

Organic Cotton: Technological and Environmental Aspects

Radostina A. Angelova

Despite the efforts of the producers and all market players in the chain “from fibers to textiles” organic cotton occupies up to 1% of the cotton textiles and apparel worldwide. This paper discusses both the technological and environmental aspects of the organic cotton production. A comparison made between organic and conventional cotton length and micronaire of crops, produced in India, is made and analyzed. The worldwide producers of organic cotton with fiber length from small to extra-large are presented. The shift from organic cotton to better or sustainable cotton is also discussed.

Keywords: organic cotton, conventional cotton, cotton length, cotton micronaire, preferred cotton

Introduction

There are four species of cotton, which are grown worldwide: *Gossypium Arboreum* (short length, < 25mm), *Gossypium Herbaceum* (short length, < 25mm), *Gossypium Hirsutum* (Upland) (medium to long length, 25-35mm), and *Gossypium Barbadosense* (long to extra-long length, 30mm and up). All four cultivated species may be grown and sold as organic or conventional cotton.

The present analysis aims to discuss and analyze the major differences between organic and conventional cotton in technological and environmental aspects. The market shift from organic cotton to better or sustainable cotton is also presented.

The Organic Cotton

The difference between organic and conventional cotton comes from the way of farming and agricultural management. The organic cotton plant is not genetically modified and is grown in a way that preserves the soil fertility, protects the biodiversity, and does not affect both human health and the environment [1]. In fact, before the 1940s, all cotton in the world was produced organically. Today, the farmers have to meet particular agricultural standards so as their cotton harvest to be recognized as organic cotton. The national standards for the organic cotton producers in different countries may vary; the organic cotton exporters have to meet also the requirements of the country that imports organic cotton [2].

In general, the organic cotton is produced without the use of chemical pesticides, a rotation system is applied for the soil, and natural ways for solving problems with pests are applied (e.g. larger space between the plants to avoid contamination). The growth of organic cotton is supported by the biggest textile and apparel brands in the world, as well as by many customers. The Top 10 users of organic cotton by volume in 2016 were C&A, H&M, Tchibo, Nike, Inditex, Lindex, Boll & Branch, Woolworths, Williams-Sonoma, and Stanley & Stella [3].

179 countries in the world are certified in organic farming, among which the vast majority of land for organic cotton production is in India, China, and Tanzania [3]. However, the organic cotton market share remains around 0.2% -1% of the world cotton production [4]. One of the reasons for the stable position of the organic cotton is its higher price, compared to the conventional cotton, and the refusal of the farmers to produce it and of the customers – to buy it. As a result, several textile and apparel brands preferred to join the Better Cotton Initiative (BCI), which started in 2010 and is part of the *Preferred Cotton*, as defined by Textile Exchange [5].

BCI offers to cotton producers and the whole cotton market a shift from organic cotton to the so-called “sustainable” or “better” cotton. BCI prohibits the most hazardous pesticides and requires the use of minimum personal protective equipment for people, working with chemicals. However, BCI does not ban the pesticides. BCI is also “technology neutral” to the genetically modified cotton [6]. Besides, BCI discusses the quality of the cotton fibers and encourages the farmers to preserve the cotton fibers characteristics and quality.

Technological Aspects of the Organic Cotton Manufacturing

In general, there are no differences between the production of textiles from organic and conventional cotton. The cotton bales, sold on the market, enter the spinning plants that are the first stage in the production chain “from fibers to textiles”. Both organic cotton fibers and conventional cotton fibers are spun into yarns with different counts, using one of the three possible spinning systems and applying particular spinning machine at the end of the production line (ring frame or rotor spinning machine).

The data for India, published in [7], give a possibility to compare the fiber characteristics of the cotton crops, grown organically and conventionally in different states of the country. Figure 1 shows the comparison between the fiber length (and more specific – the upper half mean length: the average length of the longer half of the fibers [8]) of conventional and organic cotton. Two values are shown for each Indian state: for conventional cotton (CC) and organic cotton (OC). Both the minimum and the maximum values of the fiber length are shown, as well as the middle of the interval.

