REPORT OF COTTON INCORPORATED
TO THE SECRETARY'S OFFICE

Year-End 2019
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OVERVIEW OF CONTENTS

Each year Cotton Incorporated prepares a formal Strategic Plan* that covers the key principles that guide the Company’s long-range activities. The major priority areas over the next five years for programs at Cotton Incorporated are:

- **Growing cotton demand to 135 million bales by 2028**
  - Cotton product innovation and implementation
  - Cotton sustainability
  - Global presence for cotton

- **Growing U.S. cotton demand and production to 20 million bales by 2028**
  - U.S. cotton sustainability
  - Farm profitability – cost of production
  - Fiber quality / contamination
  - Cottonseed value
  - Cotton Management System: EFS® implementation
  - CCI contribution

In order to fulfill these priorities, specific strategic objectives are outlined for each of Cotton Incorporated’s four Operating Committees and related subdivisions:

- **Agricultural Research Committee**
  - Agricultural and Environmental Research
  - Sustainability

- **Research and Development Committee**
  - Fiber Competition: Fiber Quality Research
  - Fiber Competition: Cotton Management System (EFS®)
  - Product Development and Implementation (PDI)

- **Global Supply Chain Marketing Committee**
  - Global Supply Chain Marketing
  - Importer Support Program

- **Consumer Marketing Committee**
  - Advertising, Public Relations, and Strategic Alliances
  - Corporate Strategy and Program Metrics (CSPM)

Operating Committees determine tactics and activities to meet the strategic objectives identified for their program area or divisions within their program area and provide deliverables of their activity to the Board.

This bi-annual report includes the following sections:

1. **Executive Summary**: Overview of year-to-date progress report toward achieving Cotton Incorporated’s mission and strategic objectives, organized by program committee and its related divisions.

2. **Report of Activities by Program Committee and Strategic Objectives**: Detail of year-to-date progress report toward achieving Cotton Incorporated’s mission and strategic objectives, organized by Program Committee and its related divisions.

3. **Explanation of Terms and Activities**: Summary descriptions of ongoing projects and key terminology used to explain activities within each Program Committee and its divisions are included as a reference guide

*Please refer to page 1 of the 2019 Plan & Proposed Budget Book for complete details on Cotton Incorporated’s current strategic plan.*
EXECUTIVE SUMMARY

This Executive Summary section provides an overview of the report from each of Cotton Incorporated’s four operating committees and related subdivisions.

Agricultural Research Committee

Agricultural & Environmental Research (AERD)

Cotton is a unique crop among all its rotation partners. Cotton has the highest level of complexity in both production and utilization. Cotton is a perennial tree with seed hairs to aid windborne dispersal that is farmed as an annual plant for its spinnable fiber. To achieve this transformation, substantial input is required from breeders, growers, ginners, and support industries; 2019 epitomized the substantial input required. It was a challenging year for cotton farmers due to pests, weather, and market disruptions, but an excellent year for agricultural research to step forward and address these challenges.

Over the last ten years, crop protection has expanded into a top objective for agricultural research. Many of the previous pest management “silver bullets” have been degraded due to resistance (herbicides, insecticides, and Bt toxins for weeds, boll worms and plant bugs) and many new or expanding pests need to be addressed (Cotton Leaf Roll Dwarf Virus, Cotton Leaf Curl Gezera Virus, Target Spot, and Fusarium Wilt Race 4). Unfortunately, new “silver bullets” are not forthcoming and growers must rely on multiple coordinated strategies to prevent profit damaging yield loss or expenses. Five of the seven AERD Research Directors and 41% of the AERD investments address crop protection. For 2019, 48% of crop protection investments were focused on diseases, 30% on insects, 12% on weeds, and 10% on nematodes. Over half of the disease investment was focused on halting the expansion and yield loss from Fusarium Wilt Race 4 (FOV4) and a third was focused on new viruses. Regarding FOV4 in 2019, progress was made with eleven public sector varieties/lines of Upland cotton confirmed to have tolerance to FOV4 using the 10-replication, 8-check validation methods. The most agronomically suitable of these 11 were crossed and increased in the Cotton Winter Nursery to accelerate breeding. The other major pest outbreak was Cotton Leaf Roll Dwarf Virus (CLRDV), which was identified late in 2018, causing significant yield loss in several locations. Many of the plant pathologists working on other pathogens were redirected to address CLRDV and shared their research at several meetings at the end of the year. Detection tools for CLRDV are now available, and the virus has been found in most weeds and across all cotton states east of New Mexico. Many of the symptoms have been identified in addition to management practices using tolerant varieties.

Apart from CLRDV, another example of redirecting cooperators towards new threats is plastic contamination. Over a three-year timespan, cooperators were able to design a novel approach to removing module wrap plastic in the gin and move this technology forward with commercial partners who improved and installed the system in several gins. The system that will be available commercially in 2020 detects plastic in the gin stand and removes it before it is cut into small fragments by the gin saws. Additional technologies are being developed to address plastic contamination that will be further tested and refined in 2020. Implementing this system into commercial gins, the first of its kind, is an incredible success and will help address the challenge that plastic contamination poses to the reputation of U.S. cotton for superior quality.

Research and Development Committee

Fiber Competition

Quality Research had 12 outside research projects for 2019, which consisted of the renewal of seven projects and the initiation of five new projects. The top priority for 2019 was dealing with contamination issues. The other key priority was the Fiber of the Future effort, which involves improving fiber length uniformity and fineness.

Product Evaluation Laboratory (PEL) activities continued to focus on normal day-to-day testing. Routine testing on two high volume instrument (HVI®) inter-lab evaluations involved twelve proficiency sets, and the lab also provided testing for the USDA-AMS on ten sets of calibration cotton using both HVI® models. A total of nine proficiency tests for fabric and one proficiency test for yarn was also run during the year. Testing services were active for all areas of research and implementation for both Agricultural and Environmental Research and Product Development and Implementation divisions. The lab is continuing to learn and tweak the new version of LogBook® software, a specialized system used by the PEL for all data collection and reporting to meet the lab’s specific needs.
The Cotton Management System (CMS) Product Development team continues to support MILLNet™ software products, with the primary focus on updates and enhancements for the latest version. The latest version of MILLNet™ software is being used for all new licensee installations. All but two existing users have been converted to the latest version with plans to convert the final two in early 2020.

The CMS Technical Service and Marketing teams assisted customers 3,135 times by phone, e-mail, text, face-to-face, and the Internet. Yearly service visits were completed for licensees located in Canada, China, Colombia, El Salvador, Guatemala, Honduras, Korea, Mexico, Nicaragua, Peru, Philippines, Thailand, the U.S., and Vietnam. Marketing visits were made to prospective clients in Colombia, El Salvador, Guatemala, Indonesia, Korea, Mexico, Peru, the U.S., and Vietnam. Three new MILLNet™ software licenses were signed and installed.

Product Development and Implementation (PDI)

The Product Development and Implementation (PDI) Division has accomplished many achievements within the top-three strategies set forth in 2019: Contamination, Sustainability, and Innovation. To address contamination, a cotton twine sample was developed, and tests were identified to evaluate baseline performance of current cotton wrap material. In addition, a large contamination trial was completed in Germany in coordination with the equipment manufacturer and industry partners. The new detection technology removes and quantifies debris found at the mill level during processing. A completed technical report then compared current contamination detection and removal technologies with the advanced technologies used during the Germany trial. As traceability has risen to the forefront of the cotton industry, PDI provided technical support to Cotton Council International (CCI) to investigate Britain’s Traceability Technology by processing upland cotton, from two different states, to produce yarn and fabric samples for evaluation.

In the area of sustainability, the microfiber biodegradation project examined the impact of dyes and finishes on cotton’s ability to degrade in aquatic environments. An effort to transform waste cotton into chemical intermediaries was achieved with the cotton-to-sugar project. The project realized significant process improvements, whereby chemicals and energy were reduced without sacrificing efficiency. Two outside research projects, saw promising results, examined methods transforming waste cotton into high value materials, such as nanocellulose and carbon fiber. Synthetic fleece-alternative fabrics, of cotton and wool, continued to be a highlight, as were 100% cotton thermal knits. A focus on sustainability was maintained in bottom-weight offerings, further reducing waste in selvage denim, through reducing chemical inputs of dyeing through catatonically treated woven fabrics and in mechanical fabric finishing. Lasers were also used reducing chemical inputs by creating a variation on traditionally corduroy concepts. The Life Cycle Analysis (LCA) was expanded to include Ultra Touch™ denim insulation, evaluating how it compares to the traditional fiberglass product.

Product Development and Implementation continues to develop innovative products. Novel yarns were developed using newly purchased AgTek Multi-function winders. The novelty yarns were then used in FABRICAST™ collections, enhancing the design’s aesthetic through embroidery. Developments were also initiated using the new Muratec III 870 Vortex Spinner (MVS), obtained in 2018. In an effort for MVS yarn to better compete with ring spun yarn, research trials focused on improving strength and softness of the yarns. Multiple nonwoven prototypes were developed with a wide range of forming and bonding technologies using recycled or reclaimed cotton. Five FABRICAST™ collections were released this year focusing on sustainability, performance, and activewear. This included fiber selection, construction, and finish application. Different blends and blend levels were developed to produce lighter weights with a reduced absorbent capacity. Rounding out the collection were fabrics with dual-finish technologies, fabrics with unique surface design, fabrics with conductive yarns for e-textiles, and even prototypes for shoe uppers.

New technologies continue to be released by PDI. A new Sweat Hiding™ technology, for lightweight woven fabrics, was launched enabling materials, such as dress shirts, to absorb water but not appear wet on the surface. Another new development, labeled QuickDRY™ technology, was run on 100% cotton sheeting in partnership with a U.S. mill, with the aim of reducing energy in the consumer-use phase. This non-formaldehyde flame retardant technology is still under development and new chemistries are being evaluated. Two dual-technology finishes were introduced through the FABRICAST™ collection at the Outdoor Retailer (OR) show in August. Fabrics treated with TransDRY® + TOUGH COTTON™ technology and STORM COTTON™ + TOUGH COTTON™ technology were the first requested by several retailers. Work continues to increase cotton fiber in 3D printing and injection molding. By increasing the cotton fiber content in molding technologies, the performance can be enhanced while displacing synthetics. After receiving a notice of allowance, the PUREPRESS™ technology patent has moved forward.
Strong interest has developed around PUREPRESS™ technology over the course of 2019, with six-mills becoming suppliers running 13-separate trials. One supplier increased its production to include 34-styles treated with PUREPRESS™ technology. The TOUGH COTTON™ technology continues to be implemented by major brands as well. With interest from additional mills in the U.S. and Asia to become suppliers. The implementation of STORM COTTON™ technology continues, but with emphasis on a non-fluorine formula. With the assistance of the Product Evaluation Lab (PEL), a total of 317 projects with over 900 samples were processed for technology licensing. This was in addition to technical service, analytical work, internal research, and support for fabric development.

In June, PDI traveled to Barcelona, Spain, attending the International Textile Machinery Association (ITMA) Show which occurs every four years. The team focused on new technologies surrounding cotton development in spinning, contamination detection, knitting & weaving, dyeing & finishing, printing, sustainability and emerging technologies. Six reports were prepared to share PDI’s insights within Cotton Incorporated and the cotton industry. Various activities were done to amplify cotton’s research in the LCA, such as participating in industry meetings, presenting at several international conferences, as well as authoring a position paper on LCA implementation. Product Integrity participated in an international standards organization (ISO) conference contributing to work screening for GMOs in textiles, advancing the consumer-facing dashboard used for the Higg Index, and chairing numerous committees and working groups within both SAC, AATCC, and ANSI organizations throughout the year. In addition, the results of a non-formaldehyde finish development were presented at an international conference.

Global Supply Chain Marketing Committee

Global Supply Chain Marketing (GSCM)

An important tactic for maintaining a global presence for cotton is through direct account interaction with mills, manufacturers, brands, and retailers for the apparel, nonwovens, and home products markets. GSCM staff focus their efforts on influencing major brands and retailers through coordination of various Company resources, with the goal of influencing the use of cotton versus other fibers. During the second half of 2019, GSCM staff conducted more than 400 meetings with companies in both the manufacturing supply chain and with key brand and retailer accounts.

In its sixth year, the Cotton LEADS™ program continues to educate and inform retailers, brands, and manufacturers about responsible U.S. cotton production. Cotton Incorporated participates in this program with the National Cotton Council of America, the Cotton Foundation, Cotton Australia, and Cotton Council International. In 2019, 32 new partners joined the program, thus reaching a total of 592 partnering manufacturers, brands, and retailers. During the second half of the year, Mexico City staff added two more Cotton LEADS™ members and also supported two members, one Peruvian, one Mexican, to design and launch their respective Business to Business (B2B) Cotton LEADS™ membership campaigns by labeling their eco-line products made with U.S. cotton.

Forty-four technical education workshops were held in 2019 with over 1,271 attendees. These individuals were from 128 major brands and retailers. The purpose of these workshops was to provide detailed technical information and training on relevant topics important for cotton.

The CottonWorks™ website is a marketing tool and educational resource (www.cottonworks.com). It is the leading innovative education and information resource for current and emerging textile industry professionals who are actively seeking connections to cotton. New content, both educational and marketing, continues to be added on a regular basis. In 2019, two new nonwovens courses were added and new content on cotton biodegradability was also added. Additionally, cotton fabrics from Cotton Incorporated’s FABRICAST™ collection were digitized and added to the updated FABRICAST™ collection page, bringing the total number of digitally searchable fabrics to 1,027, and two new brochures were added: microfiber biodegradability in aquatic environments and NATURAL STRETCH™ technology. Staff also implemented a new resource on the site to learn more about cotton production terms. In 2019, there were 32,108 registered users, 183,479 sessions, and 1,028,067 page views.

The GSCM division is responsible for coordinating messaging to the trade. In 2019, consistent messaging and imagery was implemented throughout, including tradeshows, tradeshow promotional items and outlets, and other publications. In addition, new messaging was created for 2019 placement to highlight “the circular economy” and combination technologies. Trade advertisements were placed in industry publications, in print and digitally. A new campaign highlighting the improvements in sustainability, innovation, and technology was developed for the 2020 year.
Several brands and retailers that have adopted multiple cotton technologies in 2019 have expanded the product offering into other categories. A significant U.S. online retailer is continuing their STORM COTTON™ and STORM DENIM™ technologies for men’s and women’s apparel. Several competing retailers have adopted the TOUGH COTTON™ technology on girls’ leggings. A large children’s brand has adopted the TransDRY® technology on a cloth diaper that will be sold through multiple large retail stores and online. A women’s sportswear brand has adopted the TransDRY® technology on a performance tank top. An online retailer has adopted TransDRY® technology on ladies’ performance underwear.

The GSCM Nonwovens Marketing team successfully completed new license agreements in the following countries: Belgium, Canada, China, Colombia, France, Germany, Indonesia, Korea, Spain, South Africa, Switzerland, Ukraine, United Arab Emirates, UK, and the U.S. The product markets included: nonwoven roll goods; feminine hygiene tampons, pads and liners; wipes and skin care masks; air filtration masks; baby diapers; and adult care pads. Trademarks included: Seal of Cotton, natural™, enhanced™, and Cotton LEADS™. Product markets expanding the use of cotton in the second half of 2019 included, global nonwovens roll goods, feminine hygiene, wipes, baby care, skin care, air filtration masks, baby diapers, adult care pads, and hospital cleansing gloves.

Consumer Marketing Committee

Advertising

In 2019, Cotton Incorporated continued with the second year of our Life Is Uncomfortable campaign, utilizing four video assets: Tattoo, Anchor, First Day, and Meme, targeting women and men 18 – 49. This 360° campaign reached consumers through TV, video streaming, and digital media, including social media and search engine marketing; driving qualified traffic to our consumer website, TheFabricofOurLives.com.

The brand ad tracker measured campaign awareness and changes in cotton perception among the target audience. The results show that label checking for fabric content and the degree of influence fabric has on clothing purchase are higher among those who have seen First Day in particular, but overall, the campaign has high emotional connection and recognition. In addition to our above-the-line campaign, Advertising also ran a health and wellness-themed video campaign consisting of three videos: Skin Irritation, Underwear, and Sheets, as well as launched a competitive Know Your Clothes social media campaign, to build awareness, educate consumers, and promote the competitive advantages of cotton.

During the second half of 2019, the Advertising Department launched a denim-focused video campaign to highlight the historical importance of denim and how authentic denim is made with cotton. The campaign reached consumers through digital and social media as well as through enhanced search engine marketing techniques. The department also completed production on a social media campaign focused on cotton farmer Wendy Yeager, to highlight the made-in-America aspect of cotton and call attention to the family farms that grow it.

Finally, production began on the second phase of the Denim campaign: Rosie Reborn. The campaign will launch in the first quarter of 2020 and will continue to tell the story of denim’s importance in our collective American history, by highlighting the stories of trailblazing women who will be dubbed “modern-day Rosies” and underscore the importance of cotton in authentic denim. The year concluded with research and creative development on a new video campaign which will debut in the second quarter of 2020.

Public Relations

Notable among the Public Relations Department accomplishments for the 2019 year were activities in support of the sustainability of U.S. cotton, the Corporate Strategy & Program Metrics (CSPM) department and the promotion of the holiday shopping survey data; and consumer-facing corporate initiatives such as the Blue Jeans Go Green™ denim recycling program.

The department secured coverage in atypical and desirable media outlets. Some were a result of an external firm, which provided support for consumer-facing media coverage of cotton and Cotton Incorporated, and some were achieved independently by the Public Relations Department. Among these were news items in Refinery29, Real Simple Online, Martha Stewart Living Online, etc.
**Strategic Alliances**

The year began with an exciting new retail partnership for Strategic and Retail Partnerships along with collection and distribution activities for the Blue Jeans Go Green™ denim recycling program. In addition to Madewell and rag & bone collecting denim for recycling in stores nationwide, other retailers, individuals, and organizations across the country got involved as well throughout the year. Additionally, the Strategic Alliances team partnered with e-tailer, Revolve, for the first time, to plan and execute an integrated marketing campaign aiming to drive sales of cotton apparel as well as Amazon for the second year, and buybuy BABY for Seal of Cotton trademark promotions that occurred online and in-store.

**Corporate Strategy & Program Metrics (CSPM)**

In 2019, CSPM led efforts to identify opportunities and threats for cotton using market intelligence gathered through ongoing studies of U.S. consumer attitudes from the *Lifestyle Monitor™* survey, assessments of cotton’s share at retail through the *Retail Monitor™* research, and comprehensive global market and economic research and analysis. CSPM provided more than 240 information requests; participated in approximately 160 meetings and presentations; authored 268 publications, videos, TV/radio segments, and podcasts; and worked on more than 20 projects.

Work completed by CSPM in 2019 includes, but is not limited to, the collection and examination of data on more than 130K products offered at retail in the U.S. and China; the evaluation of over 14K U.S. and 17K global consumers; the update of a comprehensive database of monthly apparel and home furnishing imports; the management and analysis of global quantitative research in China; the management of Cotton Incorporated’s brand tracking metrics; and the delivery of consumer and economic outlook presentations.
Strategic Objective 1: Increase the short-term profitability of U.S. cotton production.

Cottonseed
The 2019 cottonseed crop is a little larger than average and it tested the ability of the dairy industry to consume ever-increasing supplies of cottonseed without a significant reduction in price. Oil mills are running at full capacity, with an ability to process about two million tons per year (about 30% of the crop). In 2019 the dairy industry was experiencing difficult economic conditions, while at the same time the U.S. cottonseed crop continued to increase. This trend continued to require the staff to investigate ways to convince dairy producers to feed more cottonseed, expand exports or find new markets for cottonseed, perhaps in the beef industry. A dairy cow feeding study was conducted in 2019 that was designed to strengthen the argument that feeding higher levels of cottonseed to dairy cows is cost effective. Unfortunately, now that modern dairy cows are producing milk with more than 4% butterfat, nutritionists have found ways to support this higher level of production with or without cottonseed. The website, www.wholecottonseed.com, underwent an overhaul and was updated with current information that encouraged expanded use of cottonseed in dairy cow rations. Digital, print, and radio advertising was increased and the transition of these activities to the Cotton Incorporated Consumer Marketing Committee and marketing staff was completed in 2019. Marketing materials for cottonseed oil, starting with collateral, were also being created by the Marketing Department and reported on elsewhere in this report. Ongoing meetings with the oil mill industry continued to set the direction, focus, and activities of the research and marketing activities.

