Development of Mestome Sheath Cells in Leaves of *Aegilops comosa* var. *thessalica*

E. P. Eleftheriou * and I. Tsekos

Botanical Institute, University of Thessaloniki, Thessaloniki

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Summary

The development of mestome sheath cells of *Aegilops comosa* var. *thessalica* was studied by electron microscopy. Anatomical and cytological observations show that this grass belongs to the C₃ or non-Kranz plants. In the asymmetrically thickened walls of mestome sheath cells a suberized lamella is present. This lamella is deposited asynchronously. In the midrib and the large lateral bundles it appears first in the outer and inner walls and usually later in the radial walls. In the small lateral bundles its appearance is delayed in the inner walls of those cells situated on the xylem side. At maturity the suberized lamella is observed in all cell walls; however, in the small lateral bundles it is partly or totally absent from the walls of some cells situated on the xylem side. Tertiary wall formation is asynchronous as well, for it generally follows the deposition pattern of the suberized lamella.

During the development of the mestome sheath cells microtubules show marked changes in their number and orientation, being fewer and longitudinal during suberin deposition. Dictyosomes are very active and may be involved in primary and tertiary wall formation. Endoplasmic reticulum cisternae are abundant and partly smooth, while plasmalemmasomes may function to reduce the plasmalemma extension. However, cytoplasmic structures that are clearly involved in suberin synthesis could not be identified.

Suberized lamellae react strongly with silver hexamine. This is probably due to post-fixation with osmium tetroxide.

On the basis of structural characteristics the mestome sheath may be regarded as an endodermis (cf., also FaHN 1974). The significance of this view for water and assimilate exchange between the mesophyll and the bundle is discussed.

Keywords: *Aegilops comosa* var. *thessalica*; Cell wall; Development; Mestome sheath cells; Microtubules; Suberized lamella.

1. Introduction

Bundle sheaths occur in both dicotyledonous (METCALFE and CHALK 1950) and monocotyledonous (METCALFE 1960) leaves. Among monocotyledons the best known are those of *Gramineae*. In the latter, two types of bundle sheaths

* Correspondence and Reprints: Botanical Institute, University of Thessaloniki, Thessaloniki, Greece.

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are distinguished: one- or two-layered. One-layered, or single sheaths, are generally characteristic of panicoid grasses (e.g., the genera Zea, Saccharum, Panicum), while two-layered, or double sheaths, of festucoid grasses (e.g., the genera Triticum, Hordeum, Avena) (FAHN 1974). The single sheath, as well as the outer sheath when two layers are present, generally consist of parenchymatous, usually thin-walled cells, which usually develop chloroplasts. In two-layered sheaths, the cells of the inner or mestome sheath are usually colourless, smaller in diameter and with asymmetrically thickened walls (ELLIS 1977).

The cell walls of the mestome sheath of wheat and oat leaves and of the parenchyma sheath of maize leaves (O'BRIEN and CARR 1970) at maturity contain a suberized lamella, which completely encases each cell. This lamella is perforated by plasmodesmata (KUO et al. 1974). O'BRIEN and CARR (1970) suggested that the suberized lamella reduces apoplastic exchange of water and solutes between the vascular and mesophyll tissue. O'BRIEN and KUO (1975) described the development of mestome sheath cells in wheat leaves and gave particular emphasis to the appearance of the suberized lamella in the wall.

In the present paper the development of mestome sheath cells and particularly the occurrence of suberized lamellae in Aegilops comosa Sibth. et Sm. subsp. comosa var. thessalica Eig (Eig 1929) are investigated. The genus Aegilops is of special interest because of its close phylogenetic relationships with the cultivated wheat (KIMBER 1974, and literature cited therein).

2. Materials and Methods

Seedlings of Ae. comosa var. thessalica were grown in soil, in normal day-light with a dark period of 8 hours. Samples of the first leaf blade of two, three, four, five, seven and eleven days old plants were fixed for 3 hours at room temperature in a mixture of 50% glutaraldehyde and 40% paraformaldehyde fixative (KARNOVSKY 1965), in 0.05 M sodium cacodylate buffer.

Abbreviations used in Figures: \( D = \)dictyosomes; \( EC = \)epidermal cells; \( ER = \)endoplasmic reticulum; \( GV = \)Golgi vesicles; \( IS = \)intercellular space; \( M = \)mitochondria; \( MC = \)mesophyll cells; \( Mt = \)microtubules; \( MS = \)mestome sheath cells; \( N = \)nucleus; \( P = \)plastids; \( PL = \)protoxylem lacuna; \( Pl = \)plasmalemma; \( PP = \)phloem parenchyma cells; \( PS = \)parenchyma sheath cells; \( S = \)sieve elements; \( SL = \)suberized lamella; \( T = \)tracheary elements; \( TW = \)tertiary wall; \( V = \)vacuole; \( W = \)cell wall; \( XP = \)xylem parenchyma cells

Fig. 1. A light microscopy photograph of a developing large lateral bundle, 2 days old. Cells marked with a small circle are immature mestome sheath cells. \( \times 930 \)

Fig. 2. Transverse section of a young mestome sheath cell, 2 days old. Arrows point to microtubules and arrowheads to plasmodesmata. \( \times 8,300 \)

Fig. 3. Transverse section of the cell wall between a mestome sheath cell (\( MS \)) and a xylem parenchyma cell (\( XP \)), 2 days old. Plasmodesmata are gathered together to form a future pit field. \( \times 24,000 \)

Fig. 4. Part of the cell wall between a mestome sheath cell (\( MS \)) and a phloem parenchyma cell (\( PP \)), in longitudinal section, 3 days old. In both cells a great number of cross-sectioned microtubules (arrows) are observed. \( \times 23,300 \)