The environmental conditions largely influence cotton fiber length. Plant’s exposure to water stress, extreme temperatures, or poor soil may result in shorter fibers. However, these environmental conditions are almost equal for both organic and conventional cotton in different states in India; the conventional cotton growth is even supported by chemical fertilizers. The analysis of the graph (Fig. 1) shows, however, that the average length of the organic cotton fibers is higher than the average length of the conventional cotton fibers. The results for Odisha state are the only exception, but there the length interval of the conventional cotton is very short (31 mm minimum length and 32 mm maximum length) compared to that of the organic cotton (28 mm minimum length and 34 mm maximum length).

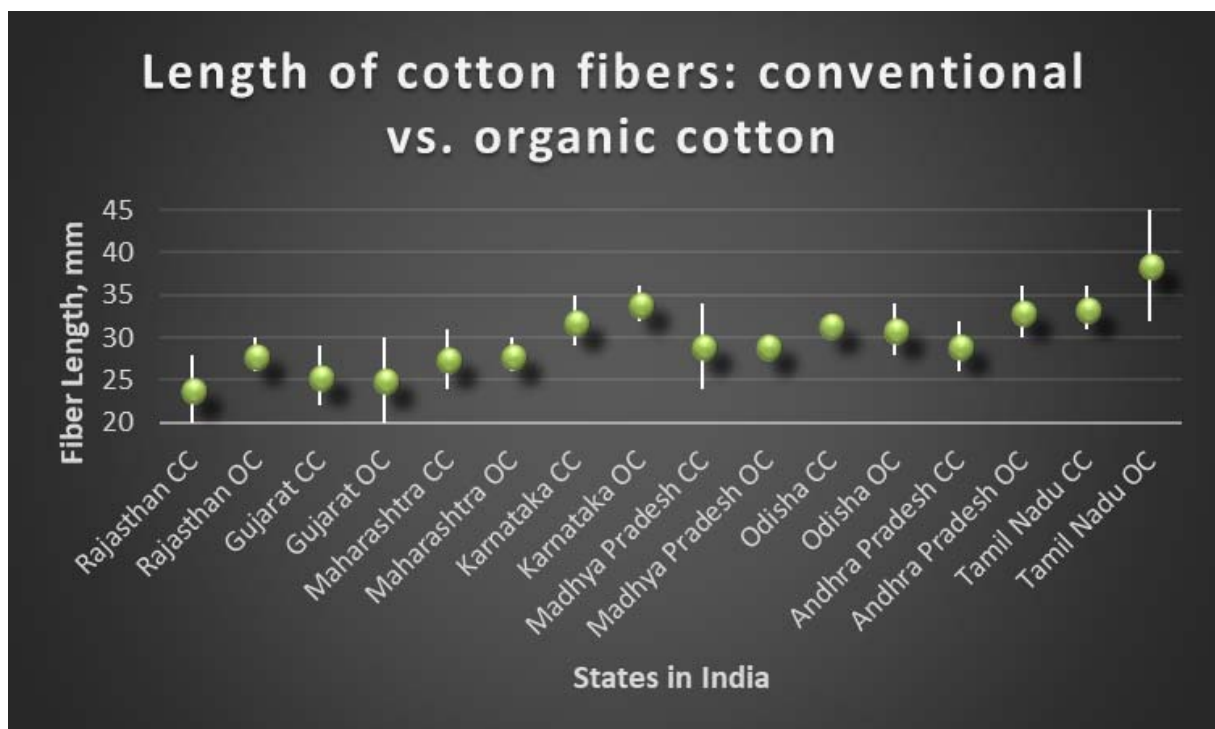


Figure 1. Length of the fibers: conventional vs. organic cotton

Fiber length affects the efficiency of the spinning process and the yarn count, as finer yarns are produced by longer fibers. Yarn strength and yarn evenness are also influenced by the fiber length. All mechanical processes during the spinning (and in the gin before the spinning) can affect the length of the cotton fibers. However, this is valid for both conventional and organic cotton.

