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Manufacture of All Kinds of Auto loom Fabrics and Natural Dye Fabrics.

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Cotton

Cotton is a soft fibre that grows around the seeds of the cotton plant (*Gossypium* sp.), a shrub native to tropical and subtropical regions around the world, including the Americas, India, and Africa. However, virtually all of the commercial cotton grown today worldwide is grown from varieties of the native American species *Gossypium hirsutum* and *Gossypium barbadense*. The fiber is most often spun into yarn or thread and used to make a soft, breathable textile, which is the most widely used natural-fiber cloth in clothing today. The English name derives from the Arabic *(al) qutn* قُطْن, meaning cotton. (The Spanish word *algodón* has the same etymology.)

Cotton fibre, once it has been processed to remove seeds and traces of honey, protein, vegetable matter, and other impurities, consists of nearly pure cellulose, a natural polymer. Cotton production is very efficient, in the sense that ten percent or less of the weight is lost in subsequent processing to convert the raw cotton bolls (seed cases) into pure fiber. The cellulose is arranged in a way that gives cotton fibers a high degree of strength, durability, and absorbency. Each fiber is made up of twenty to thirty layers of cellulose coiled in a neat series of natural springs. When the cotton boll is opened, the fibers dry into flat, twisted, ribbon-like shapes and become kinked together and interlocked. This interlocked form is ideal for spinning into a fine yarn.

Leading cotton-producing countries

As of 2007, the ten largest producers of cotton in the world are (1) China, (2) India, (3) the United States, (4) Pakistan, (5) Brazil, (6) Uzbekistan, (7) Turkey, (8) Greece, (9) Turkmenistan and (10) Syria[1].

The five leading exporters are (1) the United States, (2) Uzbekistan, (3) India, (4) Brazil, and (5) Burkina Faso. The biggest non-producing importers are Bangladesh, Indonesia, Thailand, Russia and Taiwan.

In the United States, the state of Texas leads in total production while the state of California has the highest yield per acre in the world.

Cultivation

Successful cultivation of cotton requires a long frost-free period, plenty of sunshine, and a moderate rainfall, usually from 600 to 1200mm (24 to 48 inches). Soils usually need to be fairly heavy, though the level of nutrients does not need to be exceptional. In general, these conditions are met within the seasonally dry tropics and subtropics in the Northern and Southern hemispheres, but a large proportion of the cotton grown today is cultivated in areas with less rainfall that obtain the water from irrigation. Production of the crop for a given year usually starts soon after harvesting the preceding autumn. Planting time in spring in the Northern hemisphere varies from the beginning of February to the beginning of June. The area of the United States known as the South Plains is the largest contiguous cotton-growing region in the world. It is heavily dependent on irrigation water drawn from the Ogallala Aquifer.

Cotton is a thirsty crop, and as water resources get tighter around the world, economies that rely on it face difficulties and conflict, as well as potential environmental problems. For example, cotton has led to desertification in areas of Uzbekistan, where it is a major export. In the days of the Soviet Union, the Aral Sea was tapped for agricultural irrigation, largely of cotton, and now salination is widespread.

Genetically modified cotton

Genetically modified (GM) cotton was developed to reduce the heavy reliance on pesticides. GM cotton is widely used throughout the world with claims of requiring up to 80% less pesticide than ordinary cotton. The International Service for the Acquisition of Agri-Biotech Applications (ISAAA) said that, worldwide, GM cotton was planted on an area of 67,000 km² in 2002. This is 20% of the worldwide total area planted in cotton. The U.S. cotton crop was 73% GM in 2003.

The initial introduction of GM cotton proved to be a commercial disaster in Australia - the yields were far lower than predicted, and the cotton plants were cross-pollinated with other varieties of cotton. However, the introduction of a second variety of GM cotton led to 15% of Australian cotton being GM in 2003. 80% of the crop was genetically modified in 2004, when the original variety was banned.

History

Cotton has been used to make very fine lightweight cloth in areas with tropical climates for millennia. Evidence has been found of cotton in Mexican caves (cotton cloth and fragments of bloody fiber interwoven with feathers and fur) dating back approximately 7,000 years. There is archaeological evidence that people in India and South America domesticated different species of cotton independently thousands of years ago.

Cotton cultivation in the Old World began from India, where cotton has been grown for more than 6,000 years, since the pre-Harappan period. Cotton from the Harappan civilization was exported to Mesopotamia during the 3rd millennium BC,[2] and cotton was soon known to the Egyptians as well. The famous Greek historian Herodotus also wrote about Indian cotton: "There are trees which grow wild there, the fruit of which is a wool exceeding in beauty and goodness that of sheep. The Indians make their clothes of this tree wool." (Book III. 106)

In Peru, cotton was the backbone of the development of coastal cultures such as the Moche and Nazca. Cotton was grown upriver, made into nets and traded with fishing villages along the coast for large supplies of fish. The Spanish who came to Mexico in the early 1500s found the people growing cotton and wearing clothing made of it.

