Cotton and the Environment

Approximately 25.137 million metric tons (MT) of cotton were grown globally in 2017/18 on 31.865 million hectares of land in 61 countries. This is equivalent to roughly 2.78% of global arable land in 61 countries.[1]

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. Almost 48 million pounds of pesticides were used on cotton in 2017.[2]
- The same year, cotton ranked fourth in terms of fertilizer use on crops – almost 1.5 billion pounds – behind only corn, soybeans, and wheat.[3]
- 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.[4]
- 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.[5]
- 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.[6]

Pesticide and fertilizer use on cotton

Cotton used $4.2 billion worth of pesticides in 2017 accounting for 6.35% by value of all the plant protection chemicals sold that year, including 12.34% of all insecticide sales and 3.94% of herbicide sales. (Unfortunately, pesticide *use* data are not available at the global or country level, so *sales* data are the most available data).

In the U.S., approximately 48 million pounds of pesticides were used on approximately 12.6 million acres of cotton planted in nine states in 2017 (the most recent year for which data are available), amounting to an approximate average of 3.8 pounds of pesticides per acre of cotton grown. This included 29.5 million pounds of herbicides, 4.5 million pounds of insecticides, 28,000 pounds of fungicides, and 13.9 million pounds of "other" pesticides (including defoliants).[7]

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[1] International Cotton Advisory Committee (ICAC), Cotton World Statistics. October 2017.

[2] U.S. Department of Agriculture, Agricultural Chemical Use Program, July 17, 2018.
https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/

[3] U.S. Department of Agriculture, Agricultural Chemical Use Program, July 17, 2018.
https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/

[4] 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

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

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

[7] U.S. Department of Agriculture, Agricultural Chemical Use Program, July 17, 2018.
https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/

The Top 10 pesticides used in the U.S. on cotton in 2017 were glyphosate, ethephon, acephate, dicamba, trifluralin, s-metolachlor, tribufos, glufosinate ammonium, acetochlor and diuron.

- Three – glyphosate, diuron, and tribufos – are considered known[8] or probable[9] human carcinogens.
- Four – acephate, acetochlor, s-metolachlor, and trifluralin – are considered possible or suggestive human carcinogens.[10]
- Three – acephate, dicamba, and glufosinate ammonium – are considered level II moderately acutely toxic pesticides.[11]
- Six – acetochlor (Group 1), diuron (Group 2), and acephate, glyphosate, glufosinate ammonium, and trifluralin (Group 3)—are considered known or possible endocrine disruptors.[12]
- Acephate is considered high toxic to bees.[13]

These 10 pesticides (seven herbicides, one insecticide, one defoliant, and one plant growth regulator) represented 83.4% of all the reported pesticides used on cotton in 2017.

Glyphosate, the top-ranked pesticide used on cotton in the U.S., represented 30% 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, glyphosate, was determined in 2015 to be a probable carcinogen.[14] It can also cause birth defects, as well as genetic damage, endocrine disruption, and other serious health effects. Many of these effects are found at very low, physiologically relevant doses.[15] 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.[16] It has also been found in food, with internal US Food and Drug Administration documents showing "the FDA has had trouble finding any food that does not carry traces of the pesticide."[17]

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[8] 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

[9] Environmental Protection Agency, Chemicals Evaluated for Carcinogenic Potential – Annual Cancer Report 2017. http://npic.orst.edu/chemicals_evaluated.pdf

[10] Environmental Protection Agency, Chemicals Evaluated for Carcinogenic Potential, Annual Cancer Report 2017. http://npic.orst.edu/chemicals_evaluated.pdf and Pesticide Action Network, PAN International List of Highly Hazardous Pesticides, March 2018. http://www.pan-germany.org/download/PAN_HHP_List.pdf

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

[12] 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

[13] National Pesticide Information Center, Acephate. http://npic.orst.edu/factsheets/archive/acephatech.html

[14] 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

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

[16] 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

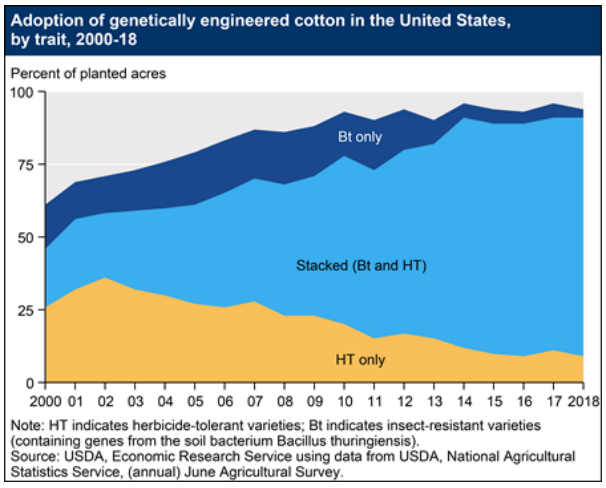
[17] The Guardian. "Weedkiller found in granola and crackers, internal FDA emails show." https://www.theguardian.com/us-news/2018/apr/30/fda-weedkiller-glyphosate-in-food-internal-emails

Synthetic fertilizers, almost 1.5 billion pounds of which were used on U.S. upland cotton in 2017[18], 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.

