# Cotton and the Environment

Approximately 22.7 million metric tons (MT) of cotton (104.2 million bales) were grown globally in 2016/17[1] on approximately 30 (29.8) million hectares of land.[2] This is equivalent to roughly 2.6% of global arable land[3] in 61 countries.[4]

**Following are several reasons why organic cotton production is important to the long-term health of people and the planet.**

**Cotton's overall environmental impact**

- In the U.S., cotton ranks in third place in terms of pesticide use after only corn and soybeans. More than 38 million pounds of pesticides were used on cotton in 2014. The same year, cotton ranked fourth in terms of fertilizer use on crops – almost 973 million pounds – behind only corn, soybeans, and wheat.[5]
- Global cotton production releases 220 million metric tons (MT) of carbon dioxide a year, with one MT of non-organic cotton fiber producing 1.8 MT of carbon dioxide.[6]
- It takes more than 2,700 liters of water to make one conventional cotton t-shirt, and almost 11,000 to make a pair of jeans.[7]
- In India, home to more cotton farmers than any other country, pesticides applied to cotton production account for over half of the total amount applied annually despite cotton acreage representing just 5% of all agricultural land there.[8]

**Pesticide and fertilizer use on cotton**

**Conventionally grown cotton used $3.3 billion worth of pesticides in 2014 (the most recent year for which data are available).**[9] Cotton accounted for 5.7% by value of all the plant protection chemicals sold that year, including 16.1% of all insecticide sales, 3.9% of herbicide sales, 4% of growth regulators /

[1] Cotton Incorporated, Monthly Economic Letter, December 2016. http://www.cottoninc.com/corporate/Market-Data/MonthlyEconomicLetter/pdfs/English-pdf-charts-and-tables/World-Cotton-Production-Bales.pdf

[2] International Cotton Advisory Committee, Cotton This Month, January 3, 2017

[3] An Open Letter to Neil Young Regarding His Protect Earth Campaign, Prepared by Cotton Analytics, Terry Townsend, CottonAnalytics.com, August 5, 2014. http://cottonanalytics.com/wp-content/uploads/2014/01/Neal-Young-Response.pdf and Personal Communication of Rafiq Chaudhry, International Cotton Advisory Council (ICAC), January 9, 2017.

[4] International Cotton Advisory Committee, Cotton This Month, January 3, 2017.

[5] U.S. Department of Agriculture, Agricultural Chemical Use Program, May 20, 2016. https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/

[6] The Soil Association, *Cool Cotton—Cotton and Climate Change*, September 2015. https://www.soilassociation.org/media/6491/cool-cotton-organic-cotton-and-climate-change-2015.pdf

[7] UNESCO-IHE, The Water Footprint of Cotton Consumption. 2005. http://waterfootprint.org/media/downloads/Report18.pdf

[8] Environmental Justice Foundation, The Deadly Chemicals in Cotton, 2007. http://ejfoundation.org/sites/default/files/public/the_deadly_chemicals_in_cotton.pdf

[9] International Cotton Advisory Council (Rafiq Chaudhry) e-mail correspondence with Sandra Marquardt citing Cropnosis Ltd., November 23, 2016.

desiccants / defoliants, and 1% of world fungicide sales.[10] (Unfortunately, pesticide *use* data are not available at the global or country level, so *sales* data are the most available data. Sales values are affected by several factors, such as inflation and the development of newer, and often more expensive, molecules).[11]

In the U.S., approximately 38.3 million pounds of pesticides were used on approximately 8.6 million acres of cotton planted in 11 states in 2014 (the most recent year for which data are available), amounting to an approximate average of 4.4 pounds of pesticides per acre of cotton grown. This included 26.3 million pounds of herbicides, 2.4 million pounds of insecticides, 26,000 pounds of fungicides, and 9.5 million pounds of "other" pesticides (including defoliants).[12]

The Top 10 pesticides used in the U.S. on cotton in 2015 were glyphosate, ethephon, trifluralin, acetochlor, tribufos, sodium chlorate, acephate, s-metolachlor, diuron, and paraquat.

- Three – glyphosate, diuron, and tribufos – are considered known[13] or probable[14] human carcinogens
- Three – acephate, s-metolachlor, and trifluralin--are considered possible human carcinogens[15]
- Three – acephate, paraquat, sodium chlorate – are considered level II moderately acutely toxic pesticides.[16]
- Six – acetochlor (Group 1), diuron (Group 2), and acephate, glyphosate, paraquat, and trifluralin (Group 3)—are considered known or possible endocrine disruptors.[17]

Glyphosate, the top-ranked pesticide used on cotton in the U.S. which represents 35% of all pesticides used on cotton by poundage (also the active ingredient in Round Up® and the herbicide associated with Roundup Ready® genetically engineered cotton), was recently determined to be a probable carcinogen.[18] It can also cause birth defects, as well as genetic damage, endocrine disruption, and other serious health

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[10] Terry Townsend, International Crop Advisory Council memo to Textile Exchange Global Organic Cotton Community Platform referencing Cropnosis Ltd., December 15, 2015.