Precision Cotton
The ability to gain value from the data recorded by modern machinery, new sensors, unmanned aerial systems (UAS), and satellite images is still emerging. Cotton Incorporated has been sponsoring several projects that will help producers and ginners capture more value from their data. The first example involves the use of Radio Frequency Identification (RFID) tags to track cotton modules from the field to the gin. John Deere introduced its new round module building cotton harvester over ten years ago and currently round modules comprise the majority of the cotton processed by gins in many regions of the U.S. With such a high level of adoption, the time has come to take advantage of a key feature of those round modules – each one contains four RFID tags and an added external tag that uniquely identifies that module. An electronic module numbering standard has been adopted that extends the use of RFID tags beyond only John Deere modules. Cotton Incorporated has funded a demonstration project with the USDA-ARS gin lab in Lubbock, TX, to allow the option to use the RFID tag to track the cotton from the harvester through the ginning process without adding other tags or marking with spray paint. Additionally, ownership information is entered only once. This project involved the generation of many software tools that were developed in an open source environment, which are freely available to gins as well as commercial software companies supporting the ginning industry.

In 2019 the open source software allowed tracking of cotton from the field to the gin yard to the module feeder. Additionally, the ability to link the Permanent Bale Identification tags on the fiber bales back to the RFID was demonstrated. In collaboration with various university engineers, the ability to link the RFID tag to the bale tag allowed the generation of maps that showed the variation in fiber properties (e.g., micronaire, length, and other measures reported by the USDA classing offices) across several cotton fields in 2019.

An additional feature of the new cotton harvesters is the data collected on every cotton module, including module weight, area harvested, moisture content, location where the module was wrapped, and the location where it was unloaded from the harvester. A "virtual variety trial" was planned with producers in which the module weight and area could be used to calculate a seed cotton yield. Regional university variety trials were also planned to estimate a lint turn out value to assess cotton yield. As these projects began, comparisons between the module weight reported by the harvester showed a consistently higher mass compared to calibrated scale weights based on data collected in Georgia, Texas, and Oklahoma. It appears the harvester predicts a mass of eight to 10% higher, and these errors appear consistently. These projects are on hold while the the magnitude of the error is better defined.

As data becomes more valuable to farmers, it is important to make that data easy to capture and manage. Software developed by a non-profit committed to enabling digital agriculture makes it easier for different companies to share data. Once a company connects their system to the software data model, they can then easily share this data and also receive data from other
companies. Cotton Incorporated recently sponsored the development of a “plug-in” for cotton classing data and also for the Harvest Identification Data. Both plug-ins are complete and should be freely available in the first quarter of 2020. Cotton Incorporated is also in discussions to gauge whether U.S. cotton ginners may benefit from data standards. Most agricultural equipment manufacturers have adopted Standard ISO 11783 (ISOBUS) to transfer data between tractors and implements. For example, a tractor from one company can plug into the ISOBUS port of a sprayer from another company and the display on the tractor will automatically configure itself to support that sprayer. Such a system could make it easier for cotton ginning equipment to “talk” to each other. There also may be opportunities for gins to anonymously and automatically share data on energy use and ginning rates so they can benchmark their performance against regional averages. A working group was formed in 2019 and identified initial objectives and measures to be included in a standard for cotton ginning that will likely be initiated in 2020.

Beyond data, several projects in 2019 were focused on evaluating the use of autonomous robots for weed control and cotton harvest. Rapid advances in computer vision, deep learning, and autonomous equipment have resulted in commercial robots for autonomous weed control, and point to a future where robotic systems will play a larger role in agricultural production. Over the last two years, Cotton Incorporated has sponsored projects to look at the potential use of robots for cotton harvest and more recently, weed control. These projects collectively resulted in an autonomous robot capable of traveling through the field using a combination of proximal sensors and GPS; a small tractor using machine vision that can autonomously harvest cotton bolls under defoliated conditions; a draft economic model that incorporates regional climate data to compare the value of a robotic harvest system to once-over harvesters; and data from plots in four locations where cotton was hand-harvested twice per week to estimate the potential yield and quality benefits of frequent harvest events to provide estimates for the economic model. Initial progress has also been made in developing new mechanisms for removing seed cotton from the plant, developing an image library of weed species significant to cotton, exploration of genetic manipulations that could facilitate robotic harvest, and concepts around material handling in the field. In addition to testing robotic systems for weed control and harvest, other areas of the production cycle have been documented that will benefit from automation and robotic systems.

Over the last 40 years, the amount of irrigation water used by cotton in the United States has decreased while yields have increased. Many factors have contributed to this increase, including varieties providing higher yields without increased water use, improvements in water delivery systems, and better irrigation scheduling methods. Cotton Incorporated funded several projects in 2019 to help this trend continue to meet the cotton industry’s sustainability goal of an 18% increase in irrigation water use efficiency. In Arkansas, on-farm field evaluations have found that cover crops and a computer aid selection program for surface irrigation systems increase irrigation application efficiencies. The University of Georgia has continued to improve an irrigation app that uses data from national weather databases and regional crop coefficients to estimate cotton’s water use anywhere in the U.S. In 2019, efforts were focused on improving crop coefficients in areas west of central Texas where the model did not perform well in past evaluations. Effort also continued in 2019 to utilize crop simulation models to improve irrigation water management. A calibrated crop model was used to determine optimal irrigation termination strategies in west Texas and for irrigation scheduling in Arizona and Texas. An evaluation of a sensor-based irrigation scheduling system developed in Australia was started in southwest Oklahoma in 2019 as well and initial results are promising. Additional on-farm evaluations will take place in 2020.

Agronomy
Numerous research and outreach efforts continued in the area of soil improvement and soil health to improve soil stability, soil water holding capacity, nutrient cycling, and reducing soil compaction and soil erosion. These efforts have involved various soil health management aspects, including evaluation of reduced tillage systems, increased crop rotations, increased use of cover crops, evaluation of soil microbial composition, and other soil health parameters. Although these various forms of soil management have increased in adoption rate, there remains considerable opportunity for improvement in adoption, economic viability, and best management practices of these more complex cropping systems. These living cover systems create some challenges and opportunities with pest management and nutrient availability, and regional variation continues to be observed and management strategies are developed based on these research projects. One example is the use of cover crops to suppress weeds in cotton, including herbicide resistant weeds, and reduced herbicide applications in these heavy cover crop systems.

In cooperation with the Extension Cotton Specialists, Cotton Incorporated continued to support the Beltwide, Large-Plot Variety Evaluation program. Ten-twelve new cultivars of the widely grown and new cultivars were grown with three replications in commercial fields, including planting, in-season management, and harvesting with farmer equipment. Plots were harvested in cooperation with the farmer and weighed using calibrated scales. Seedcotton subsamples were collected and ginned to estimate
yields and establish fiber quality. Data were statistically analyzed, and results are currently being distributed to growers and crop advisors through educational meetings, internet, and hard copies.

Weed Management
Reliance on pre-emergence herbicides, including at planting and as a residual tankmix partner, increased in use across the Cotton Belt following the development of glyphosate resistance. Both acetochlor and metolachlor have been heavily relied upon to manage grass and small-seeded broadleaf weeds, including Amaranth species. This increased use has reduced some selection pressure on the postemergence herbicides, but the broad use metolachlor on the broad acre of both cotton and soybeans has led to first documentation of metolachlor resistant Palmer Amaranth in Arkansas. Additionally, dicamba has been heavily used in both cotton and soybeans with the dicamba resistant cultivars. Despite recommendations to apply multiple modes-of-action within the dicamba resistant crops, some growers are strictly looking at the short-term economics and not including other effective broadleaf herbicides. As a result, Delta has reported reduced efficacy with dicamba in cotton and soybean fields, which is most likely the result of dicamba resistant biotypes of Palmer Amaranth. With acetolactate synthase (ALS), glyphosate, and protoporphyrinogen oxidase (PPO) herbicide resistance being present on the majority of Palmer amaranth populations in the North Delta states, the heavy dependence on glufosinate creates tremendous selection pressure on this one product. Applied research was conducted to evaluate best management practices for various weed species and slow the spread of herbicide resistant weeds.

The herbicide era has had many benefits, including reduced tillage and very cost-effective weed control. However, with an exponential increase in herbicide resistant weeds over the past two decades and no new modes of herbicides developed, weed management options have dwindled and, simultaneously, increased selection pressure on existing herbicides. Evaluation of new application technology which integrates GPS, image analysis, and machine learning to implement see-n-destroy technology, robotics, autonomous swarm systems, and precision placement of herbicides will be the key to reduce herbicide use and provide alternative management options for herbicide resistant weeds.

Nematodes: Long-term investment in identifying resistance genes, developing markers, and releasing germplasm with resistance to root-knot (RKN) and reniform nematodes has paid off. Strong, dual-gene resistance to RKN from our germplasm releases has been available in commercial cultivars for several years. RKN will be coupled with reniform resistance in commercial cultivars in a limited launch in 2020.

Bacterial Blight: Development and release of a seed test for *Xanthomonas citri pv. malvacearum* (Xcm), the causative agent of Bacterial Blight, by Mississippi State University and Cotton Incorporated has abetted the change in composition of the planted U.S. cotton crop from Xcm-susceptible to Xcm-resistant cultivars. Planting of Xcm-susceptible cultivars has now declined for four consecutive years. Planting seed companies are renewing their use of previously utilized R-genes for Xcm in part because growers now may request their respective state labs to test for Xcm contamination in planting seed.

Target Spot: Cotton Incorporated and the cooperative extension pathology specialists from seven southeastern and mid-south states have completed a regional project on the biology and management of Target Spot. This invasive foliar disease was reported in Georgia in 2009 and is now endemic in the Gulf Coastal region. While cotton can withstand late season defoliation of the interior canopy to at least 40%; 70% defoliation has resulted in 200 lbs. or more loss of lint yield. If lesions appear before row closure, application of a preventative fungicide is warranted, will delay defoliation, and will likely prevent yield loss.

Fusarium Wilt – Race 4 (FOV4): *Fusarium oxysporum f. sp. vasinfectum* race 4, a persistent soil and seed-borne pathogen is now present in every U.S. county with greater than 10,000 acres of Pima cotton – suggesting that the disease is being moved in Pima seed. Whereas there is good tolerance in certain Pima cultivars, Acala and Upland cultivars are only moderately tolerant at best. Disease expression is proportional to inoculum density, and preliminary data from the San Joaquin Valley of California shows that FOV4 inoculum increases in fields where susceptible cultivars are grown.

Cotton Leafroll Dwarf Virus (CLRDV): There are two distinct North American strains of CLRDV, one predominantly in the Southeast and the second in Texas. Both strains differ from the two found in South America, and the Brazilian cultivars that are resistant to Blue Disease and Atypical Blue Disease are susceptible to the eastern strain. Incidence, as measured by symptomatic cotton plants, is very widespread with more than 40 counties affected in Alabama, Georgia, and Mississippi. To this point severity remains low, with only a few fields experiencing loss in Georgia and Mississippi, and possibly 10-20% of the field in Alabama.
Pest Management South East: Insect pests can be major yield-limiting factors in the production of cotton in the U.S. In the southeastern U.S., major insect pests of cotton include thrips (primarily tobacco thrips, Frankliniella fusca), bollworm (Helicoverpa zea), and stink bugs (multiple species). Recently, however, plant bugs (primarily tarnished plant bug, Lygus lineolaris) have increased in importance, and cotton/melon aphid (Aphis gossypii) has been implicated in vectoring a new and potentially costly viral pathogen to the crop. An entomology working group involved with entomological research and Extension programming for cotton in the region continued to work collaboratively to address these issues by completing the following objectives for the 2019 regional study.

1. Surveyed for incidence of fields meeting or exceeding threshold for the tarnished plant bug, Lygus lineolaris, and any other mirids of economic importance in cotton. A secondary objective was to associate landscape factors with populations. Surveys included two major visits to each field – one pre-bloom and one post-bloom visit.

2. Surveyed for Cotton leafroll dwarf virus (CLRDV- Blue disease) vectored by cotton aphid, Aphis gossypii. The extent of the distribution of CLRDV across the Southeast was uncertain. The goal of this objective was to assist in mapping the current distribution of CLRDV across the Southeast by sampling cotton fields from counties not surveyed in 2018.

3. Insecticide efficacy trials for cotton aphid, Aphis gossypii, were conducted. As trial opportunities became available, insecticide efficacy trials for cotton aphid were conducted and provided data on potentially slowing the secondary spread of CLRDV with effective materials. Trials included all labeled and unlabeled products that provide control of cotton aphid.

4. Oversprays on 2- and 3-gene Bt cotton for control of bollworm and stink bugs were conducted. Replicated research plots used WideStrike technology, as it is the weakest Bt technology for control of bollworm. Varieties of 2- and 3-gene cotton from PhytoGen (similar maturities) were used. Treatments were tested in two separate trials (2-gene and 3-gene Bt cotton) and applied when the greatest impact was expected, simulating what a producer or consultant would use. This research provided valuable information on how to control Bt resistant bollworm while also providing control of stink bugs.

Additionally, tarnished plant bug (TPB) has become a more frequent problem in Southeastern cotton. In 2016, the value of cotton production in Virginia and North Carolina was just under $158 million. Cotton is both labor intensive and costly to manage compared to other field crops produced in these states. Many cotton growers face the decision to continue growing cotton, despite additional expenses associated with managing insect pests, or turn to other crops that require fewer inputs. If TPB infestations continue to increase, similar to the TPB epidemic observed in the Mid-South, the cotton industries in Virginia and North Carolina may be in jeopardy. In an effort to find both effective and sustainable integrated pest management solutions for managing TPB with reduced costs to growers and the environment, a study was replicated in Plymouth, NC, and the Tidewater Agricultural Research and Extension Center in Suffolk, VA, in 2017, 2018, and 2019. The current outcomes of this research included: (1) Determining the effects of an IPM approach on pest density, plant injury (e.g., square retention and internal boll injury), lint yield, and economic return; (2) Evaluating thresholds and sampling techniques; (3) Making beat cloths, provide them to growers, and demonstrate how to scout for insect pests using them.

Silverleaf whitefly is one of the world’s most serious insect pests. Unfortunately, whitefly populations have radically increased throughout the southern half of Georgia over the past two years and are directly responsible for widespread economic losses in vegetable and cotton production systems. Entomologists hypothesize that these populations may result from increasingly diverse cropping systems that provide excellent year-round cultivated hosts, increased survival of non-agronomic hosts due to herbicide resistance and climate change, and a lack of suitable natural enemies. Additionally, current crop specific Extension recommendations are likely increasing insecticide resistance selection pressure due to repeated applications of the same active ingredients across crops. Due to direct feeding and indirect factors, such as the transmission of new viruses, economically sustainable production will become untenable if current trends continue and insecticide resistance appears.

To address this emerging issue, funding was provided to support a Postdoctoral Researcher to coordinate whitefly research and Extension efforts across South Georgia cropping systems. The post doc conducted basic research on the host range and annual distribution of whiteflies. These data will catalyze our ability to formulate science-based recommendations and will serve as the basis for development of landscape-wide management plans for whitefly population mitigation going forward.

Mid-South: In 2019, entomology research efforts in the Mid-South focused on bollworms, thrips, and TPB management. Growers are currently able to control these pests but at a high cost. A regional study with locations in Arkansas, Louisiana,
Mississippi, and Tennessee focused on mitigating insecticide resistance in thrips and reducing the number of sprays needed to control TPB and worms.

Cotton in the Mid-South is affected by a variety of insect pests that reduce yields and increase production costs. Tarnished plant bugs, thrips, and cotton bollworm are the three most important pests. Ongoing research is needed to provide growers with timely information on the most effective management practices to maximize returns on investment, and to predict, respond to, and if possible, delay the development of resistance.

Thrips are a widespread early-season pest of cotton, and tobacco thrips are the dominant species in the Mid-South. Insecticide seed treatments with a neonicotinoid active ingredient are the most widely used tools for thrips control. Tobacco thrips have developed resistance to thiamethoxam in recent years, leading to the elimination of thiamethoxam-only seed treatments from Extension recommendations in most of the Mid-South. Experimental evidence and field observations suggest that resistance is also developing to imidacloprid, another neonicotinoid and currently the most widely used active ingredient for thrips control. Ongoing evaluations are needed throughout the region to monitor the effectiveness of these two chemicals, as well as identify alternative insecticide seed treatments that could be used effectively for thrips control. In addition, aldicarb, which was formerly a widely used material for at-planting control of thrips and nematodes, has been re-introduced as a labeled product in the Mid-South. This active ingredient has been off the market for several years, and evaluations are needed to verify its continued effectiveness.

Cotton bollworm remains a major pest of post-bloom cotton in the Mid-South, despite the widespread use of transgenic varieties that incorporate various combinations of insecticidal proteins derived from Bacillus thuringiensis to control caterpillar pests. Foliar insecticides are commonly used to supplement control of cotton bollworm. Field research is needed to evaluate the impact of these key insecticides and their ability to preserve yield in combination with the changing suite of traits used in commercial production of cotton. Monitoring for the continued susceptibility of cotton bollworm to one or more Bt-derived toxins is also necessary.

Tarnished plant bug is consistently the most destructive pest of cotton in the Mid-South. Due to the destructive nature of this pest, its high mobility as an adult, and the relatively short period of effective residual activity for most insecticides, multiple applications are needed in virtually all cotton fields throughout much of the region, representing a substantial input cost to growers. Tarnished plant bug has an established history of developing resistance to insecticides, and ongoing evaluations are needed to verify the continued effectiveness of labeled materials. The timing of and intervals between applications also impact performance; for instance, two applications in relatively quick succession might provide more effective control than the same two applications spread out over a longer time period. Determining the impact on residual control of insecticides based on the interval between applications will help producers to more effectively manage this pest and maximize returns on their input costs.

To address these pest issues the specific research activities for the Mid-South entomology working group in 2019 included:

1. **Thrips Control in Cotton.** Insecticide/nematicide combinations either as seed treatments or in-furrow applications were tested at multiple locations in the Mid-South.
2. **Bollworm Control in Cotton.** Field trials were conducted to evaluate the efficacy of second- and third-generation Bt cottons for prevention of injury and yield reduction caused by bollworm and other lepidopteran pests, and to determine the impact of supplemental foliar insecticide applications in these Bt cottons.
3. **Tarnished Plant Bug Control in Cotton.** Insecticides used for control of tarnished plant bugs were evaluated using a common treatment list and sampling protocol across the Mid-South.

This regional project sought to determine the impact of an array of insecticides on the key pests in the region and will help producers to more effectively manage these pests to maximize yields and minimize inputs.

**Southwest.** In Texas, preventive insecticidal seed treatments are used over 85% of cotton acreage. At an average cost of $10/acre, annual investment into insecticidal seed treatments accounts for greater than $50 million in Texas cotton. For thrips, as an example, seed treatments provide control for up to 2-3 weeks after planting. However, growers in the Plains region may need to put at least one additional foliar insecticide application (e.g. acephate) targeting thrips post-emergence. The major challenges growers face are the lack of preventive insecticidal seed treatments with different modes of action and the lack of
research-based information on efficacy and economic profitability of different insecticidal seed treatment packages available in the market.

Currently, there is little information available on the efficacy and the economic benefits of various seed treatment packages in cotton to be able to make proper pre-plant decisions. Texas entomologists evaluated biological and economic performance of various insecticidal seed treatments against thrips, wireworms, whiteflies, and cotton aphid populations on seedling cotton using multi-location field trials.

With increasing incidence of resistance in H. zea to Bt technologies, cotton producers have been forced to rely heavily upon supplemental insecticide applications targeting H. zea to prevent excess economic injury. The insecticides that are the best candidates for managing H. zea in cotton include pyrethroids and the diamide chlorantraniliprole (Prevathon). There are positives and negatives for both insecticide options. Prevathon is less disruptive of natural enemies and offers good residual control but is expensive. Pyrethroids are very inexpensive but are highly disruptive and short lived. Additionally, resistance to pyrethroids is common in many areas. In Texas, outside of the High Plains, H. zea susceptibility to pyrethroids has not been ascertained in over ten years. It is imperative to determine if pyrethroid resistance is problematic in Texas so growers will be better able to determine which H. zea management options might work best in their production system.

Information gathered from this new project in 2019 will help producers, IPM agents, and crop consultants make sound pest management decisions.

