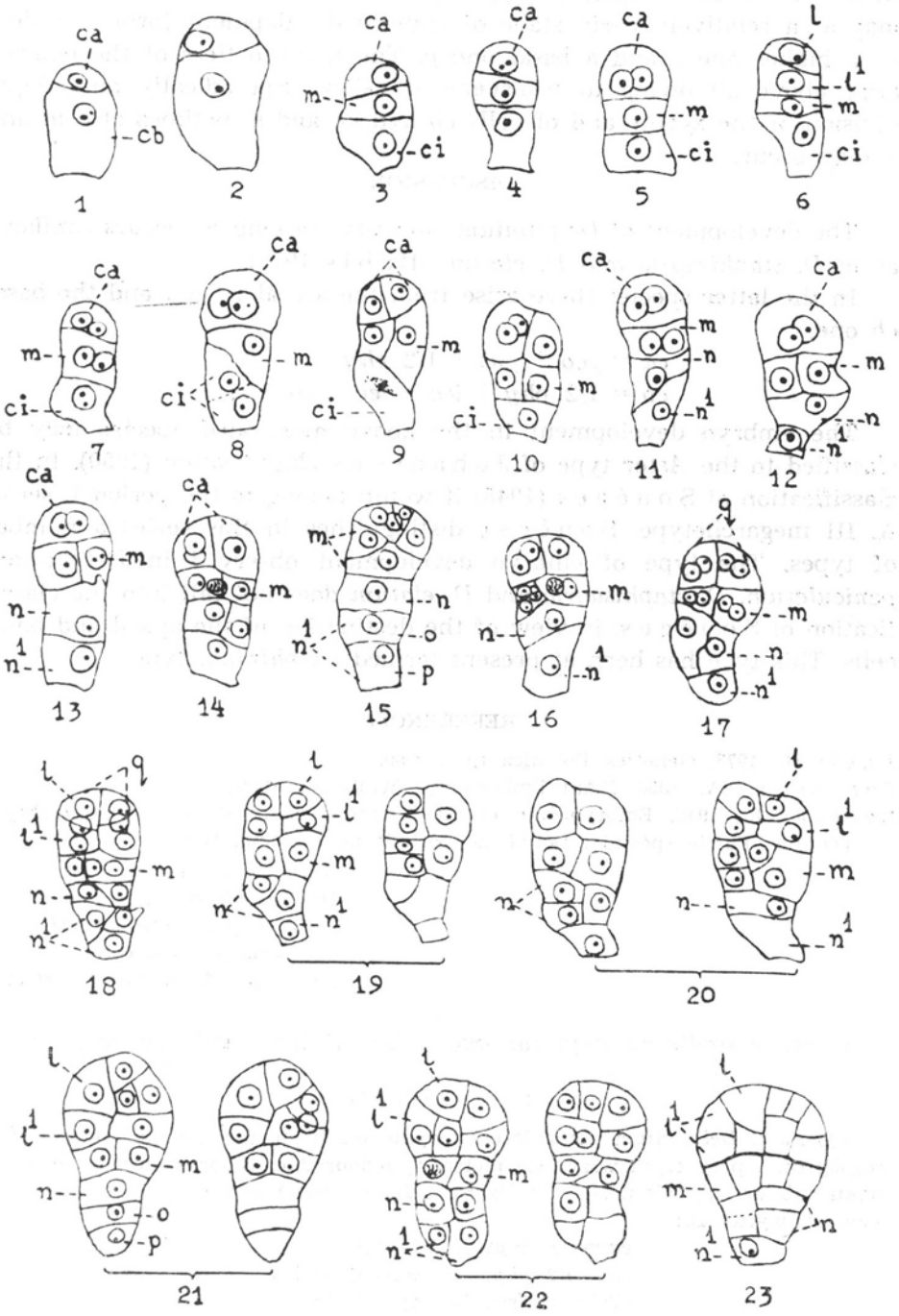
The *ca* cell divides twice longitudinally forming four quadrants *q*. Each one of these then undergoes transverse division. Of the 8 cells formed in this way four constitute the upper layer *l*, and the remaining four the lower one l^1. No deviations from this system *q* of division were observed. Thus, it is a type of division occurring regularly in *D. paniculatum* (Plate — figs 18, 19, 20, 21, 22).

The *l* and l^1 layers will in the future form the complex of epiphyseal cells and the cotyledones as well as the upper part of the hypocotyl. The upper tier of the embryo consists usually of the derivative cells of the apical *ca* cell, thus it is a homogeneous tier.

The *m* cell divides longitudinally (Plate — figs 7, 11 and 9, 10). As the result of this a 4-cell tier *m* is formed (Plate — fig. 17). Each of these cells can divide transversely or periclinally (Plate — figs 19, 20) and longitudinally. If longitudinal divisions occur more frequently a unilayer tier *m* of ceveral cells arises (Plate — fig. 23). The lower part of the hypocotyl differentiates from the *m* cell.

Cell *n* divides twice longitudinally (Plate — figs 18, 20), similarly to cell *m*. Sporadically an oblique division may occur, this does not,

Plate



Initial stages of embryo development in *Delphinium paniculatum*. Magnification of drawings ca. × 300.

however, change the destination of this tier (Plate — fig. 19), from which in the future the complex of hypophyseal cells will differentiate. Cell n^1 may at a relatively early stage of embryo development form two tiers — a higher one *o* and a basal one *p*. The definite tiers of the embryo arise above all owing to transverse divisions. Sporadically an oblique division of the zygote and of cells *cb* and *ci*, and sometimes also *m* and *n* may occur.

DISCUSSION

The development of *Delphinium paniculatum* embryo occurs similarly as in *D. staphisagria* and *D. elatum* (Babis 1979).

In the latter species there arise from the apical *ca* cell and the basal *cb* one.

$$ca = pco + pvt + 1/2\ phy$$
$$cb = 1/2\ phy + icc + iec + co + s.$$

The embryo development in the above mentioned species may be classified to the *Aster* type of Johansen's classification (1950). In the classification of Souèges (1948) it would belong to the period I, series A, III megarchetype. Souèges distinguishes in this series a number of types. The type of embryo development observed in *Delphinium paniculatum, D. staphisagria* and *D. elatum* does not fall into the classification of Souèges, in view of the destination of the apical and basal cells. This type has been at present termed *Delphinium* type.

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Wczesne stadia rozwoju zarodka u Delphinium paniculatum Host.

Streszczenie

Zygota u *Delphinium paniculatum* zwykle dzieli się poprzecznie. Tetrada jest trójpiętrowa, przy czym wszystkie piętra są jednorodne. Embriogeneza u tego gatunku odbywa się jak u *D. staphisagria* i *D. elatum*. Komórka apikalna *ca* i bazalna *cb* wytwarza:

$$ca = pco + pvt + 1/2\ phy$$
$$cb = 1/2\ phy + icc + iec + co + s$$

(Tabl. na str. 360, rys. 1—23).

Wymienione gatunki reprezentują nowy typ rozwoju zarodka nie ujęty w klasyfikacji Souègesa (1948). Typ ten został nazwany typem *Delphinium*.