[11] The Expert Panel on Social, Environmental and Economic Performance of Cotton Production (SEEP), Fact Sheet on Pesticide Use in Cotton Production, April 2012, citing Cropnosis Ltd., 2010. http://icac.org/wp-content/uploads/2012/04/seep_pesticides_facts1.pdf.

[12] U.S. Department of Agriculture, Agricultural Chemical Use Program, May 20, 2016. https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/

[13] IARC Monographs Volume 112: Evaluation of five organophosphate insecticides and herbicides. March 20, 2015. http://www.iarc.fr/en/media-centre/iarcnews/pdf/MonographVolume112.pdf

[14] Environmental Protection Agency, Chemicals Evaluated for Carcinogenic Potential – Annual Cancer Report 2015. http://npic.orst.edu/chemicals_evaluated.pdf

[15] Environmental Protection Agency, Chemicals Evaluated for Carcinogenic Potential, Annual Cancer Report 2015. http://npic.orst.edu/chemicals_evaluated.pdf

[16] World Health Organization (WHO), The WHO Recommended Classification of Pesticides by Hazard, 2009. http://www.inchem.org/documents/pds/pdsother/class_2009.pdf

[17] European Union, Strategy for Endocrine Disruptors: Priority List of Endocrine Disruptor - Annex 1 Candidate list of 553 substances. http://ec.europa.eu/environment/archives/docum/pdf/bkh_annex_01.pdf

[18] IARC Monographs Volume 112: Evaluation of five organophosphate insecticides and herbicides. March 20, 2015. http://www.iarc.fr/en/media-centre/iarcnews/pdf/MonographVolume112.pdf

effects. Many of these effects are found at very low, physiologically relevant doses.[19] In addition, scientists have found significant levels of the herbicide in air and water (both rain and river) samples in the agricultural areas in the Mississippi River watershed. According to scientists, the consistent occurrence of glyphosate in streams and air indicates its transport from its point of use into the broader environment.[20] It has also been found in food – most recently in Cheerios and Ritz Crackers, among other popular snack foods,[21] as well as honey.[22]

Synthetic fertilizers, almost 973 million pounds of which were used on U.S. upland cotton in 2015,[23]are considered detrimental to the environment, causing leaching and runoff affecting freshwater habitats and wells. Nitrogen-based synthetic fertilizers, which made up more than half (52%) of all U.S. cotton fertilizer use, are also considered a major contributor to increased nitrous oxide (N2O) emissions, which are 310 times more potent than carbon dioxide (CO2) as a greenhouse gas. For the 2015 crop year, U.S. farmers applied nitrogen fertilizer to 78 percent of planted (cotton) acres, at an average rate of 79 pounds per planted acre, for a total of 503.7 million pounds applied to the 8.6 million acres planted to cotton.[24]

**Genetically engineered cotton**

According to the U.S. Department of Agriculture:[25]

- **Herbicide-tolerant (HT) crops,** developed to survive application of specific herbicides that previously would have destroyed the crop along with the targeted weeds, are aimed for weed control in non-organic cotton. Based on USDA survey data, plantings of HT cotton expanded from 10 percent of U.S. cotton plantings in 1997 to 89 percent in 2016.[26] Data show an 80% increase in the amount of herbicides used on cotton in the U.S. from 2000 to 2015, concurrent with the expansion of HT cotton acreage.[27]
- **Meanwhile, insect-resistant crops** containing the gene from the soil bacterium Bt (*Bacillus thuringiensis*) have been available since 1996. These bacteria produce a protein that is toxic to

[19] Organic Trade Association, GMO White Paper. https://ota.com/sites/default/files/indexed_files/OTA-GMO-White-Paper.pdf

[20] U.S. Geological Survey, *Technical Announcement: Widely Used Herbicide Commonly Found in Rain and Streams in the Mississippi River Basin.* August 29, 2011. www.usgs.gov/newsroom/article.asp?ID=2909#.UBluVbT-_TA

[21] Huffington Post, "Tests Show Monsanto Weed Killer in Cheerios, Other Popular Foods," November 14, 2016. http://www.huffingtonpost.com/carey-gillam/tests-show-monsanto-weed_b_12950444.html

[22] Huffington Post, "FDA Finds Monsanto's Weed Killer in U.S. Honey," September 15, 2016. http://www.huffingtonpost.com/carey-gillam/fda-finds-monsantos-weed_b_12008680.html