In 2016, a research project at Texas A&M was initiated to employ a population genomics approach to protect and advance the ongoing boll weevil eradication efforts along the U.S.-Mexico border and beyond. This project continued in 2019 and utilized RNAi technology to address the problem of a serious pest of cotton, the boll weevil, to transform cotton plants to express RNAi constructs targeting vital boll weevil genes. Events were created but not enough plants were available for testing. This research will continue in 2020.

**Far West:** For 2019, entomology research efforts in the Far West primarily focused on lygus and whitefly management. Their efforts included new ways to manage key insect pests at lower cost and greater profitability while envisioning a near future where PCAs/growers manage beneficials more than pests.

To address these pest issues, the specific research activities for 2019 included:

1. Developing new, rapid, and easy-to-use tools incorporating crucial contribution of biological control by natural enemies. These new tools should provide for even greater reductions in risk and costs.

2. Extensively tested new active ingredients to arm growers with the best chemical controls needed to combat resistant or otherwise difficult to control pest populations and re-secure registrations (e.g., Transform).

3. One-of-a-kind evaluations of new chemistry for safety/selectivity for the beneficial insects present in our cotton system. GOAL: maximize the free biological control services in managing whitefly, Lygus bug and other pests, valued at $37.25 an acre or greater than $220 million in the last 21 years.

4. Explored a new frontier to understand broad patterns of pest and beneficial distributions as they relate to cropping and pesticide use patterns over a region. A new concept will be deployed in proactive resistance management of whiteflies through the deployment of predictive models for resistance.

Research is ongoing in Arizona to optimize the current utility of available management strategies and protect their long-term efficacy, while further efforts are being made to chronicle the industry’s successes to help support sustainability goals, showcase the progressive nature of cotton IPM in Arizona, and demonstrate to regulatory agencies the important progress made by the Arizona cotton industry and their outstanding record of stewardship.

**Strategic Objective 2: Increase the long-term profitability of U.S. cotton production.**

**Cottonseed**

Cottonseed research projects are designed to support cottonseed marketing activities by providing strong, positive, empirical data that can be used to promote cottonseed products. One such project is the completion of the three-year human feeding
study for cottonseed oil. This research was recently published in a peer-reviewed nutrition journal. The results of the study provide strong evidence that cottonseed oil is indeed a "healthy vegetable oil." These results are consistent with the findings of research conducted several years ago. Follow-up research with "at risk" individuals is being co-funded with the oil mill industry. Studies supporting the positive findings need to be completed before any major promotion campaign can be launched that make claims of health benefits from cottonseed oil consumption. The major findings of the recent study indicate that a rare fatty acid (DHSA), that is unique to cottonseed oil, is responsible for the positive effects observed in blood lipids. Efforts are underway to produce greater levels of DHSA for use in a dose titration study with mice in 2020. Another study that will support the whole cottonseed marketing efforts is a dose titration study with dairy cows that evaluated the effect of feeding increased levels of whole cottonseed in the diets of dairy cows. This study has not been fully analyzed, but it appears that it did not conclusively demonstrate that dairy cows benefit from feeding higher levels of cottonseed. There were diet interactions that have not yet been explained.

When the USDA announced the deregulation of Ultra-Low Gossypol Cottonseed (ULGCS) in 2018, preparations for commercialization of this transformative technology was put on the fast track. All of the seed available (800 grams) of the most advanced line (Stoneville 474-274) was sent to a cooperator for a seed increase, in anticipation of a large planting in 2020. Even though full deregulation was granted by FDA, efforts to find a commercial path forward have stalled out over identity preservation, international regulatory, and value capture issues. To ensure proper stewardship of this technology, efforts to deregulate ULGCS in Mexico with COFEPRIS (Mexico’s equivalent to the FDA) will continue in 2020. Until a viable commercial path forward can be established for ULGCS, research efforts on this technology will be curtailed. The original objectives of the ULGCS initiative were to develop a proof of concept and then move that event through the U.S. regulatory process. Both of those objectives have been completed.

Efforts to find a way to mitigate the negative effect of gossypol on cottonseed value can be extensive and time consuming. While research to discover new ways of blocking gossypol production in the seed was a very minor research effort in 2019, research to better understand the antimicrobial properties of gossypol was also studied. Gossypol is known to have a toxic effect on protozoa. A preliminary screening study was conducted to evaluate the ability of gossypol to control protozoa in poultry. Protozoa are considered to be a nuisance in ruminant, avian, and aquaculture species. Initial indications look promising and additional research in this area is being considered for 2020. This research might lead to increased utilization of gossypol-containing cottonseed products.

The brush delinter (in the process of being evaluated for its effectiveness at capturing some of the lost lint value and preparing planting seed) is being continuously updated and upgraded. A new pre-cleaner design was almost completed in 2019 and will be ready for testing in a commercial setting in 2020. A site has been selected and testing should be underway in the next few months.

With an ever-increasing cotton crop and an extension of the ginning season, interest in the technical aspects of cottonseed storage is increasing. Cottonseed storage research has not been recently conducted; and there are many new seed storage technologies, especially for temperature and moisture management in seed houses that are being evaluated. A multi-year project is underway that will evaluate all that is known about cottonseed storage and identify the gaps in that knowledge that need to be addressed with research in 2020.

Variety Improvement

Genomics and Genetics: The multi-institution team working to develop five reference tetraploid genome sequences finished and penned a paper currently under review by Nature. The five species are Gossypium hirsutum, Gossypium barbadense, Gossypium mustelinum, Gossypium tomentosum, and Gossypium darwinii. Each is reference grade and the highest quality ever assembled and annotated; they are expected to set the new standard that cotton researchers utilize around the world in their gene editing and genetic studies.

Germplasm and Varieties Released: There were joint germplasm releases made in the Journal of Plant Registrations between the following institutions and Cotton Incorporated in 2019: North Carolina State University (8), University of Georgia (1), New Mexico State University (2), University of Arkansas (3), and USDA (recombinant inbred lines derived from chromosome substitution lines).
FOV4 Screening Program: The 2019 FOV4 screening trial, conducted near Clint, TX, revealed previously identified putatively tolerant FOV4 germplasm are in fact tolerant as determined by field screening in year two. Of the 11 tolerant lines identified (out of 1,000) in 2018, all 11 were deemed to be at least mildly tolerant in 10 times more reps in 2019. Resistance was determined using these proven proprietary checks after measuring for parameters in each plot including percent survival, vascular staining, and boll productivity. Breeders who contributed germplasm were offered the opportunity to visit the site in fall.

Cotton Winter Nursery (CWN): The fifth season in Costa Rica was a success. The first planting occurred November 2 and the second planting was November 23. The first ever summer crop was successful. Included were populations and progeny previously screened in the NIFA supported FOV4 project. Usage in the current 2019-2020 season is down nearly 10% compared to last year.

Cotton Breeders Tour: The 2019 tour was held in the College Station and Corpus Christi corridor. Two workshops, gene editing and seed components, were held in conjunction with the field visits. Nearly 90 participants attended and learned about public sector and private industry breeding programs.

Strategic Objective 3: Increase number of future scientists of U.S. cotton and improve the reputation of U.S. cotton production.

Sustainability
The U.S. Cotton Trust Protocol (U.S. CTP) became its own limited liability company (LLC) in May. In November, a full multi-stakeholder Board of Governance was established. The Board of Governance for the U.S. CTP has representation from cotton producers, ginners, cooperatives, merchants, cottonseed crushers, brands, retailers, and civil societies. The first U.S. Cotton Trust Protocol Board of Directors meeting was held on December 2 and set to refine some of the details with this program such as determining the levels of independent verification and discussing possible funding structures for CTP in the future.

With the formal U.S. CTP pilot launch in June, several recruitment efforts and workshops were held in July and August in Lubbock and Abilene, TX. These efforts focused on enrolling cotton producers in the US Cotton Trust Protocol and to help promote more sustainable production practices. In addition to this effort, at the August Board of Directors meeting, an additional recruitment event focused on enrolling Cotton Incorporated’s Board of Directors into the U.S. Cotton Trust Protocol was held. These efforts, along with several others have enrolled over 175 producers and four merchants.

University of Georgia and Peanut Council: The University of Georgia/Peanut Council’s collaborative research project continued in 2019 with a goal of exploring the environmental benefits of the cotton and peanut rotations using the Fieldprint Calculator. This project has enrolled nearly 50 Georgia growers and 10,000 acres of cotton and peanut rotations into the Fieldprint Calculator platform to date. In 2019, a baseline was created for Georgia cotton and peanut growers. The baseline Fieldprint Calculator results will be compared to subsequent years’ data to determine relationships between production practices, economics, and sustainability.

Pheasants and Quail Forever Precision Partnership for Working Lands: Cotton Incorporated joined in a partnership to win a National Fish and Wildlife Foundation (NFWF) precision conservation grant this past spring. This program officially started in May, and a precision agriculture conservation specialist (PACS) was hired by Pheasants and Quail Forever to lead the program. The specialist is responsible for assisting landowners and their trusted allies, such as Certified Crop Advisers, with farming return on investment (ROI) analyses using precision agriculture data and tools. The ROI analyses will help growers determine if it is cost effective to continue planting in unproductive regions of their fields, or if other options exist that may increase their profitability. Converting unproductive lands to conservation areas will help the U.S. cotton industry meet their sustainability goals, increase grower profitability, and promote wildlife and pollinator biodiversity in and around planted cotton acreage. This program has been very successful in building a model for grower engagement during the course of the year. Most notable is the involvement with a large-scale cotton producer in Georgia who provided full access to current and historic farm data, which was used to run various ROI scenarios.

Cottonseed Oil LCA: In February, the Sustainability Division started a project to develop a full (cradle-to-grave) comparative LCA to explore the potential reduction in life cycle greenhouse gas (GHG) and other environmental impacts of cottonseed oil relative to representative mixes of vegetable oils and palm oil. The full comparative LCA provides information on the environmental benefits of refined cottonseed oil relative to other vegetable oils on the market, identifies environmental hotspots
in the production process and supply chain, and identifies areas of risk. This LCA study provides Cotton Incorporated and our stakeholders with a better understanding of how cottonseed oil compares with other oils which could be used in marketing purposes aimed at food businesses with GHG emission reduction targets. A full comparative LCA was completed in December, with favorable results showing reductions in climate change (GHG emission) impacts from 49%-83%, depending on which oil was replaced by cottonseed oil.

UltraTouch™ LCA: In February the Sustainability Division began the UltraTouch™ Insulation LCA project. This LCA assessed the environmental life cycle benefits of using recycled blue jeans for insulation versus traditional fiberglass insulation. To do this, a model was created to determine impacts from the production process, from waste credential acquisition to final UltraTouch™ product manufacturing. Final results from the model show only a 5% decrease in greenhouse gas emissions by using UltraTouch™ over traditional fiberglass insulation. There are a few additional assumptions to refine in the UltraTouch™ model which will be considered in 2020. One key assumption that is currently not addressed is how the model deals with waste treatment in product end of life. At the moment, it assumes both virgin fiberglass and recycled denim are treated the same, but there is an opportunity to refine this since the recycled denim insulation is an upcycled product. When reviewing the results with the manufacturing facility, they also indicated that their product has a higher density than needed to achieve added sound dampening properties. Since the functional unit of this model is related to thermal transmissivity, the volume of product needed to achieve a particular R-value, the current volume used in the model for UltraTouch™ is higher than needed. These model revisions will be considered in 2020 to achieve more representative results.

Turning the Tides, Tackling our Ocean’s Plastic Pollution Problem (CottonWorks™ Webinar): The Sustainability Division collaborated with Global Supply Chain Marketing to host a CottonWorks™ webinar titled, Turning the Tides: Tackling our Ocean’s Plastic Pollution Problem. This webinar took place in March and framed the plastic pollution problem and described how using cotton could help address this growing environmental concern. A deeper dive into this problem was provided by a Senior Sustainability Consultant who discussed their multi-stakeholder Plastic Leak Project (Cotton Incorporated is a project partner). A North Carolina State University professor presented the results from his recent research on microfiber shedding and biodegradability. This webinar helped to frame the global plastic pollution problem through the lens of textiles and provided CottonWorks™ members innovative cotton-based solutions to this growing environmental problem.

ISP Cotton Sustainability Summit: Cotton Incorporated hosted the Cotton Sustainability Summit in La Jolla, CA, in April 2019. The event was a huge success with approximately 116 brand/retail partners attending. The Summit covered a broad range of cotton sustainability topics and also included high-level discussions from experts on climate change and ocean health. Attendee feedback following the Summit was overwhelmingly positive. Another Summit highlight was the session titled, A Foundation for Understanding Cotton, where Cotton Incorporated board members gave the cotton producer side of the sustainability story.

Textile Exchange Life Cycle Assessment (LCA) Workshop and Ocean Wise Plastics Lab and Aquarium Tour: This event took place on the front end of the Textile Exchange Conference where approximately 35 brands and retailers participated. The focus of the workshop was to outline the basics of conducting sustainability assessments with a deep focus on LCA methodology. Participants gained a basic understanding of the sustainability assessment “toolbox” which included practices such as greenhouse gas accounting, life cycle costing, sustainable return on investment, and many more. Additionally, a detailed overview of LCA methodology was provided to ensure participants had a complete understanding of the LCA process. The goal of this part of the workshop was to equip students with the knowledge necessary to critically analyze LCA reports, data, and results in order to identify misinterpretations that often appear in external sustainability communications. The most common misuse of LCA data observed is when data from non-comparative LCAs are used to make comparative assertions. This practice is strictly prohibited under the International Standards Organization (ISO) requirements and guidelines for conducting LCAs and this point was made clear during this workshop. The U.S. Cotton Trust Protocol was also discussed during this workshop.

Textile Exchange Ocean Wise Plastics Lab and Aquarium Tour: Cotton Incorporated also hosted a “TExcursion” on the back end of the Textile Exchange conference where representatives from 50 brands and retailers were led on a tour of the Ocean Wise Plastics Lab and Vancouver Aquarium. The tour was designed to provide attendees a behind-the-scenes look at Ocean Wise’s cutting-edge ocean plastic research facility in Vancouver, BC. During this tour, they heard from leading experts about the negative impacts of synthetic microfibers on the aquatic environment. Participants learned about new research from Ocean Wise and Cotton Incorporated on microfiber shedding and biodegradability of different fiber types and garments and what happens to these microfibers in home laundry, wastewater treatment, and the ocean. Following the Ocean Wise Plastics Lab tour, attendees headed to the Vancouver Aquarium where they went on a microplastic focused guided tour to observe
displays that emotionally connect marine life to the plastic pollution problem. The event highlighted the threat that synthetic textiles have on our aquatic ecosystems and how cotton can be part of the solution.

**Sustainability Strategic Communications:** Working with a marketing agency, the Sustainability Division has created targeted sustainability communications to highlight cotton’s sustainability progress and help tell our success stories. The first component of this project was to develop a communications outreach plan targeting producers from the Cotton Cultivated contact list as the target audience. The communications plan was designed to increase awareness about Cotton Incorporated’s research and sustainability efforts through an email and social media campaign.

Additionally, a strategic communications plan was developed to increase U.S. Cotton Trust Protocol awareness and enrollment. This communications plan was developed collaboratively with the National Cotton Council to ensure that the communication plan is delivered using a consistent voice across leadership organizations. This project developed promotional campaigns which will be delivered by print media, radio, social media, and direct mail to reach the broadest audience possible. The U.S. Cotton Trust Protocol communications plan will be implemented in 2020, where there will be four key pillars to the enrollment journey of the program: awareness & education, engagement, registration, and completed enrollment. Further, Sustainability worked with the agency to create six sustainability factsheets. The factsheet topics are: The 10-Year Sustainability Goals, U.S. Cotton Trust Protocol, Organic & Conventional, Water & Cotton Production, Pesticides & Cotton Production, Land Use & Cotton Production. These factsheets will be used to promote the sustainability programs we currently have in place and to correct common misinformation that often circulates regarding cotton production.

**Cotton Incorporated Fellowship (CIF) Program:**
Eight CIFs were supported in 2019, including four who started their course of study this year. Two new research areas were started in 2019, including molecular characterization of FOV4 and data bioinformatics.
Addressing the Contamination Threat

Agricultural & Environmental Research, Fiber Competition, and Product Development & Implementation Divisions

There is a clear threat from plastic contamination to the value of U.S. cotton; therefore, there is a multi-divisional strategy to address the threat now in place at Cotton Incorporated. The first part of the strategy is to detect and remove contaminants at both the field level prior to harvest and at the gin during processing. The current research focus is detection and removal at the gin as that gives the opportunity to remove plastic contamination from both the field and gin. An additional strategy is to explore new materials (ideally cotton-based) to wrap both cotton modules and cotton bales, to support modifying current materials to be more easily detected and/or removed and to investigate the detection and removal technologies in spinning and nonwoven industries.

Gin Level Detection Efforts: One of the earliest projects to address plastic contamination at the gin was the use of a video camera monitoring the module feeder through a Texas State Support project. In 2018 the National Cotton Council took the lead in deploying several of these systems in U.S. gins to further demonstrate/evaluate the value of this approach, and that continued in 2019. To date, there is consensus such a system is of value and may be possible to do with lower cost camera systems.

Another gin-level detection system is an affordable machine vision system deployed on the feeder apron of the gin stand. An initial prototype camera-based detection system was fine-tuned so that 85% of the time it detected and ejected, with a “puff” of compressed air, samples of yellow round module wrap from cotton flowing down a slide simulating the feeder apron. The work resulted in a full-size prototype that researchers installed and tested at a commercial gin during the 2018 and 2019 ginning season. A commercial prototype of the system was installed at a gin in the southeastern U.S. and initial evaluations have been favorable. Minor airflow modifications were needed as well as adjustment to the pivot of the lower apron to allow for full ejection of detected contamination. Further testing is underway with the system installed on three gin stands.

Removal Efforts at the Gin: In addition to the successful air removal system at the feeder apron, past studies at the USDA-ARS gin lab in Stoneville found current cleaning equipment at the gin removes a significant amount of plastic, and they also had some success in adjusting seed cotton cleaning machine settings to remove even more plastic. Follow-up work is continuing at Texas A&M, where the research gin was upgraded to have a mini-module feeder to better simulate plastic contamination events. In 2019 a Texas State Support project focused on the development of an inexpensive way to automate the removal of plastic found at the module feeder and engineering drawings for a prototype system developed.

A foreign company sells a contamination cleaner designed to remove foreign matter from seed cotton utilizing three different cleaning sections that remove long strings and large pieces of plastic film; open seed cotton and remove fine trash; and remove small foreign matter/contamination objects by exploiting differences in settling characteristics in an air stream. An 18 bale per hour model of the machine was purchased by Cotton Incorporated and delivered in early December of 2018. Installation of the system was completed in April 2019. Initial tests of the machine’s ability to remove round module plastic and plastic shopping bags were completed. On average, the removal rate was approximately 60% at the highest air flow rate, with lighter plastics more effectively removed; however, at these higher flow rates, more seed cotton is also ejected. Video of the machine running also shows that there are instances when plastic is captured on the condenser but gets blown off before removal can occur. Discussions of potential improvements will commence after further testing. As the main purpose of these tests is to evaluate the potential effectiveness of the imported machine for use in U.S. cotton gins, significant results from this study will be shared and discussed with researchers at other USDA labs and universities, and with industry collaborators. One possible enhancement to the machine is to add a static charge to the roller at the top of the air chamber to attract plastic as data has shown that cotton has a small positive affinity for static electrical charge, while plastics tend to have a large negative affinity. Another project started in 2019 at the Las Cruces lab is a test to see if plastic mixed with cotton falling onto heated cylinders will melt and stick to the cylinders. A model cylinder was developed for testing and it was found that plastic would melt and stick to the cylinder at 200 degrees Fahrenheit. The remaining change is to remove the melted plastic from the cylinder.

Field Detection Efforts: The primary effort in 2018 and 2019 was detection and removal of plastic at the gin; however, some research is in process to consider field level contamination. For example, a system was developed to collect images of in-field module handling to identify practices that lead to module wrap damage. A similar system was developed to capture still images from a module handler on a gin yard and over 5,000 images were collected in 2019 from two Texas gins. Past studies in 2018 did show UAV images could be used to identify plastic bags and additional UAV images were collected in 2019.
Field Removal Efforts: Work on the robotics weeding and harvest efforts may yield a robot that can collect any plastic in the field while scouting for weeds. In the short-term, the USDA gin lab in Lubbock worked with students at Texas Tech to develop a system that could “turn off” a row unit if plastic is detected in that row during harvest (not funded by Cotton Incorporated).

