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Overcoming seed-coat fragment contamination in cotton fibre

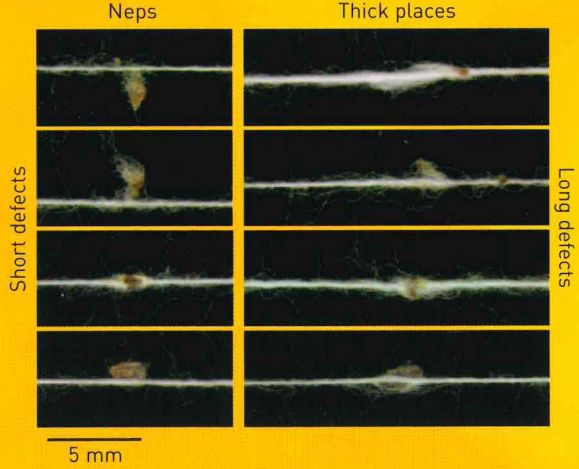
Cotton fibre contains various impurities, including leaf and stem pieces, insect droppings, whole or broken seeds, seed-coat fragments, etc. Some of this trash, such as leaf and stem pieces, is easy to remove, but seed-coat fragments are harder to eliminate because of the attached fibres. These contaminants may still be present at the spinning stage and result in production spoilage. CIRAD has developed Trashcam, an apparatus for detecting and quantifying seed-coat fragments, and its cotton breeding programmes now take this criterion into account.

What causes seed-coat fragmentation?

Cottonseed consists of a shell and a kernel. The shell has six tissue layers and each of its fibres derives from a cell in the outermost layer.

Ginning—a mechanized operation to separate the fibre from the seed—causes seed-coat fragmentation. The fragments are from fragile parts of the seed coat that are torn off or fragmented during ginning. These seed-coat fragments remain attached to the fibres they bear and are thus hard to remove during post-ginning cleaning operations. Many of these fragments are not eliminated before the spinning stage, and are subsequently found in the yarn and textiles. This trash reduces yarn strength and may lead to breakage, which diminishes the strength and appearance of the woven textile end product. Textile manufacturers have therefore become more demanding with respect to cotton fibre purity, and this rise in standards has had an impact on cotton cropping, harvesting and ginning conditions.

Economic and qualitative impacts



Seed-coat debris on cotton yarn. © M. Krifa

Spinning machines have become more sophisticated and faster, which has made them more vulnerable to the presence of lint impurities. Cotton fibre contamination, regardless of the origin, is thus an economic impediment for the textile industry.

Manufacturers strive to reduce this contamination by intensifying cleaning operations during ginning (increasing the number of seed-cotton and lint cleaners) and spinning (precleaning during general preparation, cleaning during spinning). Cleaning trash that can be separated from the fibres leads to a loss of material, which could be detrimental to the intrinsic technological fibre properties. Carding is not very effective for eliminating impurities such as hull fragments—this operation may even shatter the fragments, so carded lint may contain a higher number of fragments than raw lint.

Seed-coat fragments are a major source of yarn imperfections (neps, thick places) when fibres are processed into yarn and fabrics. The presence of this trash during spinning reduces the yarn yield (quantity of yarn obtained from a quantity of raw fibre or obtained per time unit) and quality. Moreover, yarn twisting helps bond the fibres, but bonding is hampered by the presence of these fragments, thus reducing the tensile strength of the yarn. Yarn tension is high during weaving and knitting operations, so the presence of seed-coat fragments can induce yarn breakage, thus causing machine shutdowns and increasing production costs.

Some fabric finishing operations such as scouring and bleaching may eliminate most seed-coat fragments. These operations enhance the visual aspect of the product but not its strength. After dying or printing, residual seed-coat fragments appear as dark spots, often surrounded by a paler area, which reduces the market value of the product.

plate

Trashcam assessment of seed-coat fragment contamination in fibre web and yarn. © R. Frydrych

Control methods and recommendations

Initiatives to reduce seed-coat fragment contamination in cotton fibre have been focused on cotton technology and breeding. CIRAD invented Trashcam, an apparatus designed specifically for identifying, quantifying and measuring seed-coat fragments in cotton fibres. This instrument is mainly used by scientists to assess the negative effects of these fragments on yarn quality, especially its uniformity and strength. These effects are more marked when high quality fibre is involved.

This trait is genetically heritable, so breeding studies have been carried out by CIRAD, giving rise to varieties that produce cotton with low seed-coat fragmentation, in addition to excellent agricultural and technological features. Cotton breeders also use Trashcam to evaluate this criterion in their breeding programmes.

For further information

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