FIBER ELONGATION

After one day of development, fiber initials take on a tapered appearance. Early in development fibers may exhibit a tapered or rounded tip shape (Figure 35). As fibers continue to elongate, they begin to twist together forming large clusters (Figure 36). The mechanism that regulates this process remains unknown. By ten DPA, the ovule is encased in a tight array of cotton fibers. Fibers from the ovule begin to entangle, giving the appearance of an ovule meshed in a dense mat (Figure 37).

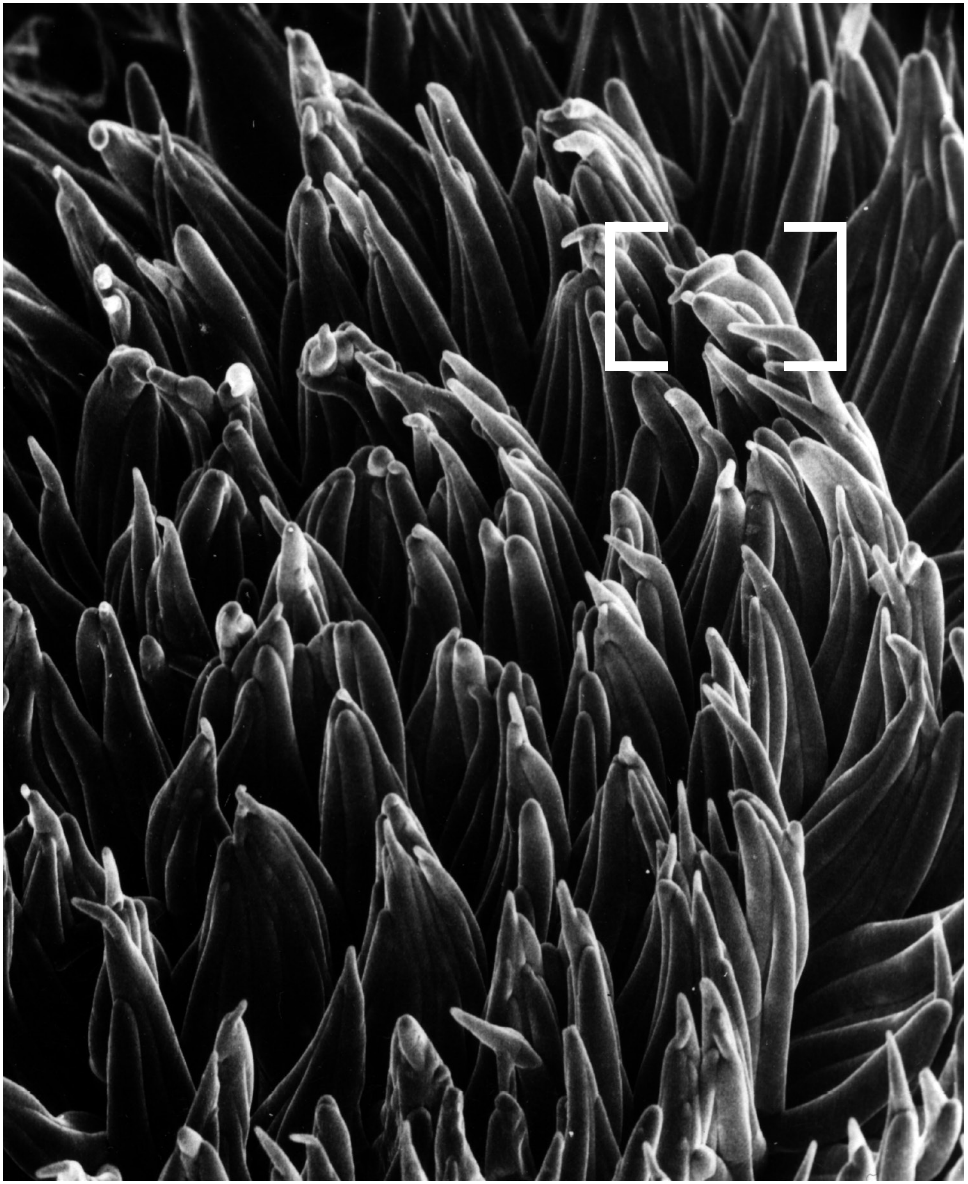

Figure 36. SEM images reveal that groups of fibers grow together. As fibers elongate they twist around each other forming clusters (brackets).
(J. McD. Stewart)

Figure 37. LM section through an ovule, showing array of fibers on the outside. (R.W. Seagull)

Fiber elongation occurs over a number of weeks. The most rapid rate of elongation occurs in the first three weeks after initiation (Figure 38). However, fibers continue to increase in length throughout most of their development. The extent of elongation and the exact rates of elongation vary among cotton genotypes and with environmental conditions. Accompanying changes in length are also changes in fiber diameter. Recent data indicate that fiber diameter continues to increase throughout the elongation phase (Figure 38). Thus the elongation phase includes not only increases in cell length, but also increases in cell diameter. Fiber diameter not only changes during development but also changes along the length of individual fibers. Lint fibers exhibit varying degrees of taper at their tip. Some fiber exhibit a relatively long tapered region (4 – 5 mm), while others have a short (> 1 mm) tapered region.