Alternative Materials: Some U.S. producers have been attempting to use hay balers to package seed cotton in the field. One challenge to this approach is the contamination potential that is introduced by the baler twine used on those machines. The twine is typically based on a synthetic fiber or sisal, both of which could contaminate cotton if not carefully removed at the gin. Therefore, work is in process to see if a cotton twine can be engineered to meet both the strength and diameter limitations of modern large bale hay machinery. Work is also beginning to examine other materials to better protect traditional and round cotton modules in the field. In addition, technical support is being provided to modify current materials to be more easily detected and/or removed.

Spinning Level Efforts: A comprehensive report was written in 2019 to help explain available contamination detection technologies available to yarn spinners and nonwoven manufacturers. In textiles and nonwovens, contamination can be anything from seed-coat fragments, bark, grass, oil, straps, ropes, textile garments, different types of plastic like plastic mulch, shopping bags or module wrap, or even roadside trash. Contamination can be introduced at many points along the cotton supply chain and can cause major problems for gins, mills, and their customers. This is by no means a new problem and many detection machinery manufacturers have been offering solutions for 20 years or more to remove contamination through innovation and technology. If contamination does find its way to a spinning mill, several solutions are commercially available to remove contamination in the opening and cleaning line to minimize the effect it has on downstream processes. If contamination is still present at spinning, mills rely on yarn clearers designed to remove manufacturing defects and contamination/foreign matter.
RESEARCH AND DEVELOPMENT COMMITTEE

FIBER COMPETITION: FIBER QUALITY RESEARCH

Strategic Objective 1: Improve quality measurements of cotton fiber, yarns, and fabrics.

Quality Measurements Improvement
Elucidating the Impact of Fiber Maturity on Fiber Length Distribution and Fiber Breakage
2019 Objectives: Elucidating the impact of fiber diameter and maturity on fiber breakage.

In 2018, a set of 129 breeder samples were subjected to laboratory-scale mechanical processing to investigate the impact of fiber diameter and maturity on fiber breakage. For 2019, a subset of 20 samples from the original 129, with a diverse range of properties, was selected for additional research. These samples underwent a range of mechanical treatments to assess their potential for fiber breakage during processing. The industrial and laboratory-type ginning treatments were completed with the fiber submitted for HVI® and Advanced Fiber Information System (AFIS) testing. A series of lab lint cleaning treatments, which included: two different Shirley Analyzers and a microdust trash analyzer (MDTA3), showed that the cleaning process from laboratory and industrial-scale lint cleaners are different. Additionally, the Shirley Analyzer removed more fibers compared to the MDTA3. This project is complete and will not be continued in 2020.

Improving the Utility of Fiber Quality Parameters as a Screening Tool in Breeding Programs
2019 Objectives: Analyze within-plant variation in fiber quality to develop screening methods. Compare screening methods and study the impact of trash on fiber quality assessment.

This project is analyzing differences between a traditional versus top-crop selection criteria to screen germplasm.

- Traditional: Fiber quality was evaluated from boll samples taken randomly throughout the plant canopy. The bolls were harvested and ginned similarly to processes frequently used in traditional pedigree breeding programs.
- Top-Crop: Fiber samples were taken from the top of the plant. The quality of the top-crop was then used to screen the breeding material selected for advancement.

The 192 samples harvested in 2018 underwent testing, and a total of 432 samples were replanted in 2019 for further testing. However, this project will not continue in 2020. The general summary of this effort is that top-crop selections trended toward better fiber properties, but additional work would be needed to confirm. Other research performed on these samples included the evaluation of the impact of trash on fiber properties. Trash assessment (leaf grade, visible foreign matter, dust, and trash) on three treatments from this project were done. Heritability estimates were calculated on three treatments, which included hand-picked boll samples, bulk harvested via machine picking, and the third involved mechanical processing for lint cleaning on the machine harvested sample. HVI® length parameters were not different between the hand-picked and bulk harvested samples. Neps increased with machine harvesting and lint cleaning.

Enhancing the Marketability of U.S. Cotton through Length Uniformity Improvement
2019 Objectives: Validate the fibrogram calibration method. Validate the new yarn models (with fibrograms) on an independent set of samples. Retrieve the strain-stress curves from the HVI® and determine if this additional information can improve yarn prediction models. Develop a method to improve the ease of fibrogram retrieval and calibration, which will be accomplished by developing software and a database. Investigate the suitability of AFIS length distributions and HVI® fibrogram for improvement of the within-sample distribution of fiber length.

In previous years it was shown that the fibrogram length curve from the HVI® does contain information about within-sample variation in fiber length that is currently unused. This information appears to be capable of explaining as much information about the variation in yarn quality as information captured by the AFIS length distribution. However, this information showed variation between repetitions of the same sample, indicating that the measurement would need calibration. The calibration protocol previously developed was tested in 2019 to estimate the stability of the fibrogram. The spread of variation covered by candidate reference bales was determined by translating the fibrograms measured from 72 commercial bales into the calibration domain using principal component coefficients. Stability analysis was made on these 72 samples tested throughout the day over multiple weeks. The short-term stability data trends show no significant drift for the measurement. A python script was developed that extracts fibrogram data from the Excel® report. The script is operational, but a user-friendly interface needs to be developed. A
Maturity and Standard Fineness: Determination, Calibration, and Use

2019 Objectives: Survey commercial cotton crop to provide recommendations to cotton breeders. Identify commercial candidate bales for calibration cotton production and determine the variability of the standard fineness within varieties of cotton commercially produced in the High Plains of Texas.

Nine levels of maturity and fineness combinations are required for this project, and as of the end of 2018, five cottons had been identified. A variety with the potential to provide two of the four-missing fineness/maturity combinations was planted in 2018; however, testing results in 2019 indicated the cotton is too mature to fit the missing fineness/maturity gaps. Further efforts to obtain the needed reference combinations will be limited to an assessment of commercial bales via the ongoing analysis of limited U.S. crop samples from USDA-AMS. Two more candidate bales have been found such that only two more bales are needed. Five of the total seven bales have been blended per calibration material protocols. Two of the blended bales have been fully tested to provide cross-sectional reference values (third bale testing is underway). This project will continue in 2020.

Finding Ginning Methods That Improve Fiber Length Uniformity

2019 Objectives: To develop, test, and report on ginning methods that improve fiber length uniformity index.

At the end of 2018, data was analyzed from the New Mexico cotton trials. Results indicated significant differences in the length uniformity from using the experimental lint cleaner connected directly to the gin stand, thereby eliminating the feed mechanism. Roller ginning prevailed; however, when comparing only the saw ginning treatments, the saw gin coupled lint cleaner had longer fiber, better length uniformity, fewer neps, and less lint trash than the saw gin with a conventional lint cleaner. Ginning at Stoneville, MS, was done in July 2019. As a result of this work, a total of six variations in gin/lint cleaner systems have officially been processed. Analysis of the latest trials is underway, with a final trial planned at the micro gin facility in Tifton, GA in late 2019-early 2020. Results to date will be reported on at the 2020 Beltwide Cotton Conferences. This project will continue in 2020.

Determining Fiber Properties from Full- and Model-Sized Saw and Roller Gin Stands

2019 Objectives: To evaluate the differences in fiber properties, lint percent, and lint turnouts when processed with table-top versus full-size gins spanning a set of nine gin treatments.

This project was started in 2019, and the research will determine the effects of gin treatments on fiber properties tested with HVI® and AFIS. Machine and hand-picked cotton have been acquired for one Pima and two Upland varieties. Refurbishment of the full-size reciprocating knife gin stand needed for this study has been completed. The refurbishment of the feeder for the gin stand was started. The reciprocating knife roller gin stand and the feeder were installed in the roller ginning laboratory. Work began on hooking up the electrical controls. Sheet metal fabrication on the feeder hopper and lint flue started late in October but were delayed owing to planned medical leave. The project will continue in 2020.

Dual-beard Fibrography for Cotton Length Distribution Measurement

2019 Objectives: The objective of this project is to develop a portable, economical, and easy-to-use system for fiber length distribution measurement based on dual-beard fibrography and an iterative separation principle.

This project is aimed at developing a portable, economical, and easy-to-use system for fiber length distribution measurement based on dual-beard fibrography and an iterative fiber separation algorithm. The specific tasks that have been completed thus far include: the dual-beard fibrograph protocol, determination of weight requirement for cotton sample and number of scans needed, calculation of fiber content at a given length, determination of fiber length distribution, 50% span length, 2.5% span length and calculation of length uniformity, mean length, and upper half mean length (UHML). The prototype system is capable of automatically performing sample scanning, fibrograph generation, and length distribution calculation upon manual sample preparation. The researchers are currently working on system improvements and cross-lab/instrumentation validation testing. Researchers have completed extensive repeatability evaluations on repositioned samples, multiple reps per sample, and scanner-to-scanner comparisons. This project will continue in 2020.
Cotton Contamination Detection at Gin Stand Feeder Apron

2019 Objectives: Assess the best method for detecting and removing plastic contamination at the gin-stand feeder apron.

A cut-down version of the plastic contamination-detector-ejection unit that was tested at a commercial gin in 2018 was retested at USDA-ARS Cotton Gin Lab in Lubbock, TX, for efficacy performance. The geometry of the system was set up to match that of the commercial gin unit to achieve commercial-scale cotton flows and operation. The detection accuracy levels for the system are 92% for opaque pink plastic and 76% for opaque yellow plastic. Commercial partners set up two beta units of the detection system to be deployed by mid to late December 2019. The final software version for the detection system was developed by the research group. The update allows for twice as many opportunities to spot plastic contamination and has improved resolution by quadrupling pixels. If the beta testing of this system reveals a need for further research development, it will be pursued in 2020.

Detection of Plastic Contaminants in Cotton Ginning Process Using Near Infrared (NIR) Optoelectronic Technology

2019 Objectives: The objective of this research is to develop an effective and affordable NIR optoelectronic system for detecting and removing plastic contamination at the gin-stand feeder apron.

This is a new project that was started in 2019 to work collaboratively with the scientists developing plastic contamination removal systems at the gin feeder apron in Lubbock, TX. The researchers investigated the options of identifying wavelengths discerning NIR-absorbance of cotton and plastics where peaks specific to cotton can be identified against polyethylene (PE) film and PE twine. The researchers have found two light-emitting diodes (LED) wavelengths suitable for plastic contamination detection, but the LEDs fail to pick up plastic when embedded under thin layers of cotton. The investigators moved to using lasers toward the progression of this work. The laser system hypothesizes a set up to use one color camera, an LED daylight lamp, and a green laser line projector to record images of moving seed cotton at a point of the gin feed apron. Laser lines are capable of generating different diffraction patterns between clear/white plastic and cotton, thereby offering promise to detect contamination not fully picked up by the color camera system. The development of the laser system is ongoing. This project will not be continued in 2020.

Exploring Methods to Extract Plastic Contamination from Cotton (GoldenLion)

2019 Objectives: Evaluate the plastic removal ability of a Chinese manufactured system that was developed to remove various foreign matter from seed cotton, including plastic sheets and strings. Investigate other methods to effectively remove plastic contamination from the cotton flow at the gin.

For this research project, the machine was delivered to the researchers at the USDA-ARS Cotton Gin Lab in Las Cruces, NM, in December 2018, and installation was completed at the end of April 2019. Initial testing indicated that the airflow needed improved efficiency. A new fan and piping system were installed to improve the airflow efficiency to get the machine running. The team redesigned the air inlet to the machine with a larger input pipe, and reduced the number of elbow connections, in addition to installing the larger horsepower fan. Airflow increased from 8,900 to 16,600 cubic feet per minute (CFM). Currently, with fan at full speed and cotton right out of module, the system captured 20% of thick round module wrap (RMW), 60% of lighter RMW, and 70% of shopping bags for a total 50% plastic captured, but captured about 78 pound/bale of seed cotton with the plastic. A more robust experimental design is planned to evaluate optimum fan speed versus plastic removal versus the ejection of seed cotton. This project will continue in 2020.

Realizing Fiber Quality Insights

2019 Objectives: The objectives of this project involve the development of a robotic system to acquire fiber quality information at the gin, explore the National Cotton Variety Test (NCVT) database to acquire new insights into fiber quality, and determine potential causes of lint color change by simulating storage conditions of raw lint.

Before the start of this new project, a robotic arm was developed and set up to acquire fiber quality measurements in a commercial cotton gin. There are three sensors on the arm to determine color, micronaire, and leaf grade information. The system was utilized to measure over 5,000 bales in the 2018-2019 ginning season, and the data comparison between at-gin measured values versus the official HVI® data is has begun. NCVT data was cleaned, analyzed, and initial findings show region-biased trends, which are an ongoing investigation. Preliminary testing indicates that iron content in cotton bales might be correlated with color change in lint.
Research and Fiber Quality Meetings
Staff participated in a variety of meetings including Beltwide Cotton Conferences; conference calls with laundry industry cooperators, conference calls for National Cotton Council (NCC) USDA Gin School planning, in-house meetings with USDA-ARS-SRRC New Orleans staff including hosting a stakeholder meeting, multiple in-house meetings with representatives of different data management and software mapping companies, Bale Packaging Meeting, in-house meeting to evaluate statistical software package, conference call on warehouse storage challenges, NCC USDA Gin Schools in Lubbock, TX, and Las Cruces, NM; a visit to FBRI to discuss research; a visit to the University of North Texas to discuss research; hosting a laundry cooperator group meeting; attending the cotton breeder’s tour in central and South Texas; attending the National Association of Plant Breeder’s Annual Meetings in Georgia; attending the Australian Cotton Research Conference Meetings in Armadale; attending the Agronomy Society of America meetings; conference call to discuss fiber quality initiatives; and hosting researchers from USDA Las Cruces Gin Lab to discuss ongoing work.

Presentations were made as follows: Gin School lectures included Cotton Quality Issues, Micronaire Issues, Textiles 101, and Textile Industry Trends; and for American Cotton Shippers Association International Cotton School: Working Towards Improved Cotton Fiber Quality.

<table>
<thead>
<tr>
<th>Strategic Objective 2: Provide accurate test data to support research and marketing efforts.</th>
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Product Evaluation Laboratory

New Equipment
The Product Evaluation Lab (PEL) replaced the 20+ year-old weather-ometer, Ci4000, in January. A weather-ometer is an instrument that tests the colorfastness and durability of fabrics and textiles to light exposure, temperature, and humidity. The manufacturer made staff aware in 2018 that this older model would not be serviceable after 2019. The new model, Ci4400, features an increased specimen capacity, can run American Association of Textile Chemists and Colorists (AATCC), American Society for Testing and Materials (ASTM), and International Standards Organization (ISO) test methods, and has a full-color touch screen user interface display of all test parameters. The lab also replaced the TruBurst tester used to determine the burst strength of knit fabrics. The old tester was donated to the Product Development and Implementation division to use for initial screening evaluations to spot check fabrics as they are developed. Official burst strength testing will still be done on those finished fabrics per accepted testing practices in the PEL.

Agricultural and Environmental Research
Testing for Agricultural and Environmental Research (AER) was focused on general Agricultural Research Initiatives and Variety Improvement.

Fiber Competition
Both Fiber Competition and Standards references cover a variety of proficiency and other evaluations as follows. Some of these efforts are reported separately in the testing table under Fiber Quality Research but will be combined into one category for 2020 reports. For fiber testing, the following routine HVI® studies were completed during the year: twelve monthly check cotton tests, two Bremen Institute round robins, four Commercial Standardization of Instrument Testing of Cotton (CSITC) round robins and ten USDA-AMS 220 Calibration Sets on two HV® systems. For fabric testing, seven AATCC and two ASTM proficiency studies were completed. For yarn testing, one TestTex yarn proficiency study was completed. Lab staff also provided training on the correct method for testing and data submission when participating in CSITC to an Engineered Fiber Selection® (EFS®) System licensee.

Under the Agricultural Research reference, a collaborative project looking at maximizing cottonseed oil while maintaining fiber quality was evaluated. And for the Importer Support reference, fabrics needed for an Importer Support Program (ISP) class were tested to provide the needed data to go with the samples.

PEL staff also organized testing needed to create standard specifications for the round module wrap. This has been a cross-division effort between PEL, AERD, and Textile Chemistry Research.

Global Supply Chain Marketing
Technology Marketing (TM) submitted Research projects for comparative testing of TransDry® technology to commercial products, evaluation of Dry Inside fabrics, and data for marketing samples to be used at various trade shows; and an Importer Support project for fabric data for samples for an ISP course.
Product Development and Implementation

Highlights of work are listed by department:

- **Fiber Processing (FP):** Research efforts involved typical support work for bale checks, combing quality research, 40s compact ring spinning for shirting research, 10s carded open end spinning for 3-end terry, hemp yarn research, PUREPRESS™ technology work, wrappy yarn research; and Technical Service for a potential domestic EFS® System licensee for lay-down and crop change problem-solving.

- **Product Development (PD):** Testing consisted of samples for the FABRICAST™ line, which were tested for basic fabric properties. If the samples contained a technology, the performance of that technology was also evaluated. Under PD Initiatives testing was done for breathable woven fabrics; Research covered efforts such as evaluations of yarns for knit developments, polar fleece research efforts, and general fabric performance testing; and for Technical Service work was done to provide reference data for a denim company.

- **Technology Implementation (TI):** Testing services (often involving multiple trials for many different groups) were provided in support of the implementation of all Cotton Incorporated technologies. Technical Service was provided for a U.S. spinning mill.

- **Technical Services (TS):** Testing services (often involving multiple trials for many different groups) were provided in support of the implementation of all Cotton Incorporated technologies. Technical Service projects included evaluations of moisture management, barre’, shrinkage issues, and sewability issues, among other technical challenges for various customers.

- **Textile Chemistry Research (TCR):** TCR Initiatives and Research efforts included continued work on non-formaldehyde options for various finishes, newness retention, moisture management work, TOUGH COTTON™, and PUREPRESS™ technologies. Implementation support was focused on PUREPRESS™ technology. Technical Service was also provided on PUREPRESS™ technology efforts.
PEL Testing Summary for 2019:

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<th>Department</th>
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Totals: 248, 30,715, 59, 79, 654
Strategic Objective 3: Develop and maintain software tools to buy, sell, move, and use cotton with improved efficiency and profitability.

Software Development and Maintenance
Three programming updates were made for the MILLNet™ software. Staff also completed a file conversion to include support for U.S. mills that require contracts priced using the Commodity Credit Corporation (CCC) loan table to include the new plastic extraneous matter discounts. The current release version is now MILLNet™ 5.1.004.

A new version of USCROP™ software was also released (version 8.3) with updated help files and a new data export feature to download the database as individual bale data for expanded fiber quality data analysis. The following attributes were also added: support for monitor resolution changes which impacts how graphs appear in Windows® 10; filtering features for the new extraneous matter codes for plastic; configurable styles for the user interface; ability to export Excel® files in XLSX format; and changes to the internal FTP download functions to enhance download reliability. The USCROP™ software database was also updated weekly during the 2018-2019 classing season as data was released by USDA-AMS. The ability to obtain all Pima data for use in USCROP™ software is still being discussed with USDA-AMS staff. USCROP™ was also updated to allow users to download weekly updates through a proxy.

Programming completed the development of the first version of the Android MILLNet™ file service for new scanners. This development allows the Android system to handle accessing MILLNet™ handheld data files over Wi-Fi or through a USB On the Go cable connected to the handheld’s cradle (via LAN Ethernet cable). Technical Service has begun testing this new MILLNet™ handheld software for units running the Android operating system. This new program will allow mills to work with a wider range of hardware and give customers options with Windows Mobile reaching the end of life (January 2020 and April 2021).

Strategic Objective 4: Service and market CMS products that promote cotton as the most efficient and profitable fiber in the marketplace.

Software Service and Marketing
Updated Trax® Software
Staff coordinated vendor updates to the team’s Trax® software, which is used to maintain information on all EFS® System licensees. A signed lease date field was added to sort customers by signing date, and consumption reports were updated to include new three-year comparative reports by country and multi-year comparative reports for long-term analysis by licensee.

MILLNet™ Software Conversions
Software conversions were completed for 29 licensees located in 12 countries. All but two licensees are now running MILLNet™ version 5, and those two licensees are scheduled for conversion in the first quarter of 2020.

