In addition to its central role in plant growth and development, the cell wall is a plant’s interface with the environment. This dynamic composite of cross-linking glycans embedded in a gel of pectin provides plant cells with a rich variety of shapes and sizes (McCann and Roberts, 1991). Different types of walls are made by flowering plants, a “Type I” pectin-rich, xyloglucan-cellulosic wall is made by most dicotyledonous and non-gramineous monocotyledonous plants, and a “Type II” pectin-poor, arabinoxylan-cellulosic wall is made by commelinoid monocots, including grasses and cereals (Carpita and Gibeaut, 1993). Unique to the walls of Poales species (grasses and cereals), is a mixed-linkage $(1\rightarrow3),(1\rightarrow4)-\beta$-D-glucan that appears transiently during cell expansion phases of growth (Carpita, 1996; Smith and Harris, 1999). Type I walls are further distinguished from Type II walls in the way their structures are reinforced when differentiation begins. The Type I is characterized by the appearance of several cross-linking structural proteins, such as the extensins and other kinds of hydroxyproline-rich glycoproteins, glycine-rich proteins, and proline-rich proteins (Cassab and Varner, 1988). Except in rare instances of tough cells, such as those of the maize periderm (Hood et al., 1988), the Type II wall has very little structural protein. Instead, the walls are cross-linked mostly by phenylpropanoids, such as esterified and etherified hydroxycinnamic acids and other aromatic lignin-like substances (Scalbert et al., 1985). This property imparts a strong autofluorescence in the non-lignified cells of the Type II, permitting a facile means to classify them (Rudall and Caddick, 1994).
The pectin-rich Type I wall provides a complex, dynamic matrix that is the major determinant of wall pH, ionic balance, porosity, and electrical status (Carpita and Gibeaut, 1993). Pectins comprise two principal uronic acid-rich polymers, homogalacturonan (HG) and rhamnogalacturonan I (RG I). The HGs have a repeating backbone of $\alpha$-D-(1$\rightarrow$4)-linked galacturonosyl residues and are secreted to the wall in largely esterified form, with 70% or more of the residues bearing methyl esters. They may be de-esterified in muro, in random and block-wise fashion, at precise stages of cell development (Willats et al., 2001). Calcium ions play a key structural role once the methyl esters are removed. If long runs of unesterified uronosyl residues exist, then anti-parallel chains of HGs in are tightly cross-linked into “junction zones”. Calcium can also cross-link parallel chains of partly de-esterified HGs (Carpita and Gibeaut, 1993).

HG may also be substituted with neutral sugars, such as xylose to form xylogalacturonan enriched in flowering and fruit tissues, and/or acetylated (Schols et al., 1995). The HGs also form the backbone of one of the most complex polysaccharides found in Nature, called rhamnogalacturonan II (RG II). RG IIs contain many rare sugars and saccharinic acids, including apiose, aceric acid, Kdo and Dha, in four distinct side chains (O’Neill et al., 1990). One of the two apiose residues forms a boron-di-diester, coupling to RG II molecules, and forming structures essential for growth and development (O’Neill et al., 2001), porosity (Fleischer et al., 1999), and wall elasticity (Findeklee and Goldbach, 1996) and tensile strength (Ryden et al., 2003). The RG I is a polymer of the repeating disaccharide, $\rightarrow$2)-$\alpha$-L-rhamnosyl-(1$\rightarrow$4)-$\alpha$-D-galactosyl-(1$\rightarrow$, which possesses neutral side-chains of highly branched (1$\rightarrow$5)-$\alpha$-L-arabinans, (1$\rightarrow$4)-$\beta$-D-galactans, and type I arabinol-(1$\rightarrow$4)-$\beta$-D-galactans (Willats et al., 2001).

Given the enormous complexities and dynamics of the negatively charge pectin matrix, it is not surprising that it plays a central role in the mineral nutrition and ion status of plants, both at the sites of absorption in the root and utilization at the shoot meristems. This section contains four articles that describe unique features of mineral nutrition and the impacts of environmental stress. Two ions, boron and silica, are considered to impact structural elements of the wall directly. Wimmer and Goldbach (this volume, pp. 19-32) review boron in the type I cell wall and provide new data on its interactions with calcium ions in the formation of boron complexes. Because the only known function for boron in the apoplast is in the dimerization of RG II molecules (Ishii and Mansunaga, 1996; O’Neill et al., 1996), and given the function of these dimers in wall architecture (Findeklee and Goldbach, 1996; Fleischer et al., 1999; Ryden et al., 2003), divalent cations and other ions have important functions in regulating monomer to dimer ratios. In fact, Ca$^{2+}$ has been shown to stabilize boron-RG II dimers (Kobayashi et al.,