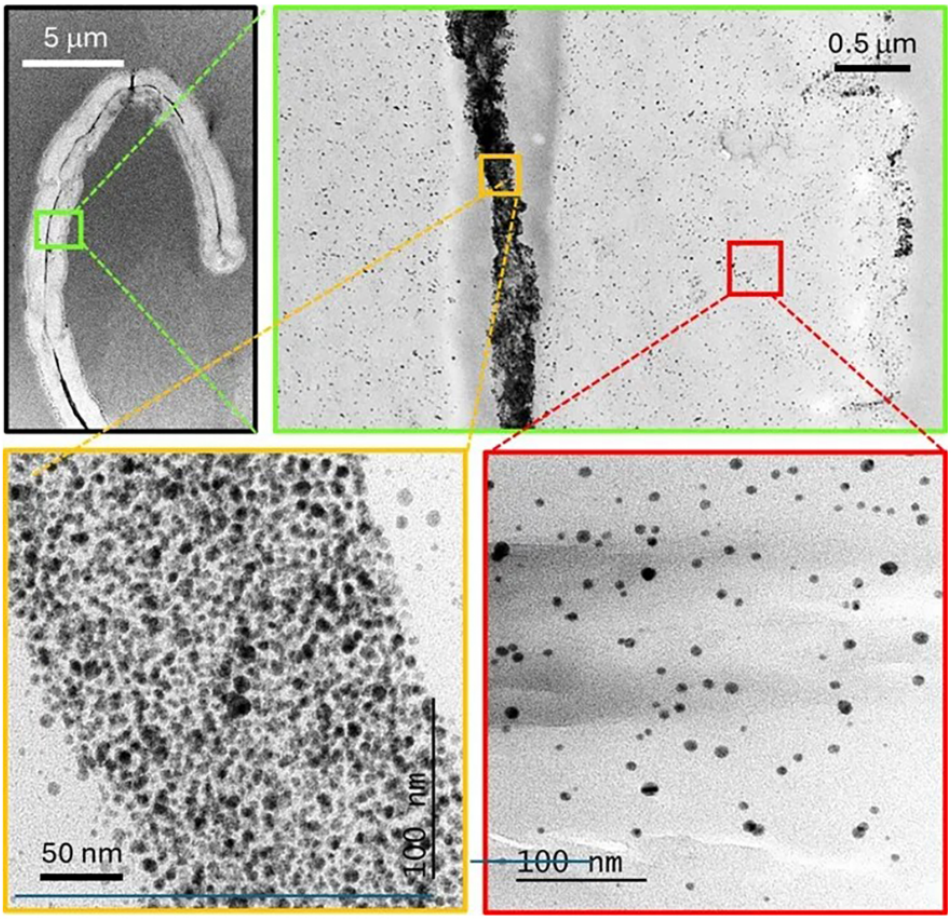
Science Societies

How immature cotton became a defense against superbugs

April 20, 2026



Transmission electron microscopy images of a cross-section of an immature cotton nanocomposite fiber at increasing magnifications. Top left: Overview of a single fiber. Top right, bottom left, and bottom right: High magnification views of the cotton lumen (yellow box) and the secondary cell wall (red box), showing a dense, high concentration of silver nanoparticles in the lumen and a lower concentration in the cell wall. Photo courtesy of Yang Mu, Louisiana State University.

Low-quality, "immature" cotton fibers represent a significant economic loss for both cotton farmers and the textile industry. Because these fibers fail to fully develop, they lack the strength and uniformity required for textile applications and are often discarded, sold at a discount, or diverted to low-value uses.

Scientists from the USDA-ARS and Texas Tech University have uncovered an unexpected advantage in these flawed fibers. Their unique structural imperfections and chemistry provide a natural platform that promotes the formation of silver nanoparticles for pathogen control in fabrics. Using only a silver precursor, the research team induced the fibers to form approximately 8-nm silver particles inside their matrix, eliminating the chemical additives required in conventional nanoparticle synthesis.

When even a small portion of these nanocomposite fibers was blended into nonwoven fabrics, the results were striking: The fabrics reduced more than 99.99% of a group of dangerous, antibiotic-resistant "ESKAPE" pathogens (*Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter* species). These organisms are among the leading causes of hospital-acquired infections and are frequently associated with severe conditions

such as pneumonia, bloodstream infections, and surgical wound infections

This study reframes fiber immaturity, once seen only as a quality flaw, as a design tool for nanotechnology. It shows how a long-standing agricultural challenge can become a sustainable, ecofriendly chemistry route to high-value antimicrobial nanomaterials for medical, hygiene, or filtration applications, ultimately creating new economic value from underutilized cotton crops for farmers.

Dig deeper

Nam, S., Kashem, M. N. H., He, Z., & Abidi, N. (2026). Structure-driven immature cotton nanocomposite fibers for ESKAPE pathogen control. *Agricultural & Environmental Letters*, *11*, e70065. https://doi.org/10.1002/ael2.70065

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