New Licensees
Two new MILLNet™ software licensees were added in the first half of this year. A large group in Vietnam now has the system running in two facilities that utilize approximately 410,000 bales of U.S. cotton each year. A smaller group located in Indonesia was signed, and the installation was completed in July. That group processes approximately 50,000 bales of U.S. cotton annually. A third licensee located in Vietnam was signed and installed in the fourth quarter. This group has multiple mills that may ultimately utilize MILLNet™, with the initial mill processing 25,000 bales of U.S. cotton each year. While three licensees were added in 2019, three were also lost. Two of the three losses are a result of the companies closing, and the third is a result of management turn-over combined with the negative impact of the tariff war.

Technical Service Efforts
With the updates to both USCROP™ and MILLNet™ software, the technical service staff provided quality assurance testing in preparation for the update roll-outs to users. The team also worked on developing a new MILLNet™ software manual to provide customers with needed documentation. This manual is being translated into Chinese, Indonesian, Spanish, and Vietnamese. Staff also researched and obtained a new technical service request tracking system. The system has been set-up and configured, and staff is developing needed operating procedures for using the system. Testing and training are expected to start in January 2020. The system will be rolled out to U.S. users first before expanding use globally. Yearly service visits were completed for licensees located in Canada, China, Colombia, El Salvador, Guatemala, Honduras, Korea, Mexico, Nicaragua,
Peru, Philippines, Thailand, U.S., and Vietnam. Technical Service answered 2,128 emails; had 139 face-to-face meetings; answered 261 phone calls; responded to 607 texts; and conducted 306 Internet sessions with 81 unique companies.

Marketing Efforts
Staff addressed the need to refresh promotional material by creating new USCROP™ software marketing content to produce a new brochure and a new short marketing video. The group also created a new opportunity to market the MILLNet™ software and recognize MILLNet™ licensees by having a wall display built for the Cary headquarters to showcase an EFS® Yarn Library composed of one yarn cone from each licensee.

The team distributed “Certificates of Partnership” in recognition of a commitment to responsible cotton manufacturing using the EFS® System. Certificates were presented to 14 mills in eight countries.

The staff gave EFS® System marketing presentations at meetings with prospective mills in Colombia, El Salvador, Guatemala, Indonesia, Korea, Mexico, Peru, the U.S., and Vietnam. The package of software products currently being marketed include:

- EFS® System MILLNet™ 5.1.004 software
- EFS® System MILLNet™ for Merchants 9.0 software
- EFS®-USCROP™ 8.3 software
- Cotton Communicator™ 1.022 software.
PRODUCT DEVELOPMENT AND IMPLEMENTATION

Strategic Objective 1: Concentrate efforts on broadly defined key market categories where cotton has suffered significant market share erosion. Identify and research sustainable innovations in technology and product development that can recover, grow, and preserve cotton market share.

Package Preparation for Functional Finish Research
Since January 2019, Fiber Processing (FP) staff have performed package preparations on 13 projects for 424 pounds of yarn helping to develop potential fluorine-free yarns treated with TransDRY® technology. Eight projects for 388 pounds of yarn were in support of Product Development (PD) projects consisting of doubling, twisting, and backwinding yarn. Four projects for 160 pounds of yarn were in support of TOUGH COTTON™ technology treatments. One winding project for 32 pounds of yarn was in support of the Importer Support Program (ISP).

Nonwovens Development
The FP staff collaborated with a major nonwovens manufacturer to produce multiple wipe prototypes with a wide range of forming and bonding technologies. Many of the prototypes were comprised wholly of recycled or reclaimed cotton while others used low micronaire and low-strength staple cotton. Experimental samples were produced by hydroentangling cotton sliver to a carded cotton web to study any advantages in wicking. If successful, this combination of materials could potentially be used in hygiene and incontinence products.

In conjunction with the Global Supply Chain Marketing (GSCM) division, FP provided financial support and peer review for two nonwovens trials conducted at North Carolina State University’s (NCSU) Nonwovens Institute during the fourth quarter. One trial aimed to overcome processing challenges when using cotton in wetlaid applications. Another trial aimed to utilize various forms of cotton in a ‘co-form’ forming and bonding technology.

FABRICAST™ Information System – Textile Collections for Marketing Toolkits
The PD team completed five FABRICAST™ collection capsules for apparel and home fabrics in 2019. This new fabric infusion updated the marketing toolkits utilized by GSCM in their interactions with brands and retailers. The themes for the 2019 fabric collections encompassed performance cottons via construction, blends, and finishes. The intent behind FABRICAST™ collections is to release new and relevant fabrics to new audiences, entice more decision makers, retain existing audiences, and keep the industry involved with inspirational and innovative cotton fabrics. Several of the apparel fabrics developed by PD for the Technology on Textural Knits collection became garments. These garments served as a main focal point at Cotton Incorporated’s booth during important shows. An overview of the various categories within the 2019 Collection follows.

- **Performance Through Construction**
  Breathable shirting-weight fabrics and sheeting textiles potentially offer performance benefits and were researched through open pore, mock leno, and leno structures using the in-house Sampling Dobby Loom. Finishing trials to optimize the ventilating structures commenced while additional yarn and construction experimentation continued. Full width weaving, at an outside facility, followed on the most successful prototype once the optimum structure was determined.

- **Lightweight Performance Blends**
  Lightweight performance blends were woven for the active outdoor apparel market. A series of cotton-rich performance textiles, being both technical and soft, in two-sided configurations, were developed. A face-dominant, nylon 6,6 filament warp provided luster and strength; while a cotton filling provided breathability and softness for the inside of a garment. The selected weave structures were more suitable for the outdoor market. They included both plain and oxford weaves for durability and drape. A satin weave was selected for strong-face and -back differentiation. To create contrasting colorations the fabrics were cross-dyed with reactive and acid dyes. The lighter weight of these cotton-rich developments made them competitive alternatives to 100% synthetic fabrics.

- **Natural Lightweight Performance Blends**
  Combining two natural fibers, cotton and wool, resulted in fabric with performance properties of both. Cotton, with its softness and breathability; wool, with its thermal regulation and odor control. This combination enhanced the aesthetic appeal of natural color variations and natural fiber textures. Intimately blended yarns, engineered into woven structures, added to the performance via texture and layers. The FPL developed a 70/30 cotton/wool blend for weaving into the
updated flannels. The natural performance attributes of cotton for comfort and breathability combined with the insulative features of wool culminated in a lightweight shirting to compete with synthetics.

- Knit-look Woven with Stretch:
  A stretch woven-dobby fabric, constructed to look like a knit while exhibiting the durability of a woven, was developed for the outdoor lifestyle sector. The two-sided effect evolved from a sulfur-blue yarn on one surface and a print on the other. A cotton/spandex, core-spun yarn added to the construction creating comfortable stretch in the width direction. The digitally printed fabric used reactive inks in a wavy embroidery-inspired pattern, creating a unique visual effect.

- Printed Indigo Knit
  The indigo knits in this collection, sourced from a European indigo yarn and fabric supplier, were used as a substrate in digital printing applications. A French-terry construction, with the illusion of a woven fabric, provided a smooth base for printing, while the looped side added surface interest. These fabrics are double sided, offering versatility in garment styling. Furthermore, the digitally printed knits used reactive inks and mimicked artisanal Shibori techniques as well as fluid geometrics.

- STORM COTTON™ Technology on Textural Knits
  By employing Cotton Incorporated technology, two-unique knit fabric constructions ascended from fashion pieces to performance pieces. Because yarns were treated with STORM COTTON™ technology for water resistance, these constructions were moved to the active outdoorknits’ category. This active outdoor grouping featured two different methods of applying the water resistance technology; first, a dip application used on a coarse gauge knitwear-sweater development; and secondly, a pad/dry/cure application for a sinker loop terry. A seven-gauge, jersey knit sweater, constructed with stripes of plied colored-cotton yarns and novelty yarns was then accented with fringed edges. A 24-gauge, sinker loop terry with combed-cotton, ring spun yarns in the ground also incorporated a stripe pattern of the same plied colored-cotton and novelty yarns as in the loop; thus, creating a novelty look of pixelated stripes. Combining fashion plus technology was received well at both Outdoor Retailer Shows this year. The sinker-loop terry knit was the most highly requested fabric in 2019, generating 122 swatch requests from 98 companies.

- Performance Cotton Oxford | Prints + STORM COTTON™ Technology
  A 100% cotton tightly-woven oxford, ideal for the outdoor market, was enhanced with prints and a softer hand via mechanical tumbling in a Biancalani Airo machine. This 5.8 ounce, per square yard, fabric was digitally printed with two different designs; a Japanese Shibori look and a modern camouflage-inspired pattern. To give this oxford another level of performance, it was treated with STORM COTTON™ technology.

- Sueded Performance Cotton with TransDRY® Technology
  This collection researched the numerous possibilities around engineering moisture management fabrics; made possible because TransDRY® technology starts at the yarn phase. This collection featured three fabrics with varied yarn placements of regular cotton yarn and yarn treated with the hydrophobic TransDRY® technology formula. These fabrics were then sueded on a machine using fine-grit sandpaper to achieve enhanced softness. Due to the strategic arrangement of yarns on the knitting machine, the single and double knits exhibited either horizontal or vertical spread of moisture.

- Textural Structures
  This collection of knits focused on sportswear. Coarse gauge ottomans, inlays, and jacquards are rich with texture and surface appeal in this grouping of top and outerwear fabrics. Mechanical finishing provided permanent surface interest as well as warmth and softness. Novelty yarns and stitches created structures which enhanced the insulative properties. All were developed in advance of the OR Summer Market.

- Performance Mesh
  In this activewear knit grouping, the PD team developed mesh constructions incorporating openings for natural ventilation and fine count yarns to achieve lighter weights, matching those of synthetics. In this project, a minimum content of 76% cotton, blended with either polyester or nylon filaments, created openings in the fine gauge knit fabrics. Cotton yarns, treated with TransDRY® technology, added the needed hydrophobicity to spread moisture and reduce absorbent capacity.
• **Combining Antimicrobial and TransDRY® Technologies**
In an activewear knit development, XT2® polyester utilized the antimicrobial properties of silver to stop odor by inhibiting the growth of bacteria. A jersey and mesh feed-stripe were constructed using cotton treated with TransDRY® technology, regular cotton, and XT2® polyester. The placement of yarns, treated with TransDRY® technology, in the construction allowed for the quick spread of moisture, ultimately resulting in a faster drying fabric. While the XT2® antimicrobial yarn was included in the fabric to minimize odor during wear.

• **Cotton Incorporated Dual Technologies**
New fabric developments in this collection extended technology marketing opportunities for Cotton Incorporated. For example, the existing formulations of STORM COTTON™ and TOUGH COTTON™ technologies, as well as TOUGH COTTON™ plus TransDRY® technologies, mixed well to form dual technologies. Dual technologies, completed in advance of the 2019 OR shows, generated increased interest during interactions with major brands. Product Integrity also provided support, by highlighting sustainable features of the dual technologies using data from the most recent cotton LCA. Fabrics included in the dual functionality collection were a coarse gauge 3x3 rib with STORM COTTON™ and TOUGH COTTON™ technologies, and a 1x1 stretch rib treated with TransDRY® technology combined with jersey fabrics finished with TOUGH COTTON™ technology. A durable woven bottom-weight with similar technology combinations was displayed during OR as well.

• **Color & Stitch**
Developed for the active lifestyle markets, double knit cotton-rich jacquards and double face constructions were the basis for a fashion plus function collection of boldly colored fabrics. Combining cotton with polyester and nylon allowed for greater contrast when dyeing, creating overall lighter fabric weights, and added unusual tactile qualities. These mid-layer knits were finished with non-formaldehyde (NF) STORM COTTON™ technology, reducing absorbent capacity and providing some water resistance.

• **Lightweight Performance Flat-woven Fabrics**
Requirements imposed by brands create challenges in competing with synthetics in the active outdoor space. The industry is requesting very lightweight fabrics and shorter dry times. The PD team focused on this challenge by researching cotton solutions. Lightweight cotton developments include a shirting fabric blend, 97% cotton/3% spandex, at 2.8 ounces per square yard, a weight that falls in line with the super lightweight nylon and polyester currently used in the market. Cotton developments in shorts and pants fell into the 3.5 to 4.5 ounce per square yard weight range. As comfort and movement is of importance within these challenges, spandex blended in the weft direction, added 10-15% stretch. Distributions of yarn treated with TransDRY® technology in the warp and fill directions enhanced moisture management and encouraged a reduced dry time. Plain weave, satin, ripstop, and twill constructions were part of this project.

• **Pleated Knits and Wovens**
Pleating is the mechanical process of placing a design of creases into a fabric. The size and shape of pleats range from simple knife or box pleats to novelty scalloped or random pleat designs. Pleating trials were conducted on a variety of fabric substrates to create interesting visual and tactile effects. The use of resins helped to lock in the mechanically produced texture; however, laundering methods impact longevity of the texture. This creative project was carried out with support of equipment at a major textile university. These fabrics were created primarily for inspiration, and efforts are in process to locate mills that have pleating equipment.

• **Performance Seersucker Wovens**
Cotton-rich seersucker constructions were developed to be lighter weight, faster drying and more durable due to the addition of nylon. The seersucker construction lends itself to increased comfort due to less touch points against the skin for a light and airy feel. The addition of interesting print designs elevated the fabrics to be both technical and fashionable. One version was printed with green pigment dyes in an abstract fern pattern; the contrast of the green on the black made for a striking effect. An additional iteration was printed with reactive inks in an organic, nature inspired pattern with a light colorway.

• **EarthColors® Denim | Print, Suede + STORM DENIM™ Technology**
EarthColors® denim was explored employing a broken twill construction with a natural colored cotton-spandex filling. The hue for the brown EarthColors® denim is derived from cotton biomass rather than synthetically derived components. A double-sided effect was achieved by printing the back of the fabric with digital reactive inks in a wood
ring inspired print pattern. The fabric was also sued on the face for a peachy soft hand feel. The addition of the STORM DENIM™ technology finish elevated the denim to be water resistant for the outdoor active market.

- **PUREPRESS™ Technology on Flat Wovens**
  Two-printed lightweight 100% cotton woven fabrics were treated with Cotton Incorporated’s PUREPRESS™ technology to improve wrinkle resistance. Other Cotton Incorporated technologies were included in FABRICAST™ collections to extend the reach of each technology by introducing them to more brands and retailers. The accomplishments of PUREPRESS™ technology are its ability to resist wrinkles, increased abrasion resistance, and no detectable-formaldehyde elements.

- **Performance Matelassé | STORM COTTON™ Technology**
  Two developments of highly textured insulative fabrics were based on classic quilted jackets. Translated into Matelassé constructions, these fabrics combined double cloth structures with a thick cotton stuffer yarn. Featured in this pair were a polyester warp with cotton filling on a cross-dyed diamond pattern, and a 100% cotton version in an hourglass pattern. Treated with STORM COTTON™ technology for water resistance, these fabrics were designed with outdoor wear as the target market.

- **Texture Dobby Zebra Yarn | STORM COTTON™ Technology**
  Featuring novelty injected ‘Zebra’ yarns from a U.S. yarn supplier, the bowtie effects created by the Zebra yarn added interesting tactile and visual textures. The fabrics were dyed with reactive dyes and finished with STORM COTTON™ Technology for water resistance. Updated textural cotton rich fabrics enhanced with Cotton Incorporated technologies elevated them to compete with all synthetic versions.

- **Selvedge TransDRY® Technology | Bull Denim Naturals Collection**
  One of the last fabrics woven at an iconic U.S. based denim factory was developed for the continuation of the Naturals Collection featuring the natural color of cotton. This 12-ounce twill featured all natural cotton yarns in the warp and filling, showcasing cotton’s visual attributes without the use of dyes. A yarn filling, treated with TransDRY® technology, added two features to the fabric; one being comfort for the wearer by removing moisture away from the outside of the fabric; and the second, providing reduced absorbent capacity for a shorter duration in drying.

**Internal Swatch Cutting Services**
The PD Sample Cutting area prepares fabric swatches and information for Cotton Incorporated’s fabric marketing and technical activities. In 2019, there were 2,496 fabric hangers made for the FABRICAST™ collection, with 11,700 swatches cut and 16 technical swatch booklets put together, then distributed to the Cotton Incorporated offices worldwide. Additionally, 9,273 swatches were provided to the Fashion Marketing department for trend presentations; 68 swatches for ISP Workshops; 5,620 generated for customer meetings and presentations; and for the New York office’s new fabric-display area, 248 fabric hangers were prepared and shipped.

**New Product Research: E-Textiles**
PDI continued R&D into wearable electronics and smart textiles with staff receiving training on recently acquired specialized embroidery equipment and software. Making sure that cotton is included in the future of e-textiles is important as most of the work that is occurring is with synthetics. PD staff was able to embed fiber optic filaments on the surface of cotton fabric using a special cording device but had issues with disruptions in the light path. This is not surprising as improvements to conductive yarns for textiles is needed. To integrate electrical properties, an LED sequin-attaching device was installed and will be part of future research with cotton. Soft switches have been embroidered with conductive yarns that sense the touch of a finger. These switches were connected to electronic devices for input.

**New Product Research: Cotton Knit Shoes**
The development of 3D knitted cotton shoes progressed this year. The first prototypes of cotton knit shoes with soles were completed and presented a variety of problems as anticipated. The second phase commenced which will involve the integration of stretch fibers.

**New Product Research: Cotton-Bale Twine Research**
A PDI team participated with the Agricultural and Environmental Research Department (AERD) and Fiber Competition (FC) in collaborative research on a cotton alternative to synthetic hay-bale twine. A PD team worked with AERD on developing a lower cost solution for creating panels used in cotton fields to count insects. Using in-house fabric, PD then created a prototype bug-shake sheet, complete with cost and material sourcing details for AERD to share with producers.
University Research Project – Digital Warp Printing
With a focus on aesthetic design and structures, PD conducted trials with a Europe-based university to research and devise a method for digitally printing on cotton warps. Textile students from the university worked with technicians to first create designs, then digitally print the designs on cotton warp yarns, and finally produce a woven cloth. This project demonstrated the complexity of combining technical processes with fine art.

New Product Research: Cotton and Graphene
In coordination between Textile Chemistry Research (TCR) and PD, research commenced into yarns containing graphene. Manufacturers claim graphene possesses a variety of properties, predominantly heat dissipation. As the first step, graphene combined with cotton was tested to identify if claims were accurate.

One Bath Bio-polish and Dye Trials – Part III
Ongoing research with an enzyme company has reached its third phase; conducting trials on an improved one bath bio-polish and dye process. These trials will compare the more sustainable one-bath option to that of a traditional two-bath option, which contains both acid and neutral cellulose enzymes. If mills switch to a one bath option, they would save water, energy, chemistry, and time versus the traditional two-bath process.

Newness Retention for Cotton
The TCR team is developing a finish application for cotton to extend the ‘as-new’ appearance of a newly purchased garment. This includes improving smoothness, abrasion resistance, and color retention. The finish will be applicable to knit and woven fabrics. Initial results showed the formula could achieve similar colorfastness and color retention, but only with minimal products. However, added benefits such as smoothness and abrasion resistance require that additional finish components be included. Going forward, two version of newness retention will be evaluated: A low-cost color retention and colorfastness, and a more complex form that includes additives for smoothness and abrasion. Initial colorfastness and physical testing show nearly identical performance of the all-around newness retention finish and the comparable version utilizing components from a specialty chemical manufacturer. The only noticeable difference in performance is lower abrasion with the specialty chemical version, presumably due to the polyethylene utilized. On the other hand, the simple three component version shows better colorfastness properties than the former recipes but does not improve physicals such as abrasion.

New Formulation of a Non-Formaldehyde Durable Press Resin (NFDPR) Finish
Smoothness rating describes the hand (or feel) of fabric. After laundering and tumble drying the smoothness rating is visually assessed. This rating is on a 1 to 5 scale, with 5.0 having no wrinkles. Based off this rating system, the TCR team is developing a NFDPR finish to achieve a 3.5 or better on top- and bottom-weight fabrics. To date, garment dip applications using PUREPRESS™ technology on cotton shirts have been encouraging. Whiteness retention trials for shirting with PUREPRESS™ technology were completed in December. Two different time and temperature combinations have been identified to impart maximum smoothness and whiteness properties. A major U.S. brand has commissioned the production of 34 different fabric constructions totaling 40,000 yards of fabric for shirting application. These trials are expected to be run in the first quarter of 2020.