Figure 2 shows the comparison between the fiber micronaire of conventional and organic cotton, based on the same data in [7]. Again, two values are shown for each Indian state: for conventional cotton (CC) and organic cotton (OC). Both the minimum and the maximum values of the fiber micronaire are shown, as well as the middle of the interval.

Micronaire reflects as a measure both fiber fineness and maturity. It is a base for the assessment of the cotton quality (among the other cotton fibers' characteristics like fiber length, length uniformity, color, strength, leaf, and cleanliness), and, subsequently, pricing. The premium cotton range is between 3.7 and 4.2. Cotton micronaire base range is between 3.5 – 3.6 and 4.3 – 4.9. The discount range is lower than 3.4 and higher than 5.0.

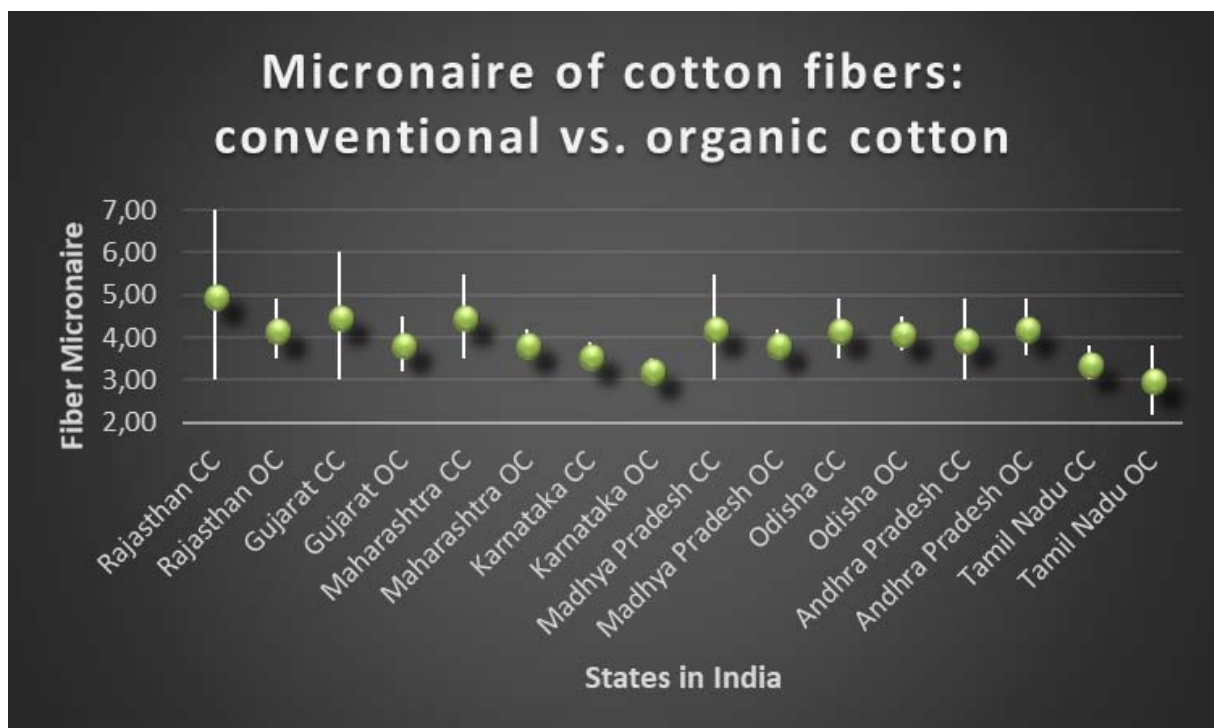


Figure 2. Micronaire of the fibers: conventional vs. organic cotton

During the plant growth, cotton micronaire is influenced by the environmental conditions (temperature, moisture, sunlight, nutrients in the soil) and extremes in boll population. However, the analysis of the graph (Fig. 2) shows that the average micronaire of the organic cotton fibers is in the premium range (except for two states, namely Karnataka and Tamil Nadu), while the micronaire of the conventional cotton is within the premium range for two states only (Odisha and Andhra Pradesh).