During the elongation phase the fiber produces a thin, flexible cell wall, capable of growing as the cell volume increases. This primary cell wall is similar in structure to the primary cell walls of most other expanding plant cells.

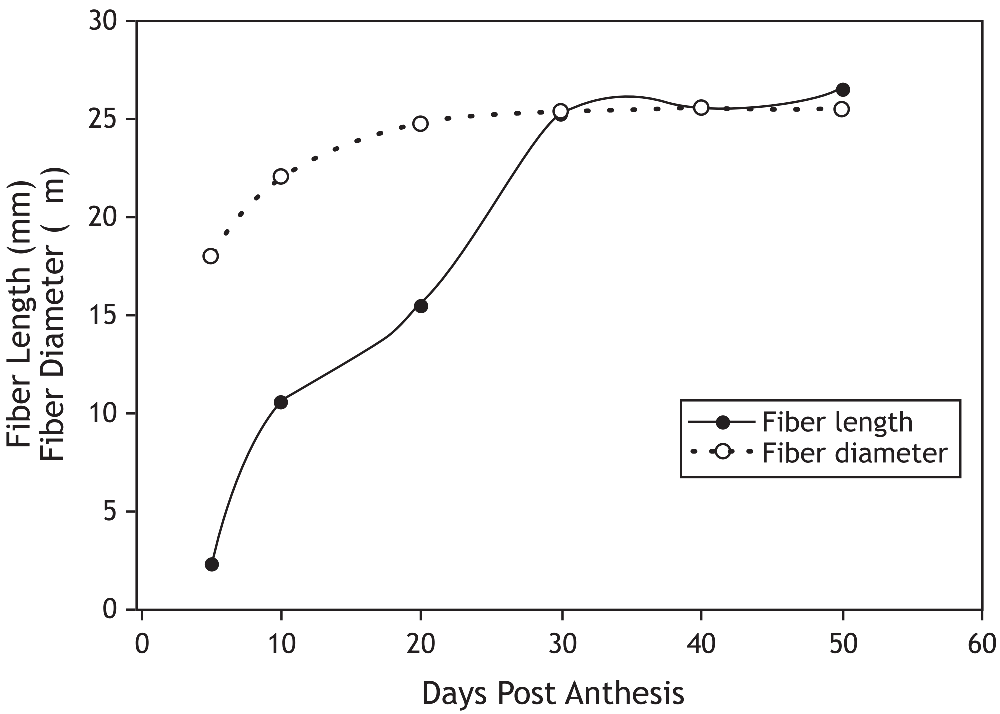

Figure 38. A graph of the changes in never dried fiber length and diameter during development of *G. hirsutum*, variety MD51Ne. Both length and diameter increase early in fiber development and exhibit a slowing rate of increase as the fiber enters into the secondary wall synthesis stage. Other varieties and species of cotton exhibit similar growth kinetics. (R.W. Seagull)

The wall is coated with a waxy cuticle and is composed of a gel-like matrix of polysaccharides in which are embedded relatively rigid cellulose microfibrils (Figure 39). The patterns of cellulose microfibrils in the wall control the direction of cell expansion and the ultimate morphology of the fiber.

Figure 39. Using transmission electron microscopy (TEM) one can observe the various components of the primary cell wall. During fiber elongation the outer surface of the primary wall is coated with a waxy cuticle (c). Throughout the thickness of the wall there are layers of cellulose microfibrils (m). (R.W. Seagull)

Within the cell is a collection of various cytoplasmic organelles (Figure 40). As the fiber grows, new components are inserted into the cell wall and membrane. Because this new material is deposited throughout the length of the fiber, this type of cell expansion is called diffuse growth.

Figure 40. Using TEM one can see that during fiber initiation and elongation the cell contains a densely packed cytoplasm that is responsible for the synthesis and distribution of the components required for fiber development. Most evident are the primary cell wall (arrow), the nucleus (n) and the vacuole (v).
(J. Berlin)