During the late medieval period, cotton became known as an imported fiber in northern Europe, without any knowledge of what it came from other than that it was a plant; noting its similarities to wool, people in the region could only imagine that cotton must be produced by plant-borne sheep. John Mandeville, writing in 1350, stated as fact the now-preposterous belief: "There grew there [India] a wonderful tree which bore tiny lambs on the endes of its branches. These branches were so pliable that they bent down to allow the lambs to feed when they are hungrie." (See Vegetable Lamb of Tartary.) This aspect is retained in the name for cotton in many European languages, such as German *Baumwolle*, which translates as "tree wool". By the end of the 16th century, cotton was cultivated throughout the warmer regions in Asia and the Americas.

India's cotton-processing sector gradually declined during British expansion in India and the establishment of colonial rule during the late 18th and early 19th centuries. This was largely due to the East India Company's de-industrialization of India, which forced the closing of cotton processing and manufacturing workshops in India, to ensure that Indian markets supplied only raw materials and were obliged to purchase manufactured textiles from Britain.

The advent of the Industrial Revolution in Britain provided a great boost to cotton manufacture, as textiles emerged as Britain's leading export. In 1738 Lewis Paul and John Wyatt, of Birmingham England, patented the Roller Spinning machine, and the flyer-and-bobbin system for drawing cotton to a more even thickness using two sets of rollers that travelled at different speeds. Later, the invention of the spinning jenny in 1764 and Richard Arkwright's spinning frame (based on the Roller Spinning Machine) in 1769 enabled British weavers to produce cotton yarn and cloth at much higher rates. From the late eighteenth century onwards, the British city of Manchester acquired the nickname *"cottonopolis"* due to the cotton industry's omnipresence within the city, and Manchester's role as the heart of the global cotton trade. Production capacity was further improved by the invention of the cotton gin by Eli Whitney in 1793. Improving technology and increasing control of world markets allowed British traders to develop a commercial chain in which raw cotton fibers were (at first) purchased from colonial plantations, processed into cotton cloth in the mills of Lancashire, and then re-exported on British ships to captive colonial markets in West Africa, India, and China (via Shanghai and Hong Kong).

By the 1840s, India was no longer capable of supplying the vast quantities of cotton fibers needed by mechanised British factories, while shipping bulky, low-price cotton from India to Britain was time-consuming and expensive. This, coupled with the emergence of American cotton as a superior type (due to the longer, stronger fibers of the two domesticated native American species, *Gossypium hirsutum* and *Gossypium barbadense*), encouraged British traders to purchase a cotton from plantations in the United States and the Caribbean. This was also much cheaper as it was produced by unpaid slaves. By the mid 19th century, "King cotton" had become the backbone of the southern American economy. In the United States, cultivating and harvesting cotton became the leading occupation of slaves.

During the American Civil War, American cotton exports slumped due to a Union blockade on Southern ports, prompting the main purchasers of cotton, Britain and France, to turn to Egyptian cotton. British and French traders invested heavily in cotton plantations and the Egyptian government of Viceroy Isma'il took out substantial loans from European bankers and stock exchanges. After the American Civil War ended in 1865, British and French traders abandoned Egyptian cotton and returned to cheap American exports, sending Egypt into a deficit spiral that led to the country declaring bankruptcy in 1876, a key factor behind Egypt's annexation by the British Empire in 1882.

During this time cotton cultivation in the British Empire, especially India, greatly increased to replace the lost production of the American South. Through tariffs and other restrictions the British government discouraged the production of cotton cloth in India; rather the raw fiber was sent to England for processing. The Indian patriot Gandhi described the process:

1. English people buy Indian cotton in the field, picked by Indian labor at seven cents a day, through an optional monopoly.
2. These cotton are shipped on British bottoms, a three weeks journey across the Indian Ocean, down the Red Sea, across the Mediterranean, through Gibraltar, across the Bay of Biscay and the Atlantic Ocean to London. One hundred per cent profit on this freight is regarded as small.
3. The cotton are turned into cloth in Lancashire. You pay shilling wages instead of Indian pennies to your workers. The English worker not only has the advantage of better wages, but the steel companies of England get the profit of building the factories and machines. Wages; profits; all these are spent in England.
4. The finished product is sent back to India at European shipping rates, once again on British ships. The captains, officers, sailors of these ships, whose wages must be paid, are English. The only Indians who profit are a few lascars who do the dirty work on the boats for a few cents a day.
5. The cloth is finally sold back to the kings and landlords of India who got the money to buy this expensive cloth out of the poor peasants of India who worked at seven cents a day. (Fisher 1932 pp 154-156)