The cotton fiber micronaire is closely related to the spinning process and the quality of the final yarns and fabrics from them. Premium range micronaire leads to spinning of finer yarns, as the number of the fibers in the yarn's cross-section is higher and enough to assure the yarn strength. The lower fineness of the fibers (lower than the premium range) requires slower speeds during the yarn manufacturing (in the opening, carding, and drafting) to prevent the fiber breakage. The higher fineness of the fibers (higher than the premium range) leads to the spinning of coarser yarns and fabrics with higher thickness. At the same time, the better maturity of the organic cotton fibers will positively influence the dyeing process.

According to the data in [3, 7], short length organic cotton is produced in four countries: India, Peru, Brazil, and the United States – Fig. 3. Medium length organic cotton grows in 16 countries, namely Tanzania, Ethiopia, Madagascar, Uganda, Mali, Senegal, Benin, Burkina Faso, China, Turkey, Tajikistan, India, Pakistan, Columbia, Brazil, and the United States – Fig. 4. Figure 5 shows the producers of long fiber organic cotton: Madagascar, Uganda, China, Turkey,

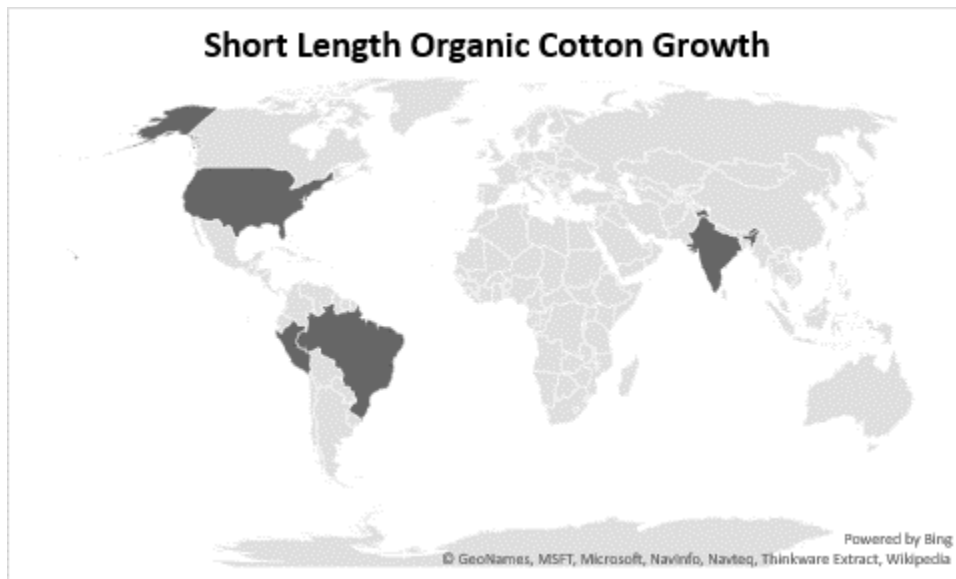


Figure 3. Short length organic cotton growth (by country)