[23] U.S. Department of Agriculture, Agricultural Chemical Use Program, https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/

[24] U.S. Department of Agriculture, 2015 Agricultural Chemical Survey, May 2016. https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/2015_Cotton_Oats_Soybeans_Wheat_Highlights/ChemUseHighlights_Cotton_2015.pdf

[25] U.S. Department of Agriculture's Economic Research Service, Adoption of genetically engineered crops in the U.S., July 14, 2016. http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us/recent-trends-in-ge-adoption.aspx

[26] U.S. Department of Agriculture's Economic Research Service, Adoption of genetically engineered crops in the U.S., July 14, 2016. http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us/recent-trends-in-ge-adoption.aspx

[27] U.S. Department of Agriculture, Agricultural Chemical Use Program, https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/

specific insects, protecting the plant. Plantings of Bt cotton also expanded rapidly, from 15 percent of U.S. cotton acreage in 1997 to 84 percent in 2016.[28] Organic proponents note that the ubiquitous use of Bt may well create resistance among insects, thus rendering one of organic's only and primary tools for pest management useless.

- Adoption of "stacked" varieties of cotton—containing both the HT and Bt traits— reached 80 percent of all upland cotton plantings in 2016. Adoption of all GE cotton varieties, taking into account acreage with either or both traits, reached 93% of upland cotton in 2016. [29]

Commercial GMO cotton products first were introduced in 1996. By 2015, approximately 78 percent of the world's cotton acreage was planted with genetically modified seed.[30]

GMO cotton has been widely adopted in important organic cotton-producing countries including China, India, and the U.S. Approximately 94 percent (3.4 million hectares/8.5 million acres[31]) of all cotton grown in the U.S. in 2015 was GMO.[32] In 2014, India planted approximately 93 percent of its cotton as GM (11.6 million hectares/28,664,224 acres), as did China (93 percent or 4 million hectares/9,884,215 acres).[33]

**Organic Cotton Production Practices**

**Organic agriculture protects the health of people and the planet by reducing overall exposure to toxic chemicals from synthetic pesticides that can end up in the ground, air, water and food supply, and that are associated with health consequences, from asthma to cancer. Because organic agriculture doesn't use toxic and persistent pesticides, choosing organic products is an easy way to help protect you and your family.**

Organic farmers have a very limited number of materials in their toolbox to manage pests such as insects and weeds. These include natural (or "non-synthetic") materials that are derived from mineral, plant, or animal matter and do not undergo a synthetic process[34]. Examples include garlic, hydrogen peroxide, neem oil, and vinegar.[35] Organic farmers do have restricted access to 25 synthetic active pest control

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[28] U.S. Department of Agriculture's Economic Research Service, "Adoption of genetically engineered crops in the U.S.," July 14, 2016. http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us/recent-trends-in-ge-adoption.aspx

[29] U.S. Department of Agriculture Economic Research Service database, "Adoption of Genetically Engineered Crops in the U.S.," 2015. http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us.aspx

[30] ISAAA, Pocket K No. 16. "Biotech Crop Highlights in 2015." http://www.isaaa.org/resources/publications/pocketk/16/

[31] USDA National Agricultural Statistics Service (NASS), Agricultural Statistics Board, "Acreage." June 30, 2015. http://usda.mannlib.cornell.edu/usda/nass/Acre/2010s/2015/Acre-06-30-2015.pdf

[32] U.S. Department of Agriculture Economic Research Service database, "Adoption of Genetically Engineered Crops in the U.S.," 2015. http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us.aspx.

[33] Nazimi Açıkgöz, "Future of crop biotechnology in Brazil, China and other BRIC nations," Genetic Literacy Project. March 7, 2016. https://www.geneticliteracyproject.org/2016/03/07/future-crop-biotechnology-brazil-china-bric-nations/

[34] U.S. Department of Agriculture, "Guidance Materials for Organic Crop Production," https://www.ams.usda.gov/sites/default/files/media/NOP-5034.pdf

[35] U.S. Department of Agriculture, Guidance for Organic Crop Production," https://www.ams.usda.gov/sites/default/files/media/NOP-5034-1.pdf

products (over 900 are registered for use in conventional farming.)[36] These materials must be on the USDA National List of Allowed and Prohibited Substances.[37]

According to the Texas Organic Cotton Marketing Cooperative (TOCMC), which grows the majority of the organic cotton in the U.S., its growers do not use any inputs for weed control, preferring to use mechanical tillage and hand weeding. They very rarely use anything for insect control, preferring to create resilient crops by building healthy soils and using inputs such as neem oil only as a last resort.

