3 Seedless Vascular Plants

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3.1 Introduction

Prior to research with the electron microscope, little detailed information was available on the ontogeny and structure of the sieve elements in seedless vascular plants. About all that could be said about the mature sieve-element protoplasts in this diverse group of plants was that they generally had a very clear appearance, contained variable numbers of structures called refractive spherules, and apparently lacked nuclei. Little was known about the connections or sieve-area pores between contiguous sieve elements in the seedless vascular plants because their pores are too small (0.5 μm or less in diameter in most plants) to be satisfactorily examined with the light microscope.

Motivated largely by electron microscopy, which enabled them to reveal details of ontogeny and structure unobtainable with traditional light microscope methods, investigators began to turn their attention to the phloem in seedless vascular plants, beginning with the studies by Maxe (1964, 1965, 1966; Liberman-Maxe 1968) on the phloem of the fern Polypodium vulgare. Since then the phloem of representatives of every major taxon of seedless vascular plants has been studied with the electron microscope. From these studies, a rather clear picture has emerged of the ontogeny and structure of the sieve elements in the ferns and their so-called allies.

Typically, the sieve elements of seedless vascular plants are quite long, in some species reaching lengths of 30 to 40 mm (Lamoureux 1961). The degree of inclination of their end walls ranges from transverse to very oblique and apparently may vary from plant part to plant part within the same individual. In addition, the degree of inclination of the end walls may be greatly influenced by the growth rate of the plant part (Hébant 1969). The more rapid the growth, the longer the sieve elements and the more greatly inclined the end walls. Branched sieve elements have been found in Lycopodium lucidulum (Warmbrodt and Evert 1974a), Ophioglossum vulgatum (Warmbrodt and Evert 1979b), and in several species of tropical ferns (Shah et al. 1976).

3.2 The Sieve-Element Protoplast

Ultrastructural details of the very young sieve elements of seedless vascular plants are similar to those of the parenchyma cells bordering them. Both cell types have all of the components commonly associated with meristematic cells.