Yosinori SUGIHARA*: Further development of embryo of *Cupressus sempervirens* L.

杉原美徳*: セイヨウヒノキの胚発生（続報）

In an earlier paper on the embryogeny of *Cupressus sempervirens*, the present writer described the development of proembryo as a new type in conifers (Sugihara 1956). In the present report further development of embryo (early embryogeny) is described. The material used for this study was collected from the tree used in the previous work. The whole embryo was dissected out from the ovule and was stained in ruthenium-red solution.

By the proembryonal second mitosis four nuclei are formed. Then, wall formation takes place between the four nuclei, and each nucleus is wrapped completely with the cell wall. The resulting four cells are disposed in two tiers with each one containing one, two or three cells. The upper tier is the primary upper tier and the lower one is the primary embryonal tier. At this stage the proembryonal development comes to an end. Consequently, in the proembryonal development of this plant, the free nuclear proembryonal stage and the primary proembryonal stage are found but internal division and the secondary proembryonal stage are not found. In the next stage the primary upper cell begins to elongate directly as a suspensor carrying the primary embryonal cell at its tip (Fig. 1 a-c). After the suspensor has somewhat elongated, the apically situated embryonal cell is divided into two cells by a horizontal wall. Then, the cell situated next to the suspensor elongates as a embryonal suspensor carrying the embryonal cell at its tip (Fig. 1 d-e). Formation of embryonal suspensor in the same manner takes place repeatedly once or twice (Fig. 1 f-g). The suspensor and the embryonal suspensor grow not so windingly as those of many other conifers. In the next stage, the embryonal cell begins to divide repeatedly to form a mass of embryonal cells. The cells of the proximal part of the mass elongate as embryonal tubes and those of the distal part develop to the embryo proper (Fig. 1 h). There are not found cleavage polyembryony but sometimes accidental lobing of embryo is found (Fig. 1 i-j). In some cases two or three

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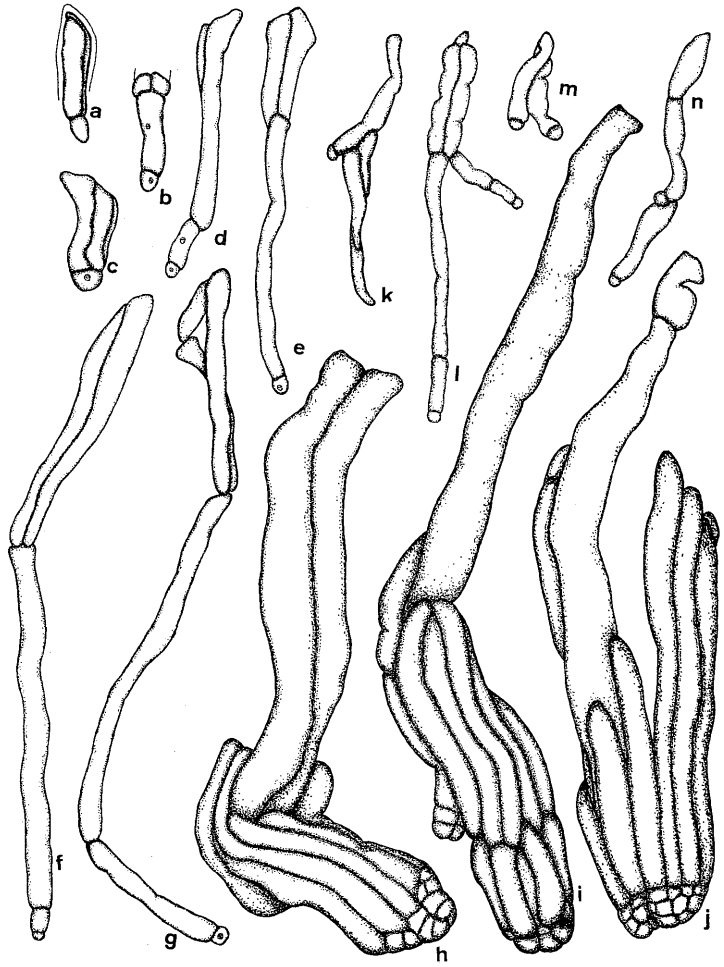

Fig. 1. Embryo of *Cupressus sempervirens*. ×90. a-c, Early stage of the suspensor elongation. d-e, Early stage of the embryonal suspensor elongation. f-g, Early stage of the secondary embryonal suspensor elongation. h, Early stage of elongation of the embryonal tubes. i-j, Accidental lobing of an embryo. k, Two primary embryonal cells elongate abnormally. l, Elongation of separate embryonal suspensor at the tip of a suspensor. m-n, Separate suspensor developed from a proembryo.

primary embryonal cells are found at the tip of suspensor. These cells, sometimes, develop independently to form a separate embryonal suspensor (Fig. 1 k-l). In such cases there are found cleavage polyembryony. In the other cases two cells out of four in a primary proembryo elongate respectively as a separate suspensor, each of which carries a primary embryonal cell at the tip (Fig. 1 m-n). In these cases cleavage polyembryony may be found.

In such species of conifers and taxads, as *Actinostrobus* (Saxton 1913), *Callitris* (Saxton 1910a, Looby & Doyle 1940, Baird 1953), *Widdringtonia* (Saxton 1910b), *Fitzroya* (Doyle & Saxton 1933), *Athrotaxis* (Saxton & Doyle 1929, Brennan & Doyle 1956) and *Torreya* (Robertson 1904, Coulter & Land 1905, Buchholz 1940, Tahara 1942, Tang 1948), the wall formation of proembryo takes place in four nuclei and then internal division occurs. Consequently, the secondary proembryo is found. In *Cupressus sempervirens* the simplified primary proembryo is found but internal division and the secondary proembryo is not found. The primary upper cell elongates directly as the suspensor. The primary embryonal cell differentiates as the embryonal suspensor, embryonal tubes and the embryo proper. In conclusion, the embryogeny of *Cupressus sempervirens* seems to be derived from the basal type in conifers (Doyle 1954, 1963, Dogra 1967, 1978, Singh 1978) and one of the most advanced types in the conifer embryogeny.

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筆者は1956年にセイヨウヒノキの前胚形成が特殊なことを報告した。このたびそれに引き続く胚発生の状態を報告する。前胚は 4 自由核形成後に隔壁形成がおこるが，それにより前胚の自由核期はおわり，一次前胚期となる。内分裂 (internal division) はみられず，したがって二次前胚期はない。ついで一次上層細胞が伸びて胚柄になる。胚柄の先端の一次胚性細胞はその後に分裂して，胚原胚柄 (embryonal suspensor)・束胚柄 (embryonal tubes) と胚の本体を形成する。分裂多胚形成は通常はないが，ときには偶発的な胚の分裂をする。しかし胚柄の先端に一次胚性細胞が 2～3 個あるときには，それ等が別々の胚をつくることにより分裂多胚形成をすることがある。また一次前胚期の 4 細胞のうちの 2 細胞が別々に分離した胚柄として伸びだすと，分裂多胚形成となる。本種の胚発生は毬果植物の胚発生の基本型から導かれたきわめて単純化した，最も進んだ胚発生の一型と考える。