Organic farming methods also use natural fertilizers, such as compost and animal manure, which recycle the nitrogen already in the soil rather than adding more. This reduces both pollution and N2O emissions.[38] Such methods also sequester and reduce carbon emissions. Instead of synthetic fertilizer, most TOCMC farmers use compost, and a few use manure or natural biological products.[39]

**Benefits of Organic Cotton Farming**

A Textile Exchange life cycle analysis comparing organic cotton to conventional cotton production indicated that with organic cotton there is:

- 46% reduced global warming potential
- 70% less acidification potential
- 26% reduced eutrophication (soil erosion) potential
- 91% reduced blue water consumption
- 62% reduced primary energy demand.[40]

In addition, organic cotton is non-genetically modified (non-GMO). The use of genetic engineering is prohibited in organic agriculture.[41]

**Climate change impact**

According to the Soil Association:[42]

- Switching to organic cotton production could reduce the global warming impact of cotton production overall by 46% compared to non-organic cotton.

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[36] Organic Trade Association, "National List of Allowed and Prohibited Substances," https://ota.com/advocacy/organic-standards/national-list-allowed-and-prohibited-substances

[37] U.S. Department of Agriculture, National List of Allowed and Prohibited Substances. https://www.ams.usda.gov/rules-regulations/organic/national-list . For OMRI's list of Brand and Product/Generic Materials lists, see https://www.omri.org/.

[38] Food and Agriculture Organization of the United Nations, Organic Agriculture FAQ, http://www.fao.org/organicag/oa-faq/oa-faq6/en/

[39] Personal communication with Kelly Pepper, Texas Organic Cotton Marketing Cooperative, April 4, 2017.

[40] Textile Exchange, Life Cycle Assessment (LCA) of Organic Cotton, PE International. 2014. http://farmhub.textileexchange.org/upload/library/Farm%20reports/LCA_of_Organic_Cotton%20Fiber-Summary_of%20Findings.pdf

[41] U.S. Department of Agriculture, Organic 101: Can GMOs Be Used In Organic Products? May 27, 2013. https://www.usda.gov/media/blog/2013/05/17/organic-101-can-gmos-be-used-organic-products

[42] The Soil Association, *Cool Cotton—Cotton and Climate Change*, September 2015. https://www.soilassociation.org/media/6491/cool-cotton-organic-cotton-and-climate-change-2015.pdf

- Such a switch to organic cotton production would reduce the consumption of fresh water by over 90% and energy use by over 60%. By contrast, cotton production using non-organic practices could release 300 million metric tons (MT) of carbon dioxide by 2020.
- Organic cotton produced in 2013/14 saved the equivalent of nearly 95,000 Olympic-sized swimming pools of fresh water compared to non-organic production.
- The energy saved in that period could have kept a 60-watt light bulb going for over 57,000 years.
- The reduction in greenhouse gas emissions was the equivalent of driving a car around the world over 14,000 times.

**Processing Organic Textiles**

During the conversion of conventionally grown cotton into apparel and textiles, many hazardous materials are used during processing and screen-printing, including dyes, silicone waxes, harsh petroleum scours, softeners, heavy metals, flame retardants, ammonia, formaldehyde, and polyvinyl chloride (PVC in screen printing) —to just name a few. Many processing stages result in large amounts of untreated toxic wastewater being carried into drinking water sources.[43]

Safeguarding the integrity of organic practices in the finished product, the Global Organic Textile Standard (GOTS) prohibits the use of toxic inputs in the processing of finished organic apparel and textiles.[44] The number of facilities worldwide certified to GOTS grew to 3,814 facilities in 68 countries in 2015, and GOTS certified facilities around the world. The Top 15 countries in terms of the total number of GOTS certified facilities are India (1,441), Turkey (489), Germany (306), Bangladesh (210), China (201) Pakistan (142), Italy (141), Portugal (89), South Korea (80), Japan (65), USA (60), France (56), UK (49), Austria (49), and Denmark (41).[45] More than a million workers are employed in GOTS-certified facilities.[46]



[43] Yale Environment 360, Can Waterless Dyeing Processes Clean Up the Clothing Industry?, June 12, 2014. http://e360.yale.edu/feature/can_waterless_dyeing_processes_clean_up_clothing_industry_pollution/2775/

[44] Global Organic Textile Standard, GOTS Version 4, 2014. www.global-standard.org.

[45] Global Organic Textile Standard, "GOTS Growth Continues." **February 18, 2016.** http://www.global-standard.org/information-centre/press-releases.html

[46] Global Organic Textile Standard, 2015 Annual Report. May 2016. http://www.global-standard.org/images/stories/Annual_Reports/GOTS_AR2015Public_low.pdf