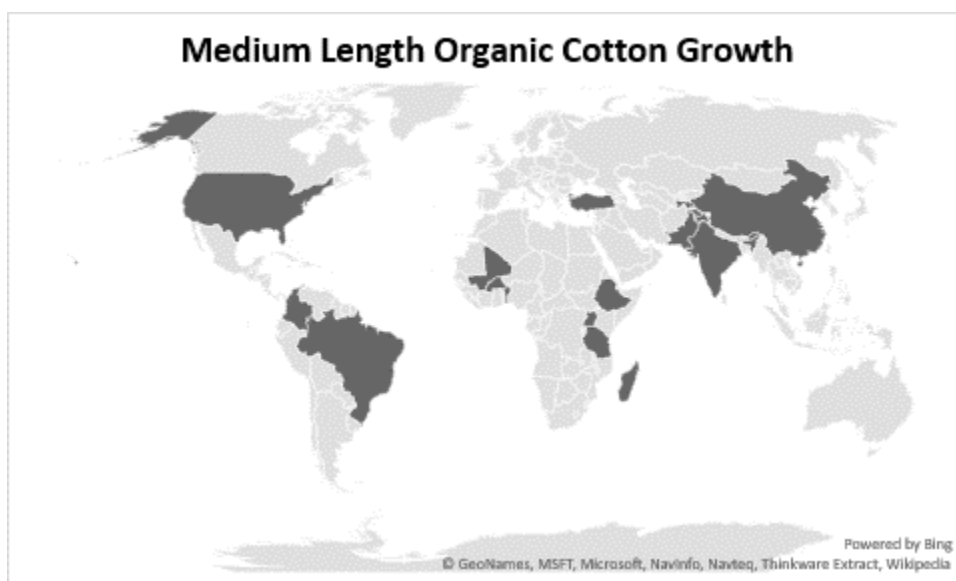


Figure 4. Medium length organic cotton growth (by country)

Kyrgyzstan, India, and Peru. Figure 6 visualizes the six countries, producing extra-long organic cotton: China, Egypt, Israel, India, Peru, and the United States.

Environmental Aspects of the Organic Cotton Farming

Organic cotton growth is friendly to the humans and the environment. The farming of the cotton crops without the use of pesticides is best for the farmers, their families and neighbors, as they are not exposed to toxic chemicals, some of them with lethal effect. The non-use of pesticides preserves underground water, which is the only drinkable water in several countries [1]. This also preserves the rivers, lakes, and water basins, which can be directly affected by the chemicals or be contaminated indirectly, through the rains and underground water.

Organic cotton growth protects the soil due to the lack of toxic chemicals. Pesticides applied to conventional cotton and the genetically modified cotton crops decrease the fertility of the soil [1].

Pesticides, used in conventional cotton growth are dangerous for all living organisms in soil and water, as well as in the air, during the process of cotton spraying. Toxic chemicals, related to

conventional cotton farming are found in fishes, eggs, and cow milk. The cultivation of organic cotton does not provoke such environmental problems.



Figure 5. Long length organic cotton growth (by country)

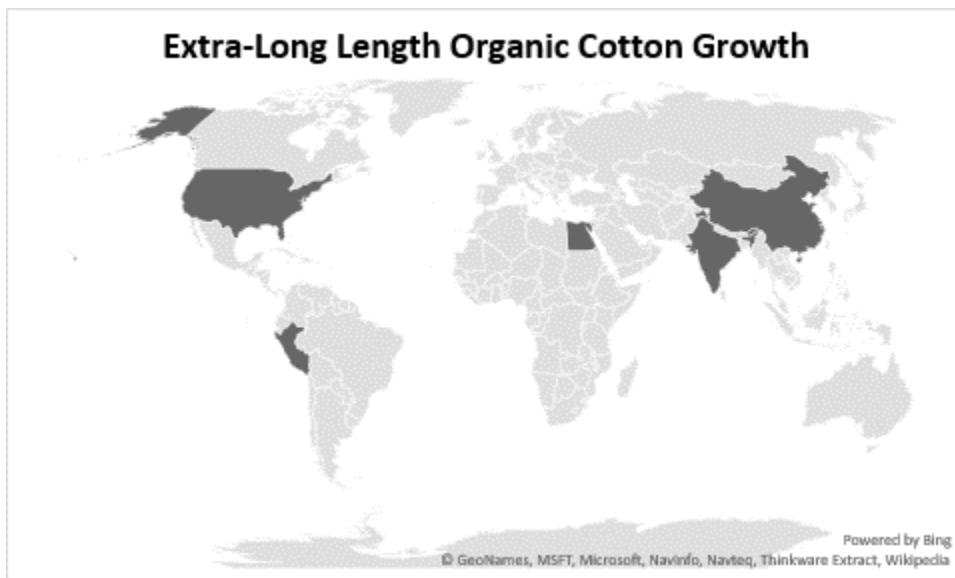


Figure 6. Extra-long length organic cotton growth (by country)