Genetically engineered cotton

According to the U.S. Department of Agriculture:[19]

- **Herbicide-tolerant (HT) crops** are designed for weed control in conventional cotton. They were developed in 1994 to survive application of specific herbicides that previously would have destroyed the crop along with the targeted weeds. U.S. adoption rates for HT cotton-only decreased from a high of 36% of planted cotton acreage in 2002 to 9% in 2018.
- **Insect-resistant crops** containing the gene from the soil bacterium *Bt* (*Bacillus thuringiensis*) have been available since 1996. The bacteria produce an insecticidal protein that is toxic to specific insects, and the plant-incorporated protectant concentrated in the plant tissues protects the plant from pests. U.S. acreage in *Bt* cotton-only has decreased from a high of 18% in 2008 to 3% in 2018. (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 - has expanded the greatest of any genetically engineered cottonseed variety to reach 82% of all upland cotton plantings in 2018. The percent of cotton acreage grown with both HT-only and stacked-gene varieties expanded from two percent in 1996 to 91%in 2018.
- Acreage of **Bt-only cotton plus stacked-gene cotton** reached 85% of cotton in 2018. Adoption of *all* GE cotton varieties, taking into account acreage with either or both traits, reached 94% of upland cotton acreage in 2018.



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

[19] U.S. Department of Agriculture's Economic Research Service, Adoption of genetically engineered crops in the United States, July 16, 2018. https://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us.aspx and Recent Trends in GE Adoption, July 16, 2018. https://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us/recent-trends-in-ge-adoption.aspx

Commercial GMO cotton technology has been widely adopted in countries around the world. Countries growing close to or more than 90 percent genetically engineered cotton are Argentina, Australia, China, India, Mexico, Pakistan, Paraguay, South Africa and the U.S.[20]

Organic cotton is not genetically modified, as the use of genetic engineering is prohibited in organic agriculture.[21]

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 does not 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 derived from mineral, plant or animal matter and that have not undergone a synthetic process.[22] Examples include garlic, hydrogen peroxide, neem oil, and vinegar.[23] Organic farmers do have restricted access to 25 synthetic active pest control products (in contrast to over 900 registered for use in conventional farming.)[24] These materials must be on the USDA National List of Allowed and Prohibited Substances.[25]

According to the Texas Organic Cotton Marketing Cooperative, which grew 63% of the organic cotton in the U.S. in 2017, 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.[26]

Many management practices used by organic agriculture (such as minimum tillage, returning crop residues to the soil, the use of cover crops and rotations, and the greater integration of nitrogen-fixing legumes) increase the return of carbon to the soil, raising productivity and help sequester carbon.[27]

Benefits of Organic Cotton Farming

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[20] ISAAA, Brief 53: Global Status of Commercialized Biotech/GM Crops: 2017. June 26, 2018. http://www.isaaa.org/resources/publications/briefs/53/default.asp

[21] 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

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

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

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

[25] 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/.

[26] Correspondence of Sandra Marquardt with Texas Organic Cotton Marketing Cooperative, June 2018.

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

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
- 62% reduced primary energy demand.[28]

Climate change impact

According to the Soil Association:[29]

- Switching to organic cotton production could reduce the global warming impact of cotton production overall by 46% compared to non-organic cotton.
- 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 name just a few. Many processing stages result in large amounts of untreated toxic wastewater carried into drinking water sources.[30]

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.[31] The number of facilities worldwide certified to GOTS grew to 5,024 facilities in 62 countries in 2017. The top ten countries in terms of total number of certified facilities were: India (1,658), Bangladesh (534), Germany (480), Turkey (445), Italy (307), China (292), Pakistan (194), Portugal (180), USA (99) and South Korea (69). Approximately 1.74 million workers are employed in GOTS-certified facilities.[32]

[28] 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

[29] 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

[30] 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/

[31] Global Organic Textile Standard, GOTS Version 5, 2017. www.global-standard.org.

[32] Global Organic Textile Standard, "Global Organic Textile Standard (GOTS) Tops 5000 Facilities in 2017." March 8, 2018.