Non-Formaldehyde Flame Retardants (NFFR) for 100% Cotton Fleece
There has been data to indicate that polyester fleece fabrics could be contributing to the presence of polyester microfibers that are polluting the oceans. All flame retardant fabrics must pass a 45-degree angle flammability test. One hundred percent cotton fleece fabrics will normally fail the 45-degree angle flammability test required for all consumer apparel. To pass this test approximately 20% polyester is blended into the pile of a cotton fleece. An NFFR system for 100% cotton fleece fabrics has been developed with the aid of a non-formaldehyde (NF) crosslinker. The NF crosslinker used provides similar FR properties with less strength loss than its conventional formaldehyde-containing counterpart. The latest trials in DFAL had an issue with durability after extended hot storage for the non-formaldehyde flame retardant formula. The fabrics were treated with a pad/dry/cure/frame wash/napping procedure. After napping, the amount of phosphorus appeared adequate (as received and after laundering). However, since final framing to width could not be scheduled immediately, the fabric sat in hot summer heat in DFAL for a few weeks. After final framing to width, the sample failed the 45° flammability test; and phosphorus and nitrogen values dropped as compared to the data immediately after napping. Efforts are underway to screen samples using an accelerated aging test. It will then be determined if the issue can be resolved by adjusting the formulation or procedure.
Sweat Hiding™ Technology
Development work on Sweat Hiding™ technology continued to seek a softer hand, durable to print on lightweight woven goods, while still allowing sweat to soak into the underside of the fabric but not all the way through. A soft-hand non-fluorine formula and C6 WICKING WINDOWS™ print formula were used in lab trials then compared after 30 home launderings in testing data (HLTD) to confirm their durable application visually and with the Moisture Management Tester (MMT) used in determining one-way moisture transport. Either formula, when applied to either jersey knits or interlock knits, maintained a one-way moisture transport after 30 launderings. To hide sweat, new C6 chemistry can be durably applied at the same low application concentration as the WICKING WINDOWS™ finish, and the application of two new, non-fluorine water repellents applied in the Sweat Hiding™ technology print, at lower levels, can continue to hide sweat after 30 HLTD. In December a production trial was run to combine Sweat Hiding™ technology with a WICKING WINDOWS™ + Phase Change Material (PCM) finish.

For lightweight woven fabrics, a non-durable pre-treatment must first be applied to the fabric to assist in keeping the Sweat Hiding™ technology print on the surface of the fabric. Additionally, in the case of Sweat Hiding™ technology for light weight woven fabrics, a C6 chemistry must be used in the Sweat Hiding™ technology formulation. Currently non-fluorine water repellents are not robust enough for this system. This technology was launched in 2019. Sweat Hiding™ technology for light weight woven fabrics can be combined with a durable press (DP) finish.

QuickDRY™ Technology Development
The goal of this study is to create faster drying cotton for sheeting/home applications. Faster drying is an area where synthetics currently excel. Faster drying cotton would reduce energy consumption in the dryer and be attractive for those who prefer to air dry their textiles. Work was undertaken to create a durably soft fabric with reduced moisture absorbency and with the goal of drying up to 3x faster than an untreated control. Several lab trials were conducted with a scaled-up production trial run in the U.S., comparing three different formulations. During the fourth quarter, the samples were in testing. This formulation was also compatible with a DP finish as well as an anti-microbial finish. In addition, it can be achieved with both C6 and non-fluorine water repellents.

Outside Research: Fabric Degradation Study
This study will quantify and provide scientific evidence, in a controlled laboratory experiment, of the influence various finish chemistries have on the biodegradation or decomposition of cotton fabrics in compost conditions. Degradation testing for an initial set of samples require a 150-day duration, and initial testing is complete, and the report is filed. The finishes did appear to have different impacts on the degradation behaviors of each fabric sample. Among the finishes, a control of untreated cotton was established. The principle investigator concluded that finish does have an impact on the biodegradation rate of fabrics but no-matter what finish is applied, cotton will still degrade in compost conditions. The researchers from Cornell and NCSU plan to publish a collaborative report in The AATCC Review.

Outside Research: Assessment of End of Life Options of Cotton for Environmental and Economic Sustainability in the Promotion of Cotton Recycling
This project aims to identify promising applications for recycled cotton with low environmental footprints, desirable life-cycle costs, and high market and technical potential. The research will start with a literature review for all potential applications of recycled cotton. An indicator-based framework will then be developed and used to evaluate the environmental impacts and life-cycle cost of all options identified. The framework will use streamlined life cycle assessment (LCA) to evaluate the key environmental indicators that are highly valued by the textile manufacturing industry and consumers. The research is focusing in on end-of-life options with the most potential for matureness of technology and profitability measured against LCA standards. Currently, this research has identified composites, formation of viscose type fibers, and cotton-to-sugar as the most viable areas to pursue.

Outside Research: Continuous Mercerization of Loose Stock Cotton
This project is aimed at allowing loose-stock cotton fiber to be mercerized immediately following ginning. Compared with un-mercerized loose stock, the project hypothesized that these mercerized fibers would be stronger, potentially longer, straighter, more lustrous, and with activated surfaces that could then be amenable to further finishing treatments. It was hypothesized that the mercerized fibers would suffer less breakage during subsequent processing; therefore, increasing the quality of spun yarns by reducing the unfavorable qualities inherent to immature fiber.
However, this project has concluded that the required apparatus in the process needs further development before it can become a viable hypothesis. Results for whiteness and yellowness were not included in the final report, as the research team believes the wooden frames, used in the apparatus, caused severe staining of the fiber samples. The research team also concluded that the belt-mercerized samples did have better dyeability than the slack-mercerized sample, and that both mercerized samples had better dyeability than the control. However, the initial discoloration of the mercerized samples and other inconsistencies in the dyeing procedure brought that conclusion into question. This project was completed, and no further research is anticipated.

Outside Research: Application of Aqueous Glycine to Improve Quality and Efficiency of Cotton Dyeing

The project examined the addition of aqueous glycine and its effect on dye uptake and input efficiencies. The work focused on color yield and efficiencies that can be obtained by altering the pH and temperature of the glycine treatment. The process was to investigate and optimize the nature of any additional dye pick up to determine if this would assist in deeper shade pick-up or the use of less dye, water, time, and salt in the dyeing process. Glycine treatment improves whiteness and softness of fabric compared to scouring. It was found the rate of uptake for a 20% glycine solution, at pH 11, begins to level off after approximately 30 minutes. Other testing results indicate that glycine treatment should be applied for 45 minutes or more for best results. Glycine treated fabrics have higher burst strengths and longer treatment durations tend to increase the burst strength. Glycine treated fabrics did yellow on exposure to UVb radiation. It was also found the uptake of Novacron dyes was hindered by glycine treatment while the uptake of Procion dyes improved. Glycine treatment lowered the zeta-potential on the surface of the fabric; however, salt was still required to overcome the negative charges on cotton.

Outside Research Project: Reactive Dyeing of Cotton Using Cottonseed Oil/Water System

This outside research project carried over from 2018. The objective in 2019 was to achieve a high level of color evenness in hot, warm, and cold dye baths using a cottonseed oil/water system. The project hoped to achieve an overall increase in efficiency by enhancing the method of removing cottonseed oil from dyed cotton fabrics. By reusing the collected oil in a continuous dyeing cycle, you become more sustainable and reduce overhead.

Initially, researchers blended the dye solution/cottonseed mixture with a ball mill to explore the impact of mixture ratios and different droplet sizes on the fixation and levelness of dyed samples. Finding larger droplet sizes contribute to higher fixation rates; however, the Delta E (ΔE) is greater for larger droplets. Researchers believe this occurred because larger droplets are less stable in the emulsion, which causes them to move quickly onto the fabric. Once the large droplets are in contact with the fabric, they do not disperse readily through the fabric, which leads to poor levelness. The researchers also explored the impact of various percentages of water content in the aqueous dyed solution/cottonseed oil dyeing system. Lower percentages of water contributed to higher color strength (K/S) values; however, the ΔE also increased indicating decreased levelness.

Work conducted during the second phase compared depth of shade and levelness for warm dyeing with Reactive Blue 19. Three dyeing systems were compared: conventional aqueous; dual-phase using ball milling; and dual-phase using emulsion. The ball milling system had the most rapid dye-uptake and highest K/S value. However, the ball milling system also resulted in the highest ΔE values indicating poor levelness. The emulsion system had slower uptake compared to both ball milling and conventional aqueous systems. The levelness results for the emulsion system were equivalent to those seen in aqueous dyeing. Additionally, the K/S values were nearly as high as those achieved through the ball milling system. A potential disadvantage for the emulsion system was that the dye uptake had not leveled off and was still on a sharp upward trajectory after 60 minutes, which indicates that time is critical for this system. The next phase of the project will focus on using temperature control to promote diffusion of dyes to further improve levelness as well as different techniques to remove residual oil from the fabric.

Outside Research: Six Sigma Approach to Dyeing

The objectives of this research were to quantify the actual savings that are realized when a commercial firm adopts a Lean Six Sigma approach to cotton dyeing. Quantifiable metrics are to measure and offer suggestions based on cost, time, water, dye, energy, and percent of revisions. This project was completed, and results were presented to the AATCC Chemical Applications Interest Group and the results were published in a journal article by the AATCC.

Outside Research: Improved Thermal Management Performance of Bedding Systems for Effective Recovery in Dynamic Sleep Environments Through Cotton-Containing Products

This research project was developed to investigate, identify, and highlight the unique thermal, humidity, and moisture management benefits of cotton products when next to the skin in sleeping environments. Results were compared to competitive non-cotton synthetic products, and to new treatments claiming to provide a positive impact on the cotton market. Findings of
this study show that cotton is the preferred fabric for both sleepwear and sheeting from the standpoint of comfort, in both humid and warmer climates.

Outside Research: Processing and Property Evaluation of Nanocellulose Extracted From Cotton Waste
This research project was to investigate the influence of various nanocellulose extraction processes on the yield and properties of nanocellulose from cotton waste. Processes include disk refining, sulfuric acid hydrolysis, and TEMPO oxidation assisted with a high-pressure homogenization process. Sulfuric acid hydrolysis and TEMPO-oxidation methods were applied to extract nanocellulose from indigo-dyed denim, bleached cotton fabrics, and wood pulp, aiming to examine the influence of indigo dyes on the nanocellulose extraction and its ensuing nanocellulose characteristics. Results showed that indigo dyes on the cellulose had little influence on the nanocellulose extraction and their material properties in terms of yield, morphology, size, surface charge, crystallinity, and thermal properties when compared to those from bleached cotton. Compared to wood pulp, cotton yielded nanocellulose with a higher cellulose crystallinity and thermal stability. Using the disk refining process, a pilot production of nanocellulose was scheduled and data on processing parameters and nanocellulose properties will be collected. Techno-economic analysis will be prepared to compare the yield, chemical/energy, consumption, and properties of nanocellulose produced from cotton waste to those obtained from wood pulp.

Outside Research: Producing Carbon Fiber/Fabric Using End-of-Life Cotton and Application Development
This project investigated carbonization conditions of cotton in hydrothermal and microwave carbonization processes, with respect to desired carbon properties and functionalities for targeted applications. Proof-of-concept products will then be developed using the produced carbon from cotton and will include a novel high-performance polylactide (PLA) system, high performance self-healing epoxy coatings/adhesives, supercapacitor electrodes, and liquid or gas absorption/separation devices. In 2019, carbonized-cotton fibers were produced using hydrothermal and quartz furnace methods and then incorporated in different polymers to make composites. During the initial carbonized-cotton fiber fillers results, researchers did not record a large improvement in the reinforcement properties of the polymer. However, follow-up studies completed with a reduced treatment time seems to have improved the mechanical properties of the composite material. The process will now be optimized to get carbonized cotton fibers that can have a positive impact on the composite material.

New Platform for Cationization of Cotton
The TCR team is working to develop a new cationization cotton platform, based on a newly patented cationization molecule Bis-ether-di-quat (BEDQ) from a major chemical supplier. The newly developed molecule has no odor and possesses a much higher efficiency compared to traditional cationization reagents. The TCR team compared the reaction efficiency of the new quat-BEDQ to a quat-188, as in a cold-pad batch process, a pad-cure process, pad-steam process, and exhaust process. Additionally, the lab has carried out cationizations utilizing the chemical supplier’s kinetic calculators. The team concluded the new bifunctional quat is clearly more efficient during cationization in these processes, but the final step in this project is to compare dyeability differences between the two quats to ensure that it dyes similarly as well. To do this, TCR first prepared black shades, then determined the cationization amount and dye amount of both quats. They utilized an innovative approach to saturate dye different cold-pad batch cationization levels of the two chemistries to ascertain the amount of cationization reagent required to match a conventional dyeing 5% self-shade of Novacron Super Black R. Due to the enhanced reaction efficiency of BEDQ, a much lower amount of nitrogen was required for application than compared to quat-188. However, due to lower solids and a higher molecular weight for BEDQ, from a product perspective, the g/L application of the actual products ended up being identical. To obtain an equivalent shade required an identical amount of dyestuff for both cationization reagents. This finding suggests that dye blocking may not be an issue with the new chemistry. Additionally, in general, colorfastness was comparable and better for the BEDQ dyeing’s in many cases. This project has clearly proven the superior reaction and cationization efficiency of the new quat. But the major concern of this product will be costing, especially when compared to the very inexpensive quat-188.

Crosslinking Polymers for Durable Press
Explored the possibility of utilizing developmental non-formaldehyde crosslinking polymers to impart DP properties to cotton by evaluating the smoothness and physical properties of cotton fabric with crosslinking polymers applied. The TCR team conducted several rounds of trials and found very encouraging smoothness results, especially when the polymers were combined with low levels of DMUG (a non-formaldehyde resin). The biggest challenge with utilizing the polymers in a finish bath was the acidity level of the polymers which cause precipitation of other finish bath components. Through the project, a combination of alternative finishing components was found not to precipitate when combined with the polymers. This concept of utilizing crosslinking polymers to impart DP to cotton needed further exploration. Summer trials studied the effect of pH after application of the highly...
acrylic crosslinking polymers. Initial results showed encouraging smoothness results of 2.7 when the finish bath was adjusted to a pH of 4.5 using less than 100 g/L of a crosslinking polymer. Utilizing a higher pH application would also allow utilization of more common finish bath components such as a typical polyethylene and silicone combination which may give a partial boost to the smoothness results. Fall trials repeated the previous procedures, but positive results were unsuccessful. Textile Chemistry Research has also been unsuccessful in combining alternate crosslinkers with these polymers to obtain promising smoothness results. As a result, they have decided not to carry out any additional experiments and write up a research report documenting the work to date.

Low-Formaldehyde Durable Press and Soil Release
The TCR team is developing a low-formaldehyde resin treatment that provides improved strength retention and “no-iron” DP performance (The goal is a DP rating ≥ 4). To date, a dress shirt treated with non-wrinkling SportDRi™ finish can dry in five minutes when tumble-dried. The SportDRi™ finish, developed by a co-application of the SportDRi™ treatment with DMUG and two different DMDHEU resins, and applied with less than 16 ppm of formaldehyde (allowable detection limit), imparts a durable press rating of 3.4 after 30 HLTD on woven-cotton shirting fabrics. In other work, the combination of an application of SportDRi™ finish, made with soil release C6 treatments instead of repellents, then combined with the less than 16ppm of formaldehyde resin, has proven to be durable to laundering at 140°F and releases corn oil with a four rating (AATCC TM 130) after 30 industrial launderings.

Pre-Treatment for Disperse Dyeing of Cotton
Develop an economical pretreatment that would enable cotton to be dyed with disperse dyes. This would facilitate a one bath dyeing of a cotton/poly blend and allow cotton to be dyed with neon shades. Initial supercritical carbon dioxide (sCO2) dye trials were conducted at a lab in Pennsylvania, on fabrics treated at Cotton Incorporated, utilizing a TSP emulsion. The TSP treatment yields the darkest and most uniform dyeings. During the fourth quarter, TCR was in the process of dyeing several different fluorine-free water repellents that were recently prepared for TransDRY® technology research. Based on what research has seen to-date on the behavior of hydrophobic dyes and fluorine free water repellents, TCR believes there may be an opportunity to develop a low-cost easily adaptable pretreatment that is dyeable with disperse dyes.

Cationic Antimicrobial Treatment for Cotton
The project goal for a cationic antimicrobial treatment for cotton is to provide an alternative treatment to silver with high performance which could open new markets for cotton in the medical and hospitality areas. Samples developed by PDI were supplied to an independent antimicrobial testing lab. The lab analyzed the samples under the auspices of ASTM E3160 TM. The antimicrobial cationic-cotton concept has not yet been tested with this methodology. Results showed, when exposed to E. Coli, all treated samples demonstrate a 100% reduction at 24 hours.

Cotton to Sugar
The goal of this research is to develop a process that allows cotton-based textiles to be enzymatically digested into sugar, with potential to further obtain ethanol or other value-added products. Lab work slowed in the second quarter to spend time fully documenting prior work. Through outside counsel, TCR submitted a provisional patent to cover the work to date developed at Cotton Incorporated. Textile Chemistry Research then conducted a scaled-up trial running a larger batch, but in a continuous process with more trials planned. The PDI division also signed an agreement to work with NCSU in evaluating a mechanical-fibrillation pretreatment technique. In addition, TCR commissioned a business analysis of this concept, which was very encouraging and somewhat surprising as to the potential for profitability. Some of the suggestions made by this group require that PDI explore new options that may have to be done offsite and after finalizing a path forward, took advantage of the momentum of this project.

Textile Chemistry Research strategically focused on the cotton to sugar project the second half of 2019. Experiments examining the level of chemistry utilized in the hydrolysis process, as well as the size of the substrate presented to the process were carried out. Initially it was found that up to 50% less chemistry (and maybe even more) can be utilized to still obtain similar efficiency. Similarly, by varying the substrate from ground powder all the way to a 6 x 6-inch square, comparable hydrolysis efficiencies were still obtained. The research is very encouraging as it suggests much less chemistry and physical processing of samples is required for hydrolysis. The new refining process was also evaluated after TCR received multiple samples of cotton refined by NCSU. This new refining process, in combination with the hydrolysis process developed at Cotton Incorporated, obtained between 90-99% glucose conversion efficiency. The TCR team was also able to utilize these samples reducing the level of enzyme by half, down to 5%, and still obtain 90% glucose efficiency. As well, this combined process did not utilize a high
temperature pretreatment step. This is very exciting preliminary research and TCR is working to further explore and collaborate on the next steps of this approach with NCSU.

**Durable Temperature-Regulation Finish for Cotton**

This project focused on developing a durable non-formaldehyde, thermal regulation finish for cotton. By incorporating Cotton Incorporated’s moisture management technology into the finish, PDI can expand cotton’s presence in the activewear market. For this study, TCR printed a combined chemistry of PCM and non-fluorine WICKING WINDOWS™ technology on knit and woven fabrics. The knit fabric already contained TransDRY® technology; adding multiple technologies to one fabric application. After, 20 HLTD, the samples were evaluated using Color Spectroscopy and MMT Testing to evaluate the durability of the finish and the functionality of the WICKING WINDOWS™ technology. Sweat Hiding™ technology was also combined with PCM+ WICKING WINDOWS™ technology prints to achieve a multifunctional fabric. The print paste combinations were explored to determine the right combination to obtain a smooth hand and durable print on the fabrics. In the fourth quarter, the formulation was finalized for the non-fluorinated WICKING WINDOWS™ technology chemistry with PCM chemistry, and the fluorinated chemistry with dual technologies, containing both WICKING WINDOWS™ technology with PCM and Sweat Hiding™ technology.

**Cotton in New Markets: 3D Printing**

This research is exploring using cotton fiber in materials used to print 3D objects. Textile Chemistry Research is exploring new opportunities to introduce cotton into the market and 3D printing is a growing trend. The TCR team joined an outside company to develop injection-molded products such as hangers, small storage boxes, and toothbrushes, each containing a percentage of cotton fiber. In addition, the TCR department purchased a second 3D printer for research and development (R&D). Prototypes are now printed and showcased at different conferences and tradeshows. The next step is to determine a way to analyze finished products to report the advantage(s) of adding cotton to print 3D objects.

**Different Chemistries for Thermal Performance**

This project evaluated the heating performance of various finishes and yarns applied to and blended with cotton. A high interest in the concept of bio-ceramics was reported in 2019, most noticeably in the sleepwear category, on products marketed with rejuvenating finishes. To begin the study, different print formulations were evaluated. A ceramic-carbon black was both foam- and screen-printed onto regular cotton fabric samples. After washing, samples were tested to collect data. The prints performed but had a negative effect on the fabric hand.