In the United States, cotton remained a key crop in the southern economy after emancipation and the end of the civil war in 1865. Across the South, sharecropping evolved, in which free black farmers worked on white-owned cotton plantations in return for a share of the profits (although in reality, the system was little changed from the days of slavery). Cotton plantations required vast labor forces to hand-pick cotton fibers, and it was not until the 1950s that reliable harvesting machinery was introduced into the South (prior to this, cotton-harvesting machinery had been too clumsy to pick cotton without shredding the fibers). During the early twentieth century, employment in the cotton industry fell as machines began to replace laborers, and as the South's rural labor force dwindled during the First and Second World Wars. Today, cotton remains a major export of the southern United States, and a majority of the world's annual cotton crop is of the long-staple American variety.

Pests and weeds

The cotton industry relies heavily on chemicals such as fertilizers and insecticides, although a very small number of farmers are moving towards an organic model of production and organic cotton products are now available for purchase at limited locations. These are popular for baby clothes and diapers. Under most definitions, organic products do not use genetic engineering.

Historically, in North America, one of the most economically destructive pests in cotton production has been the boll weevil. Due to the US Department of Agriculture's highly successful Boll Weevil Eradication Program (BWEP), this pest has been eliminated from cotton in most of the United States. This program, along with the introduction of genetically engineered "Bt cotton" (which contains a bacteria gene that codes for a plant-produced protein that is toxic to a number of pests such as tobacco budworm, cotton bollworm and pink bollworm), has allowed a reduction in the use of synthetic insecticides.

Mechanised harvesting

Offloading freshly harvested cotton into a module builder in Texas. Previously built modules may be seen in the background.

Most cotton in the United States, Europe and Australia is harvested mechanically, either by a cotton picker, a machine that removes the cotton from the boll without damaging the cotton plant, or by a cotton stripper, which strips the entire boll off the plant. Cotton strippers are used in regions where it is too windy to grow picker varieties of cotton, and usually after application of a chemical defoliant or the natural defoliation that occurs after a freeze. Cotton is a perennial crop in the tropics and without defoliation or freezing, the plant will continue to grow.

The logistics of cotton harvesting and processing have been improved by the development of the cotton module builder, a machine that compresses harvested cotton into a large block, which is then covered with a tarp and temporarily stored at the edge of the field. Additionally, in August 2007, John Deere introduced a self-propelled cotton picker that rolls the harvested cotton into round modules similar to round bales of hay. The rolls are automatically wrapped in a protective film and deposited at the edge of the field. This integrates the module builder with the cotton picker, making a machine that roughly equates to a combine harvester, allowing for continuous harvesting.

Cotton continues to be picked by hand in poor countries such as Uzbekistan.

Research and promotion

Beginning as a self-help program in the mid-1960s, the Cotton Research & Promotion Program was organized by U.S. cotton producers in response to cotton's steady decline in market share. At that time, producers voted to set up a per-bale assessment system to fund the program, with built-in safeguards to protect their investments. With the passage of the Cotton Research & Promotion Act of 1966, the program joined forces and began battling synthetic competitors and re-establishing markets for cotton. Today, the success of this program has made cotton the best-selling fiber in the U.S. and one of the best-selling fibers in the world.

Administered by the Cotton Board and conducted by Cotton Incorporated, the Cotton Research & Promotion Program works to greatly increase the demand for and profitability of cotton through various research and promotion activities. It is funded by U.S. cotton producers and importers.

Uses

Cotton is used to make a number of textile products. These include terrycloth, used to make highly absorbent bath towels and robes; denim, used to make blue jeans; chambray, popularly used in the manufacture of blue work shirts (from which we get the term "blue-collar"); and corduroy, seersucker, and cotton twill. Socks, underwear, and most T-shirts are made from cotton. Bed sheets are often made from cotton. Cotton is also used to make yarn used in crochet and knitting. Fabric can also be made from recycled or recovered cotton that would otherwise be thrown away during the spinning, weaving or cutting process. While many fabrics are made completely of cotton, some materials blend cotton with other fibers, including rayon and synthetic fibers such as polyester.

In addition to the textile industry, cotton is used in fishnets, coffee filters, tents, gunpowder (see Nitrocellulose), cotton paper and in bookbinding. The first Chinese paper was made of cotton fiber. Fire hoses were once made of cotton.