Preferred Cotton vs. Organic Cotton

According to the Textile Exchange [5] organic cotton is part of the *Preferred Cotton*, together with several other types: recycled, CmiA, Fair Trade, BCI, Cleaner Cotton, REEL, and e3cotton. With so many initiatives, acronyms, projects, etc. the customers of cotton textiles and apparel may be confused, as they usually make difference only between organic cotton (thanks to the special labels on the textile items) and the other items, which are not marked as organic. In fact, buying organic cotton people support the organic cotton farming and all its positive effects on the environment and human health. But they can hardly fill the difference between organic and conventional cotton shirts or underwear, despite the reverse claims in media and advertisements.

Therefore, it is very important to be known how the organic cotton is related to the other types of cotton in the *Preferred Cotton* segment:

- **BCI Cotton:** it is cotton, produced as a part of the Better Cotton Initiative (BCI). It can be organic but usually is conventional or genetically modified cotton.
- **Fair Trade Cotton:** it is certified by a fair-trade organization, meaning that the cotton farmers receive a fair price for their production. It can be organic but usually is conventional or genetically modified cotton.
- **REEL Cotton:** The Responsible Environment Enhanced Livelihoods (REEL) cotton is an agricultural program of CottonConnect. It can be organic but usually is conventional or genetically modified cotton.
- **CmiA Cotton:** this is the acronym for “*Cotton Made in Africa.*” It can be organic but usually is conventional or genetically modified cotton.
- **Cleaner Cotton™:** This is conventional cotton produced within the Sustainable Cotton Project (SCP) in the United States. It does not involve organic and genetically modified cotton.
- **e³ Cotton:** it is a sustainable cotton crop of Bayer CropScience. This is not organic cotton.

Conclusion Remarks

There is no best cotton nowadays than the organic cotton. All other initiatives have a partial effect on human health and the environment, prohibiting the most dangerous pesticides, but allowing other toxic chemicals to be used in the cotton fields. The very high market demand for cotton textiles and apparel does not allow organic cotton to be the only way for cotton growth.

However, even the partial solutions, related to the initiatives of the *Preferred Cotton* segment, such as the ban on child labor and work of pregnant women in the cotton fields during or short after pesticides' spraying, the requirements for use of personal protective equipment and protection of underground water, are useful for preserving nature and people. However, consumers should know that only the organic cotton label on cotton textiles and apparel provides their support for organic farming worldwide.

References

1. Action, P. *The Deadly Chemicals in Cotton*. Environmental Justice Foundation in collaboration with Pesticide Action. London, UK: Development House, 2007.
2. Textile Exchange, *Quick Guide to Organic Cotton*, 2017.
3. Textile Exchange, *Organic Cotton Market Report*, 2017.
4. van Duijn, H., & Maas, M. *Organic Cotton's Threshold Moment*, 2017. Retrieved from http://www.organiccottonaccelerator.org/wp-content/uploads/dlm_uploads/2017/03/OCA-Organic-Cottons-Threshold-Moment-2017.pdf
5. Textile Exchange, *Preferred Fiber & Materials Market Report*, 2017. Retrieved from <https://textileexchange.org/downloads/2017-preferred-fiber-materials-market-report/>
6. *Better Cotton Principles and Criteria*. (2018). Retrieved from <https://bettercotton.org/about-better-cotton/better-cotton-standard-system/production-principles-and-criteria/>
7. Textile Exchange, *Organic Cotton: A Fiber Classification Guide*, 2017.
8. Cotton Incorporated. *The Classification of Cotton*. 2018.

Assoc. Prof. Radostina A. Angelova. MSc, PhD, DSc, Technical University of Sofia, Department of Textiles, phone +359 2 9652904, e-mail: joy_angels@abv.bg