Cotton/thermal fiber blended fabrics were evaluated next with interesting results. First, an Ne 18/1 yarn was spun and blended with acrylic, then knitted in-house. Next, a cotton was blended with nylon fibers that contained 3% graphene; finally, cotton was blended with a cotton-carbon fiber. All three blends exhibited heating characteristics. Of the blends, the graphene blend performed best regarding heating. Data collection continued through the year on dyed, knit cotton/nylon-graphene fabrics using sensors and iButtons to obtain comparative data. Also, woven cotton/nylon-graphene fabrics were subsequently dyed, and data was collected on these samples as well. There is a synergistic effect between the dye and the graphene. The dyes themselves absorb IR energy and adding graphene increases the capacity for heat retention. Different methods to analyze the heat transfer and retention will be explored in 2020.

**Evaluation of Performance Sheet Sets**

Questionable marketing claims spurred this project focusing on evaluating various claims that a company was making regarding their synthetic sheet set as compared to a traditional cotton sheet set. The company’s knit synthetic sheets were then compared to both woven and knit 100% cotton sheet sets. Tests evaluated a variety of different properties and virtually all claims made by the synthetic sheet manufacturer were refuted. A report, written on the findings, was submitted to the Marketing team.

**Microfiber Degradation in Aqueous Conditions**

To date, wastewater, freshwater, and seawater degradation has been completed for the 100% cotton, 100% rayon, 50/50 cotton/poly, and 100% polyester fabrics. In every condition, cotton degraded significantly more quickly than the polyester. In 2019, PDI began a new phase of this work. In this project 100% cotton fabrics finished with different dyes and chemicals were exposed to the same conditions as in previous trials. The treatments included a reactive blue dye, a silicone softener, a C6 water repellent, and a formaldehyde containing DP resin. The cotton fabrics were compared to a micro-crystalline control as well as an oak leaf, something that would naturally find its way into the water supply. Preliminary results show that all cotton conditions degrade, some faster than others, and all faster than the oak leaf. During the end of the fourth quarter, the above samples were exposed to a wastewater inoculum under anaerobic conditions. This work will continue in 2020.
**Low-Micronaire Cotton Processing**
A series of adverse weather events led to an increase in the amount of low micronaire cotton, produced in some regions. Mills may face challenges processing this material as it moves through the supply chain. A pilot plant study will be conducted to determine which processing conditions will produce knit fabrics with an acceptable level of quality for the retail market. This study is comparing a standard 4.3 micronaire blend to a low 3.3 micronaire blend. Processing variables include ring vs. rotor spinning system, conventional vs. enzymatic bleaching, non-biopolished vs. biopolished, and standard vs. migration exhaust dyeing. Pilling results tended to be better for fabrics spun from low micronaire fibers. Whiteness results were similar for all standard bleached samples; regardless of micronaire, spinning system, or biopolishing. The samples were then dyed and visually rated by a panel. The ratings were analyzed using a polytomous universal model. The 4.3 micronaire, rotor spun, biopolished fabrics were rated highest overall. The 3.3 micronaire, ring spun, non-biopolished fabrics were rated lowest. The bleaching system and dyeing temperature did not appear to have an impact on ratings. Micronaire was the most influential factor followed by biopolishing and then spinning.

**Life Cycle Assessment (LCA)**
With assistance from the Sustainability Division staff, PI completed the LCA on the Blue Jeans Go Green® recycled denim insulation. Although the LCA did not show a major benefit from using recycled denim, the results for most impact categories were equal or slightly better than using fiberglass insulation. There are other benefits that cannot be quantified by the LCA that must also be considered.

**Strategic Objective 2: Optimize and implement products and technologies to advance cotton in global markets.**

**Technical Service Meetings with Yarn Spinners and Manufacturers**
Fiber Processing provided mill technical services to a domestic spinner to minimize problems associated with cotton crop change and with the assistance of the Product Evaluation Lab (PEL), analyzed test data to advise optimum process settings. The FP team also provided support to a U.S. supplier of ASTM standard test material for use in Random Tumble Pilling tests worldwide. The test material will be processed in the FP Lab for controlled processing into combed sliver and delivered back to the supplier.

In September, FP and FC’s Engineered Fiber Selection (EFS®) team conducted a tandem visit with two large spinners in Guatemala, providing technical support for crop change and guidance for improved fiber processing. Multiple days were spent with both operations who purchase U.S. cotton exclusively. Technical service support is ongoing with the involvement of Cotton Incorporated’s Mexico City staff.

Additional technical service visits were conducted by FP staff during October and November with two domestic spinners. Both are large consumers of U.S. cotton and EFS® customers. Technical service advice was offered to reduce the effects of crop-change related quality issues. Improved methods for category separation and blend-in rates were advised and implemented. Plans for collaborative opportunities for technical service and/or research were also discussed for 2020.

**Contamination Detection and Removal Trials**
The FP team worked with a major machinery and plastic wrap provider to provide a solution to quantify and collect plastic contaminants left in cotton bales after a large ginning contamination trial. Fiber Processing coordinated meetings and arranged contamination detection trials in Germany, which PDI staff and company engineers attended. Trials were very successful, and a more complete report will be compiled during the first quarter 2020.

**Installation of New Machinery**
Murata MVS 870 airjet-spinning technology, installed in 2018, has promoted itself with the ability to run higher speeds and better quality than the previous MVS technology. Fiber Processing technicians performed a complete spinning limit trial from Ne 12/1 – 60/1 yarns to develop “soft hand” MVS yarns. A control MVS and best “soft hand” MVS yarn were spun and sent to PD for knitting. Following the dyeing and finishing process, these fabrics will undergo a full evaluation.

AgTek Multi-Function winders were installed in May. Setup and initial testing were then completed with utilization underway to produce yarns for PD in the area of flatbed knitting. Packages with up to five-plies have been produced from fine count yarns, of multiple colors, and transferred to the Knitting Lab for fabric trials. Additional testing was performed on “fancy” or “slub” yarns, cotton yarns with elastane cores, as well as conventional “covered” yarns. Utilization of the AgTek winders continued in the second half of 2019. With FP staff producing yarns with opposing twist characteristics and multiple plies that were embroidered onto denim for surface effect. The resulting fabric was adopted into the FABRICAST™ collection from PD.
Production of High-Quality Yarns for Shirting Research
In support of PD, FP produced high quality warp yarns for a shirting development. The yarns were produced from a laydown of high-quality Upland cotton. After a premium level of combing, yarns were spun on a compact ring-spinning system to produce superior softness with lower than normal twist. This yarn will provide support in the development of higher quality light-weight shirting materials produced from Upland cotton.

Production of Premium, Soft-Hand MVS Yarns
To demonstrate MVS capabilities, FP produced premium soft-hand MVS yarns for dissemination. In 2019, FP shared developments with a major machinery manufacturer at ITMA 2019. The manufacturer then showed these fabrics to hundreds of visitors at their booth in Barcelona. The FP continues to share fabric hangers and discussions with textile mills. Soft hand developments continue to be important for cotton and the MVS spinning systems.

Production of Yarns from Multiple Spinning Systems
The FP team produced over 400 pounds of combed yarn in three counts, from two spinning systems, to support ongoing fabric development work for PD knitted fabrics. High-quality, compact ring-spun yarns, in tandem with MVS yarns, in single and plied varieties were also spun. Package preparation included yarns for use as natural and dyed varieties. These yarns are being utilized in multiple styles to reduce cost and improve strength. This complex project offered flexibility to PD research, eliminating the need to source yarns externally.

Collaborative Research with Machinery Manufacturer
The FP team provided 300 pounds of finished sliver in support of research reducing cotton fiber waste in the MVS spinning process. The FP staff conducted a visit to the company’s headquarters, in Charlotte, NC, to observe runnability and discuss further future collaborative opportunities. Data results were then shared with Cotton Incorporated; with analysis conducted during the fourth quarter. During 2020, research will be expanded into a production facility with FP having full access to results of ongoing trials. Progress will be reported in the first half of 2020.

Combing Quality Research
To advance the production of higher quality combed cotton yarns, FP conducted research specific to the combing process for technical service use with yarn spinners. Three rates of short fiber (noil) removal rate and two directions of fiber feed were selected to determine optimum combing efficiency and yarn quality for today’s longer Upland cotton. Ring spun Ne 30/1 yarns were produced to represent all variables and results indicated quality improvements were realized in the reverse-feed direction with products requiring higher noil removal percentages.

Cotton Origin Project to Evaluate Capability of Potential Fiber Identification Technology
Fiber Processing provided fiber, yarn, and fabric from two known states for the evaluation of a potential fiber identification technology. Processed sliver and carded ring-spun yarns were produced for comparison purposes. With the combined assistance of PD and DFAL, both greige and dyed fabric, slated for tee-shirt production, were delivered. All samples were provided to be directly involved in origin testing of the raw cotton used.

Evaluation of U.S. Grown Raw Hemp Fiber Blended with Cotton
Cotton Incorporated’s FP team engaged in development work to evaluate the feasibility of spinning cotton/hemp blends on a short staple spinning system. The hemp was up to seven inches long and contained very coarse fibers. A blend of 87% cotton with 13% hemp (as delivered) was evaluated. The hemp resembled the barky plant material sometimes found in raw cotton. The FP technicians did not experience any major issues in opening and cleaning, carding, drawing, or roving. However, once the material was taken to spinning and set up for Ne 20/1, the ring spinner realized 100 times more ends-down/per spindle hour than what is normally acceptable on the ring spinning frame. This type of ends-down rate is not commercially viable and related directly to the coarseness of the hemp fibers. The trial concluded with the following conclusions: a.) The quality of hemp sent for this trial is not suitable for short staple spinning process; b.) The yarn experienced 100x the normal ends-down during ring spinning of Ne 20/1 yarn; and c.) Hemp suppliers should find partners that are developing refining machinery that can better prepare the hemp for short staple spinning with cotton.

Developments on Amsler Core Spinning/Wrapping Technology
Following the installation of an Amsler "wrap yarn" system on an existing Zinzer 351 ring spinning frame, FP has been developing parameters to improve the runnability of this new effect yarn. The goal is to produce a final yarn with improved hand, special performance, and/or special visual attributes. While the initial fabrics produced from this effect yarn showed promise, machine

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efficiency (and ultimately commercial viability) remains a major hurdle. Because of the way the yarn is produced, the friction created when knitting causes excessive fly, which in turn can build up around the needle bed. To overcome this issue, the knitting frame was slowed to approximately 50% of normal speed and stopped often for cleaning of the excess fly. As more fabric is produced, additional testing will be required to determine washability, color fastness, pill rate, and overall durability. During meetings in May and June, FP staff conveyed issues with the machinery manufacturer to try to assist in creating positive solutions. Fiber Processing will continue to work on this interesting but problematic novelty attachment.

Internal Fabric Development Assistance
Technical fabric development expertise was provided by PD to evaluate seed varieties, spinning systems, and new finishes with FP. Fabrics were developed in support of the ISP program and for research into new yarn treatments. The PD lab completed 75 internal knitting and weaving projects for departments across PDI, used in both internal and outside research.

Optimization for Moisture Management Technologies Using Non-Fluorine Durable Water Repellent
Production trials were run on new more durable and less expensive formulations than what are currently available, with the intention of providing alternative options to mills. Lab trials suggest that some non-fluorine water-repellents attract detergents to the treated articles when washed. Spray testing after 30 HLTD, both with and without additional water rinsing, confirms that detergents require removal with at least three “water-only” launderings. Design continued, on the application concentration of the STORM COTTON™ technology treatments. A standardized, non-fluorine water repellent evaluation procedure was created to compare non-fluorine water repellents at the same application concentrations, based on percent solids, and at various cure temperatures/durations. The new testing procedure confirmed the durable water repellency of three non-fluorine repellents with the information forwarded to TSI.

Optimization of Non-Formaldehyde Durable Press Resin (NFDPR) Finish on Cotton Knits
Throughout the industry, resins help improve durability in textiles. The TCR team continues to optimize NFDPR formulations to determine the best overall parameters for applying the technologies. Cotton Incorporated has recently developed an NFDPR technology specifically for cotton knit fabrics. Ongoing trials examine DP, wicking, and dry time performance to better optimize the final formula. Previous projects involving resin on knits have shown potential for improving fuzzing/pilling, quicker wicking, and faster drying properties. The incorporation of a modified polyurethane enhanced wicking in some cases with resin finishes. To date, PUREPRESS™ technology, especially with the modified polyurethane, has yielded some encouraging results on knits, with and without calendering.

Non-Fluorine STORM DENIM™ Technology
Work to identify a durable non-fluorine water repellent treatment continues. As application techniques were studied to improve the water repellency chemistry of STORM DENIM™ technology, a finish confirmation trial was run with the top four non-fluorine and C6 water repellents. Each application was co-applied with and without silicone water repellents, and/or a chelating sequestrant, conforming to the STORM DENIM™ treatment requirements. The results suggest that both non-fluorine and C6 water repellents require the co-application of a type of polybenzimidazole (PBI) cross-linker and a chelating sequestrant to improve the water repellency of the STORM DENIM™ treatment. Production trials of non-fluorine STORM DENIM™ technology were run with a mill in China. The treatment on the light-colored denim met the STORM DENIM™ technology criteria; however, the dark denim did not. Further lab trials indicated that the formulation must be increased to maintain the required performance spray rating of 70 after 30 HLTD cycles. Trial work continues with a U.S. brand optimizing the required formulation.

Screening of Various Polyethylene Softeners for Low Curing TOUGH COTTON™ (Without Resin) Technology for Cotton Socks or Cotton Yarns for Socks or Other End Uses
Using available yarn dye and sock processing equipment, trials continue seeking to develop a method of applying TOUGH COTTON™ technology on socks. Even though the TOUGH COTTON™ technology has been gaining momentum for Cotton Incorporated, it would be beneficial to develop a method to exhaust this technology onto yarns and potentially fabrics. Initial trials (using dip/extract/dry/cure) on cotton socks provided excellent results using the modified Martindale Abrasion test method. Trials on yarn packages run in the DFAL were successfully completed and the data is promising. Experimentation demonstrated that the amount of product could be reduced by half and improve processing without impacting performance. A production trial is planned for the first quarter in 2020.
Non-Fluorine Yarn Treated with TransDRY® Technology & Non-Treated Yarn — The Effects of Dye Structure on the Differences Between Dye Uptake

Technical Services and Implementation (TSI) encountered an issue where a mill in Peru was having trouble dyeing Union Shade on fabric containing alternating feeds of a non-fluorine yarn treated with TransDRY® technology. The project goal was to provide the mill with a solution that would allow them to dye their fabric without shade-depth differences between the non-fluorine yarn treated with TransDRY® technology and the untreated yarn. Initial dyeing was conducted in-house using yarn provided by the mill. The yarns were then knit into one-inch bands of non-fluorine yarn treated with TransDRY® technology and untreated yarn. This resulted in the discovery that, contrary to conventional assumption, the non-fluorine yarn treated with TransDRY® technology was actually dyeing darker than the untreated yarn, rather than lighter. After this discovery, additional trials researched various reactive dyes. Each trial represented various dye structures, different reactive and solubility groups, all within the dye molecule. The results indicate that while the non-fluorine water repellent demonstrates cationic characteristics, it is actually more complex. With 80 lab-dip results analyzed by the fourth quarter, data suggests that the problem is primarily inherent to mono-reactive, Vinyl Sulfone dyes with two or fewer solubility groups. However, there are dyeability differences on other dyes to various degrees based on differences in chemical structure and color. The most prevalent dye is Reactive Blue 19, which happens to be the dye used in the mill’s formula. The end result concluded that the best way to minimize shade differences between non-fluorine TransDRY® technology yarn and untreated yarn is through careful dye selection.

Cotton Incorporated Technology Implementation Advancements

The Technical Services and Implementation team remains at the forefront of expanding Cotton Incorporated’s technologies through continued research and internal optimization trials. Work includes internal and external technical assistance, production scale trials, and implementation services with mills and manufacturers to advance cotton in global markets. The following activities detail key advances TSI made in global markets.

- Implementation of the PUREPRESS™ technology continues with numerous trials run and scheduled. Trials have advanced by mills interested in becoming licensed suppliers of the technology, as well as brand interest. Mills in China, S.E. Asia, Pakistan, India, Mexico, and South America have run trials. To date seven mills have been brought online as licensed suppliers of the PUREPRESS™ technology, and two more have run trials and are awaiting test results.
- Implementation and support of TOUGH COTTON™ technology remains strong with more mills and brands running trials (largely in S.E. Asia). Testing submissions from trial and production runs increased in 2019.
- Implementation trials using STORM COTTON™, TOUGH COTTON™, WICKING WINDOWS™, and TransDRY® technologies continue with new brand and mill interest.
- The team assisted a U.S. brand in expanding their U.S. supply chain of the STORM COTTON™ technology.
- The team traveled to South America in October to assist in the application of TransDRY® technology onto dark yarns. This mill supplies a large U.S. shoe and sock brand.
- The team traveled to South America in August to present the findings of the TransDRY® technology dyeability project to customers, with trials run in November using recommendations made by Cotton Incorporated.
- In conjunction, TSI and TCR teams conducted trials in November on a new technology to promote faster drying properties of home goods.
- The team traveled to Valdese, NC, in October and November to assist the largest U.S. yarn supplier of TransDRY® technology in implementing the technology at their brand new dyehouse using all new equipment.
- The team ran numerous trials in the DFAL optimizing the TOUGH COTTON™ technology applied to yarn packages. This work was done in preparation of mill trials scheduled for Asia.
- In conjunction, TSI and TCR teams collaborated in the development and application of the non-fluorine STORM DENIM™ technology on dark indigo denim.
- The team collaborated with TCR to bring the non-fluorine STORM COTTON™ technology to a top denim manufacturer looking to apply the technology to black denim.
• The experimental-implementation efforts surrounding joint research, known as the TransDRY® Dyeability Project, was completed during the third quarter. The joint project supported the changeover of several South American mills to non-fluorine TransDRY® technology.

• Cross-divisional support has been critical in the development and application of dual technology fabrics in the DFAL with the Dyeing and Finishing Lab processing close to 200 pounds of yarn and 250 yards of fabric for this project alone, producing a total of 1,800 pounds year-to-date for a variety of internal research, FABRICAST™ collections, Marketing support, and/or technical support services. The Analytical Lab has processed 49 service requests, with the Technical Services team processing 187 service requests during 2019.

Strategic Objective 3: Augment cotton marketing activities/influence industry decisions through technical avenues such as standardization and education.

Sustainable Apparel Coalition (SAC)
Work refining the final methodology details of the Higg Product Tool takes place during regular web meetings and an in-person meeting in Europe. Methods are only one piece that needs to be created before SAC, and the new Higg.co LLC, can release the Product Module. Because validation, training, and transparency also must be in place, the release date has been pushed to 2020. With the additional time, the Material Sustainability Index (MSI) is being recreated on the new Higg platform by Higg.co with improved user interface and graphics. On the technical side, the background data is shifting to use GaBi data, which is the same data that was used for the cotton LCA, and an updated water scarcity methodology (AWARE) is being implemented. Comments have been submitted on the first draft of the scores in the new platform. Several mistakes in the old MSI mapping and scoring were identified. The 2015 cotton data has been submitted for conversion to the new platform.

Based on an idea from the previous annual meeting, a draft Product Impact Calculator (PIC) was piloted to obtain feedback from consumers and industry on possible ways to display the influence of consumer wash habits on a product’s score. Feedback is being reviewed for changes to the PIC and how it can inform the Higg Product tool.

ISO Activities
Since midsummer, Product Integrity picked up several new activities that will be carried forward into 2020. Most new activity related to international standards and European initiatives. ISO Technical Committee (TC 323) on Circular Economy was formed in late 2018, and during the second half of 2019, PI joined the ISO/TC 323 U.S. Technical Advisory Group (TAG), which coordinates U.S. positions and participation. The first work items related to a management system, business plans, and other base requirements and were outlined based on input from small ad-hoc drafting groups. Non-governmental organizations and about 40 countries expressed intense interest in TC 323 and its work program. Now the U.S. is trying to catch up as quickly as possible with the activities that occurred before membership was approved.

In other ISO news, ISO/TC 38 on Textiles met during the fourth quarter in Italy. During the main TC plenary, several new work items in areas of interest to Cotton Incorporated were proposed, including two relating to microplastics. The conversion of the International Workshop Agreement surrounding GMO testing of cotton and cotton products into a standard was also discussed.