The cottonseed which remains after the cotton is ginned is used to produce cottonseed oil, which after refining can be consumed by humans like any other vegetable oil. The cottonseed meal that is left is generally fed to livestock. In the past, cotton seeds were used as an abortifacient, that is, a folk remedy to provoke abortion.

Cotton linters are fine, silky fibers which adhere to the seeds of the cotton plant after ginning. These curly fibers are typically less than 1/8in, 3mm long. The term may also apply to the longer textile fiber staple lint as well as the shorter fuzzy fibers from some upland species. Linters are traditionally used in the manufacture of paper and as a raw material in the manufacture of cellulose.

Shiny cotton is a processed version of the fiber that can be made into cloth resembling satin for shirts and suits. However, its hydrophobic property of not easily taking up water makes it unfit for the purpose of bath and dish towels (although examples of these made from shiny cotton are seen.)

The term **Egyptian cotton** is usually applied to the extra long staple cotton produced in Egypt and favored for the luxury and upmarket brands worldwide. In fact, the cotton species which produces extra long staple "Egyptian" cotton is the native American species Gossypium barbadense, also known today as American Pima cotton, which was introduced by Mohammad Ali Pasha in the 19th century. During the U.S. Civil War, with heavy European investments, Egyptian-grown cotton became a major alternate source for British textile mills. Most of what is labeled "Egyptian cotton" today, however, also includes long staple cotton, the product of the other native American species *Gossypium hirsutum* . The ancient Egyptians made their clothing from linen, a product of the flax plant.

In South Asia, cotton is widely used in mattresses, which are the most common type of mattress used in that region.

Organic cotton

Organic cotton is cotton that is grown without insecticide or pesticide. Worldwide, cotton is a pesticide-heavy crop, using approximately 25% of the world's insecticides and 10% of the world's pesticides. According to the World Health Organisation (WHO), 20,000 deaths occur each year from pesticide poisoning in developing countries, many of these from cotton farming. Organic agriculture uses methods that are ecological, economical, and socially sustainable and denies the use of agrochemicals and artificial fertilizers. Instead, organic agriculture uses crop rotation, the cropping of different crops than cotton. The use of insecticides is prohibited; organic agriculture uses natural enemies to suppress harmful insects. The production of organic cotton is more expensive than the production of conventional cotton. Although toxic pollution from synthetic chemicals is eliminated, other pollution-like problems may remain, particularly run-off. Organic cotton is produced in organic agricultural systems that produce food and fiber according to clearly established standards. Organic agriculture prohibits the use of toxic and persistent chemical pesticides and fertilizers, as well as genetically modified organisms. It seeks to build biologically diverse agricultural systems, replenish and maintain soil fertility, and promote a healthy environment.

Critical temperatures

- Favorable travel temperature range - no lower limit =< 77°F (25°C)
- Optimum travel temperature - 68°F (20°C)
- Glow temperature - 401°F (205°C)
- Fire point - 410°F (210°C)
- Autoignition temperature - 765°F (407°C)
- Autoignition temperature (for oily cotton) - 248°F (120°C)

Cotton dries out, becomes hard and brittle and loses all elasticity at temperatures above 25°C. Extended exposure to light causes similar problems.

A temperature range of 25°C to 35°C is the optimal range for mold development. At temperatures below 0°C, rotting of wet cotton stops. Damaged cotton is sometimes stored at these temperatures to prevent further deterioration.

Old British cotton yarn measures

- 1 thread = 54 inches (about 137 cm)
- 1 skein or rap = 80 threads (120 yards or about 109 m)
- 1 hank = 7 skeins (840 yards or about 768 m)
- 1 spindle = 18 hanks (15,120 yards or about 13,826 m)

Properties of cotton fibres

Property	Evaluation
Shape	Fairly uniform in width, 12-20 microns; length varies from ½ to 2½ inches; typical length is ⅞ to 1¼ inches.
Luster	low
Tenacity (strength)	
Dry	3.0-5.0 g/d
Wet	3.3-6.0 g/d
Resiliency	low
Density	1.54/1.56 g/ccm
Moisture absorption	
raw:conditioned	8.5%
saturation	15-25%
mercerized: conditioned	8.5-10.3%
saturation	15-27%+
Dimensional stability	good
Resistance to	
acids	damage, weaken fibers
alkali	resistant; no harmful effects
organic solvents	high resistance to most
sunlight	Prolonged exposure weakens fibers.
microorganisms	Mildew and rot-producing bacteria damage fibers.
insects	Silverfish damage fibers.
Thermal reactions	
to heat	Decomposes after prolonged exposure to temperatures of 150˚C or over.
to flame	Burns readily.