Anatomy of the mature embryo and seedling of *Picea smithiana* (Wall) Boiss

K. Venkataratnam, B. Chacko, B. D. Deshpande and S. K. Pillai

Department of Biological Sciences, Birla Institute of Technology and Science, Pilani 333031

MS received 27 September 1973

(Communicated by Prof. V. Puri, F.A.Sc.)

**ABSTRACT**

The anatomy of the mature embryo and 34-day old seedling of *Picea smithiana* (Wall) Boiss. has been described. The organization of the shoot and root apices in both is similar. The shoot apex shows five cytological zones, where the entire surface layer shows periclinal divisions and a small subapical initials zone. In the radicular and root apices there is a common initiating zone for the stele and columella in the centre surrounded by another common initiating zone for the cortex and peripheral region of the root cap. In the mature embryo the *kappe* divisions of the protoderm resulting in the peripheral region of the cap can be noted, which, however, disappear in the root of the seedling. The 34-day old seedling shows a root-hypocotyl-cotyledon vasculature without any connection with the shoot, where no vasculature has yet developed.

**INTRODUCTION**

Reports on the structure of the mature embryo and seedling of gymnosperms are rare (Buchholz and Old 1933; Schopf 1943; Allen 1947a, b; Tepper 1963, 1964; Gregory and Romberger 1972; Riding 1972). The shoot apex of the adult plant of *Picea smithiana* has been studied by Shah and Thulasi (1967). This report presents information about the anatomy of the mature embryo and 34-day old seedling of *Picea smithiana*.

**MATERIALS AND METHODS**

Seeds of *Picea smithiana* (kindly supplied by Prof. R. V. Singh, Department of Forestry, Himachal Pradesh University, Solan, Simla Hills) were soaked in water for an hour, the seedcoat removed and the embryo fixed. Seeds germinated only after a cold treatment at about 5°C for 25 days or

---

*This work has been financed in part by a grant made by the United States Department of Agriculture, Agricultural Research Service, authorised by Public Law 480.*

101
more. The treated seeds were sown in the soil in September 1972, and they germinated in about 15 days. All materials were fixed in formalin-acetic acid-alcohol, processed through the alcohol-xylol series and embedded in paraffin. Serial sections, transverse and longitudinal, of the mature embryo and shoot and root apices of the seedlings, were cut at 8 μ thickness. Transverse sections of the seedlings were taken at 15 μ thickness for studying the root-shoot transition. Northan's variation of Foster's schedule (Johansen 1940) for tannic acid-iron chloride and safranin was used in most cases. Chlorazol Black E also gave good results.

**Observations**

The shoot apex of the mature embryo is dome-shaped initially (figures 1 and 22), and conical after soaking in water (figure 2). The shoot apex of the 34-day old seedling, though bigger, exhibits the same shape, and the first needle primordia become evident (figures 3 and 23). The average height and width of the shoot apex of the mature embryo are 91.32 μ and 205.02 μ and of the seedling 139 μ and 250.2 μ respectively. Tanniferous contents are noticed in the seedling apices.

In the embryonic apex many granular contents are noticed in the cells, which disappear with germination and advancement of growth (figure 22).

*Zonation of the shoot apex*—The following zones are evident.

Zone 1. *The apical initials*—These cells occupy the summit of the apex and in the mature embryo range from 6 to 8 (figure 22). In the 34-day old seedling apex their number is only 4 or 5 (figures 23). Shah and Thulasi (1967) have reported 2 to 6 apical initials in the adult plant apices.

The apical initials are large with spherical, deeply staining nuclei and cell contents. In the cells of the mature embryo the nuclei are more prominent and occupy three-quarters of the cell volume. The cell walls are more or less uniformly thickened and the corner thickenings reported by Shah and Thulasi (1967) were not observed. Both anticlinal and periclinal divisions occur with the former predominating (figures 22). Periclinal divisions in the apical initials contribute to the subapical initials proximally, the distal derivatives persisting as the apical initials. Periclinal divisions in the shoot apical cells of the young embryo at cotyledonary initiation was reported by Gregory and Romberger (1972) in *Picea abies*. Periclones have been reported in the apical cells of the mature shoot of *Torreya californica* by Kemp (1943), four species of Cupressaceae by Al Sherifi (1952), five species of Conifers by Jackman (1960), *Cephalotaxus drupacea* by Singh (1961), *Cupressus* species by Pillai (1963 a), *Thuja orientalis*, *Thuja compacta*, *Juniperus chinensis* and *Callitris robusta* by Pillai (A. 1963 a).