Participation in USDA Gin Schools
Fiber Processing staff instructed both the Lubbock, TX, and Stoneville, MS, gin schools in 2019. Instruction was provided on three levels, in addition to continuing education classes which allowed ginners to receive their Cotton Ginner certification. Instruction and demonstrations focused on the processing of cotton after leaving the gin and the importance of proper ginning methods. Both schools stressed the importance of fiber quality, with a presentation of FP’s research project on low micronaire cotton as focus of the school in Lubbock.

Participation in TechTextil 2019
Techtextil Frankfurt, held every two years in Germany, is the leading international exhibition for nonwovens and technical textiles, bringing together hundreds of vendors representing all aspects of product development. Techtextil Frankfurt 2019, delivered on its promise to shift focus towards sustainability in all parts of the global supply chain. The vote in March, from the European Parliament to ban single use plastics, has many companies rethinking their manufacturing strategies. With similar legislation proposed in Canada, North America may soon see a similar shift as well. Companies are making it economically viable to use more cotton in all nonwoven processes. A newly opened, Customer Innovation Center, in Egelsbach, Germany emphasized many of the new technologies allowing for more sustainable manufacturing.
Participation in FLAME30
In support of PDI, members of PI and TSI presented at the FLAME30 conference covering recent flammability research conducted by TCR and the Analytical Lab departments. Materials were well received.

Participation in ITMA 2019 Machinery Exhibition
In June, PDI staff members attended ITMA 2019. Held every four years in Europe, ITMA is the marquee exhibition for nonwoven and textile machinery manufacturers from around the world to show off their latest technological advancements. The FP staff met with many important spinning, nonwoven machinery manufacturers and companies offering contamination detection over four days in Barcelona, Spain. Several reports were compiled to provide reviews by PDI. A report detailing fiber processing and nonwoven machinery highlights has been shared with textile/nonwovens companies, manufacturers, and retailers.

Product Integrity attended the ITMA show, in addition to the Planet Textiles conference, and the SAC 2019 Annual Meeting. Sustainability claims at ITMA seem to have increased in the dyeing and finishing phase. In preparation for the SAC annual meeting, the Product Advisory Council (PAC) was able to hold an extended work session on topics that needed advance in-person consultation. The PAC focused on an initial outline of how product validation might work, and how the Higg Product Module tools could fit into SAC transparency framework to inform consumers of a product’s sustainability. Based on an idea from a 2018 meeting, a draft PIC tool that shows consumer use impact was designed and reviewed. Meetings concluded with data collection needs discussed.

Participation in RISE 2019
INDA, the nonwovens industry trade association, holds a yearly conference, Research, Innovative & Science for Engineered Fabrics Conference (RISE). This conference showcased technological advances in materials research. The FP staff evaluated new technologies and networked with industry and university professionals.

Sponsorship at Southern Textiles Association Fall Marketing Meeting
In September, FP sponsored the Southern Textiles Association fall marketing meeting in Belmont, NC. Fiber Processing took this opportunity to network with industry professionals to discuss the services Cotton Incorporated has to offer to cotton users worldwide.

Participation in IDEA 2019
The most comprehensive nonwovens exhibition held every three years in the U.S. drew over 7,000 attendees in 2019. In conjunction with GSCM, FP staff exhibited cotton innovations in nonwovens products and discussed opportunities for increased cotton usage with industry decisionmakers and hundreds of show attendees.

Industry Engagement
Staff use industry engagements to develop new ideas, source new cotton yarns and fabrics, as well as meet with vendors, discussing possible collaborations. Technical staff from PDI assisted Account Managers at Cotton Incorporated booths during trade shows, presenting new fabric developments and answering technical questions. Listed below are trade shows, conferences, and/or presentations the PDI team participated in.

- Outdoor by ISPO, Europe (January)
- West Texas Cotton Producers Conference, U.S. (January)
- ASTM International Meetings, U.S. (January)
- Outdoor Retailer (OR Show), U.S. (January, and June)
- Techtextil, U.S. (February)
- AAFA Product Safety and Environmental Control Committee Meetings, U.S. (February)
- The Pittsburgh Conference and Exposition (PITTCON) 2019, U.S. (March)
- New York Home Week, U.S. (March)
- AATCC International Conference Event (ICE), U.S. (April)
- Great Ideas in Cotton Conference, Hong Kong (May)
- Innovate Textiles & Apparel, U.S. (May)
- Performance Days, Europe (May)
- The Sustainability Consortium (TSC) Summit, U.S. (May)
- The FABRICAST™ Collection 2019-Release, Asia (May)
- Flame Retardancy and Lightweight Transportation Materials Conference (FLAME 30), U.S. (May)
- Asian Nonwovens Exhibition and Conference (ANEX 2019), Japan (June)
- ITMA 2019, Europe (June)
- WEAR 2019, U.S. (June)
- RISE Conference, U.S (September)
- LCA XIX Conference, U.S. (September)
- IPC E-Textile Conference, U.S. (September)
- AAFA Traceability Seminar and Environmental Committee, U.S. (August)
- AATCC Sustainability Conference, U.S. (October)
- ISO/TC38 (Textiles) Committee Meetings, Europe (October)
- Textile Exchange, Canada (October)
- AATCC Antibacterial and Odor Control Conference, U.S. (October)
- Hygienix Conference, U.S. (November)
- AATCC Digital Printing Conference, U.S. (December)
- ASTM International Committee Meetings, U.S. (December)

Blue Jeans Go Green® Program
In support of Consumer Marketing’s Blue Jeans Go Green® sustainability program, PD compiled a resource packet highlighting sustainable denim projects developed at Cotton Incorporated. The resources were meant to engage potential industry partners. In addition, Product Integrity supported by providing an LCA on the denim insulation. The analysis proved helpful in highlighting production inefficiencies.

Garment Review
In support of marketing activities and to influence industry decisions through technical avenues, PD provides Fashion Marketing support through swatch notebooks. Specific time was allocated by the PD team, for a Technical Review with the Fashion Trend Analysis Team. The review provides technical fabric discussions to enhance seasonal trend presentations. Each notebook provided analysis on 138 knit and woven fabrics.

Industry Publications
Two industry journals, the International Cotton Advisory Committee (ICAC) and AATCC, published articles provided by PD complete with fabric images, regarding information about denim and cotton innovations. Product Integrity co-authored an article with 18 other LCA experts on reporting and review requirements for life cycle assessment. The result was published online in the International Journal of Life Cycle Assessment, one of the major journals for LCA study and practice.

Global Research
In May of 2019, a cross-divisional trip through Asia was executed to further market reach, educate industry leaders, provide technical assistance, and follow-up on recent technology implementations. Information covering the microfiber research and an overview of cotton technologies was presented during the Great Ideas in Cotton 2019 Conference in Hong Kong to almost 400 people. Following this conference, the trip continued with several mill visits, sharing information on cotton technologies, which included Sweat Hiding™ technology, PUREPRESS™, and STORM DENIM™ finishes. Several meetings with chemical companies presented learning opportunities during this trip. Team members discussed experiences and concerns with certain chemistries as well as learned about new offerings from the different companies.
GLOBAL SUPPLY CHAIN MARKETING

The scope of the GSCM division covers a wide range of activities with manufacturers, retailers, brands, and trade organizations throughout the world. These activities are anchored in three important strategic objectives: build a global presence for cotton, promote product and technology ideas, and conduct education, training, and technical assistance through marketing programs that further the use of cotton in products.

**Strategic Objective 1: Maintain a global presence for cotton.**

An important tactic for maintaining a global presence for cotton is through direct account interaction with mills, manufacturers, brands, and retailers for the apparel, nonwovens, and home products markets. GSCM staff focus their efforts on influencing major brands and retailers through coordination of various Company resources, with the ultimate goal of influencing the use of cotton versus other fibers. GSCM staff conducted more than 700 meetings with companies in both the manufacturing supply chain and with key brand and retailer accounts.

In October, staff attended both the Sourcing Journal Event sponsored by WWD and the Functional Fabric Fair, sponsored by Performance Days. These shows provide an opportunity for Cotton Incorporated to showcase performance technologies, innovations, and sustainability capabilities to sourcing agents and key industry leaders looking for cutting edge fiber performance options.

Staff in the Mexico City office granted two press interviews including one TV interview, which served to direct shoppers’ attention to cotton fiber advantages on performance and sustainability versus synthetic fibers.

Mexico City staff organized the 2019 edition of the Mexican Retailer Workshop on Cotton Fundamentals, which combined a day of lecture and a day of touring mills with the aim to educate 67 apparel buyers from 15 retailers on the benefits of cotton in order to make better product decisions and to better commercialize cotton-rich garments. Additionally, the staff hosted the Cotton Innovation Session II gathering for nearly 85 companies and more than 170 executives with the aim to guide the industry toward cotton products based on fashion and new product ideas.

Cotton Incorporated, through its Mexico City office, sponsored two large events. The Mexican Apparel Chamber Congress in Puebla, Mexico, drew in the 70 top garment manufacturers and large domestic brands. The second, the Mexican Textile Chamber Annual Convention in Cancun, Mexico, Cotton Incorporated had a prominent presence by opening the ceremony in front of 110 of the most relevant top executives in the industry. Mexico City staff also participated in the launching of the Exintex trade show in Puebla, Mexico.

Global Supply Chain Marketing sponsored Fashion Summit 2019 in Hong Kong. The event was organized by members of the Hong Kong Legislative Council and local textile associations. More than 2,000 participants attended the two-day event. As a part of the sponsorship, Cotton Incorporated was featured in event marketing materials and had a booth in the exhibition area.

GSCM exhibited at Intertextile Shanghai Apparel Fabrics, Autumn Edition in Shanghai, China, in a joint booth with Cotton Council International. The tradeshow event attracted more than 70,000 global attendees. The Cotton Incorporated booth theme was “Cotton Does Breakthroughs” and featured cotton innovations, product developments, and information on sustainability.

Cotton Incorporated joined with Ningbo Garment Association to host a one-day mini fair event themed Great Ideas in Cotton, in Ningbo, China. The event showcased the latest innovative performance and cotton fabrics from ten exhibitors comprising technology partners and chemical suppliers. Presentations and updates to the local textile industry and cotton related information and services were delivered to more than 80 Chinese brands and retailers.

Cotton Incorporated sponsored the 2019 China Textile Innovation Conference held in Beijing, China. More than 1,000 participants from government associations and textile companies attended the event. As a part of the sponsorship, Cotton Incorporated was featured in event marketing materials and presented during the conference.
Additional participation in industry events included:

- Staff recruited brands and retailers to attend the Cotton USA Sourcing Fair in Mexico.
- Staff attended the 2019 International Textile Congress in Belo Horizonte, Brazil.
- Staff presented at a sustainability workshop organized by Shanghai Mart in Shanghai, China. A presentation was delivered to a group of attendees from brands, manufacturers, and independent design studios at Shanghai Mart.
- Staff attended and presented at Cotton Council International's Cotton Day Events in Indonesia, Thailand, and Bangladesh.
- Staff attended and presented at the Ningbo Garment Association Annual Meeting in Ningbo, China.
- Staff served on a panel of judges for the China International Fabric Design Competition in Beijing, China. The panel judged fabric submissions from leading Chinese manufacturers and conducted several interviews with leading trade media.
- Staff attended 2019 SpinEXPO in Shanghai, China, which consisted of 260 exhibitors and more than 10,000 visitors.
- Staff attended Hong Kong Fashion Week, Spring/Summer in Hong Kong.
- Staff attended Centrestage 2019 in Hong Kong. In conjunction with the event, the 9th Hong Kong Knitwear Designers Contest and Hong Kong Young Fashion Designers’ Contest were organized. This event was a platform for Asian fashion designers to promote and launch their collections to global buyers.
- Staff attended the 19th CBME Show in Shanghai, China. It was one of the world’s largest trade fairs for child, baby, and maternity apparel, products, and services.
- Staff attended a technical seminar organized by Japan Textile Finishers Association in Osaka, Japan.
- Staff attended CosmoProf Asia in Hong Kong. The show featured 3,000 exhibitors and attracted more than 265,000 attendees.
- Staff attended the Spring/Summer 2020 Denim Fashion Show in Beijing, China. The event was held in conjunction with Beijing International Fashion Week.
- Staff presented and provided training on cotton technologies to a group of key personnel at the headquarters of Anta Sports Products Ltd. in Shanghai, China. Staff from planning, design, training, branding, and merchandising attended the session.
- Staff managed a joint booth with CCI at Intertextile Shanghai Autumn Edition in Shanghai, China.

In its sixth year, the Cotton LEADS℠ program continues to educate and inform retailers, brands, and manufacturers about responsible U.S. cotton production. Cotton Incorporated participates in this program with the National Cotton Council of America, the Cotton Foundation, Cotton Australia, and Cotton Council International. The program reached 592 partners.

Mexico City staff added five Cotton LEADS℠ members and also supported two members, one Peruvian, one Mexican, to design and launch their respective Business to Business (B2B) Cotton LEADS℠ membership campaigns by labeling their eco-line products made with U.S. cotton.

The GSCM division is responsible for coordinating messaging to the trade. In 2019, consistent messaging and imagery was implemented throughout, including tradeshows, tradeshow promotional items and outlets, and other publications. In addition, new messaging was created for 2019 placement to highlight “the circular economy” and combination technologies. Trade advertisements were placed in industry publications, in print and digitally. A new campaign highlighting the improvements in sustainability, innovation, and technology was developed for the 2020 year.

**Strategic Objective 2: Develop and facilitate the adoption of product and technology ideas.**

The GSCM team continued to work with the Product Development & Implementation Division to develop and promote fabrics with dual technologies. The combinations of TransDRY® and TOUGH COTTON™ technologies provide moisture wicking and
durability benefits, while STORM COTTON™ and TOUGH COTTON™ technologies provide water repellency with added durability. These technology combinations offer multiple benefits for cotton to compete with and displace synthetics.

Marketing support was provided to one of the largest underwear brands in China at their initial launch of cotton blended socks. More than 100,000 hangtags carrying the Cotton LEADS™ trademark were supplied and products were distributed on many online shopping websites, including Taobao and Amazon.

The Seal of Cotton trademark initiative in Latin America added another two new licensees during the second half of 2019, while a large feminine hygiene company produced and broadcast a TV commercial displaying the logo reaching millions of consumers in Colombia since August.

Additional trademark adoptions included:

- A U.S.-based retailer was licensed to use the Seal of Cotton trademark on 100% cotton bed sheets.
- A U.S.-based retailer was licensed to use the Seal of Cotton trademark on 100% cotton blankets.
- A U.S.-based brand was licensed to use the Seal of Cotton trademark on 100% cotton quilts.
- A U.S.-based brand was licensed to use the Seal of Cotton trademark on 100% cotton towels.
- A U.S.-based brand was licensed to use the Seal of Cotton trademark on 100% cotton tee shirts.
- A U.S.-based online retailer was licensed to use the Seal of Cotton trademark on 100% cotton socks.
- A U.S.-based online retailer was licensed to use the Seal of Cotton trademark on 100% cotton ladies’ tanks and underwear.
- A U.K. nonwoven brand launched organic cotton tampons carrying the natural™ trademark. Products were distributed in Hong Kong and South Africa.
- A South Korean brand launched cotton panty liners and cotton tampons carrying the natural™ trademark. The top sheet of the panty liners was made of 100% cotton and the absorber of the tampons used 100% cotton. Products were distributed in the South Korean market.
- An Indonesian nonwoven brand launched cotton glove wipes carrying the cotton enhanced™ trademark. The product contains 15% cotton and is used in hospitals in Indonesia and Singapore.
- The Thai licensee of a U.S. denim brand released 8,000 pieces of cotton garments carrying the Cotton LEADS™ trademark. The products included jeans and tee shirts and were on sale in stores in Thailand.

Mexico City staff continue to support Latin American mills to develop and supply cotton products featuring technologies such as TransDRY® (Peru and Honduras), WICKING WINDOWS™ (Mexico), STORM COTTON™ (Mexico), and TOUGH COTTON™ (Honduras, Guatemala, and Mexico). At the retail level, the largest apparel department store in Mexico has initiated the production of a sport line using the WICKING WINDOWS™ technology that will be launched in early 2020, while the fastest growing Mexican mass merchant has initiated the adoption of the TOUGH COTTON™ technology for a leggings program for 2020.

Commercialization of cotton technologies also included:

- A leading U.S.-based denim brand expanded the TransDRY® technology worldwide. Products are offered in retail stores and on their website.
- A major U.S.-based sport performance brand has treated men’s bottoms with WICKING WINDOWS™ technology.
- The STORM COTTON™ technology continues to expand in knit and woven outerwear for men and women featuring the technology in a comprehensive marketing campaign with a leading U.S.-based lifestyle brand.
- The STORM COTTON™ technology has been featured on jackets, pants, shorts, and hats with a U.S.-based skate brand.
- An upscale U.S.-based women’s brand is now offering TransDRY® technology on their polo tops.
• A major U.S.-based golf brand is featuring SWEAT HIDING™ technology on their 100% cotton golf shirt in the men’s market.

• A Hong Kong-based knit fabric mill supplied STORM COTTON™ technology knit fabric to the Thai licensee of a U.S. denim and apparel brand. A total of five styles of tee shirts and sweatshirts, carrying the STORM COTTON™ technology trademark, were launched in the Thai market through e-commerce channels.

• A Japanese trader worked with a Thai fabric manufacturer to develop TOUGH COTTON™ technology without resin for a Japanese athletic wear brand. The products will be distributed in the Japanese markets.

• Another Japanese trader had worked with a Chinese garment manufacturer for three seasons to develop 20,000 pieces of TransDRY® technology casualwear for ladies for the Japanese market.

• A leading U.S. apparel brand placed an order for 1,200 yards of cotton blister fabric with a mill in Hong Kong. The fabric will be for cotton jackets for distribution in the U.S. market.

• A leading U.S. apparel brand placed a bulk order of 150,000 yards of TOUGH COTTON™ technology knit fabric for kids’ leggings for the U.S. markets. Fabric was supplied by a Hong Kong fabric mill with production based in China.

• A leading U.S. lifestyle brand developed 2,500 handbags with STORM COTTON™ technology. Fabric was supplied by several Chinese fabric mills and products were distributed in the U.S. market. The same brand worked with another leading Chinese textile company to develop 2,000 yards of TOUGH COTTON™ technology woven fabric for handbags to be distributed in the U.S.

• A U.S. apparel brand worked with a Chinese textile company to develop 135 tons of STORM COTTON™ technology knitted fabrics. Approximately 20,000 pieces of STORM COTTON™ technology hooded fleece jackets were marketed in the U.S. for Fall/Winter 2019 and another 20,000 are set to be released for Spring/Summer 2020.

• A Chinese textile company developed 3,000 pieces of STORM COTTON™ technology hooded fleece jackets for one of the largest retailers in Russia. Products were distributed in Russia.

• A leading Chinese textile company worked with a U.S. retailer to develop 20 tons of STORM COTTON™ technology knitted fabric. An estimated 20,000 hoodies were marketed in the U.S. during Fall/Winter 2019.

• A U.S. menswear brand worked with a Chinese textile company to develop nine tons of TransDRY® technology knit fabric; 36,000 pieces of cotton tee shirts were produced for the U.S. market.

• A leading Hong Kong textile company with a production base in China developed WICKING WINDOWS™ technology fabrics for the Chinese licensee of a U.S. apparel brand; 29,000 pieces of WICKING WINDOWS™ technology tee shirts were put on sale in the Chinese markets.

• A Chinese printing company applied WICKING WINDOWS™ technology to knit fabrics for one of the largest underwear companies in China; 500,000 pieces of WICKING WINDOWS™ technology undergarments for men and women were available in the Chinese markets.

• A leading U.S.-based outdoor apparel brand commercialized 6,000 pieces of STORM COTTON™ technology woven men’s bottoms for the Asia Pacific market for Fall/Winter 2019. Fabric was sourced from a licensed technology supplier in Taiwan.

• A Swedish men’s apparel brand made a bulk order of 1,050 pieces of STORM COTTON™ technology jackets for the European market for Holiday Season 2019 and Spring/Summer 2020. Fabric was sourced from a Chinese mill and produced through a garment mill in China.

• One of the world’s largest shirting fabric suppliers successfully adopted PUREPRESS™ technology shirting fabric for a U.S. apparel company. An order of 16,000 yards of PUREPRESS™ technology fabric was placed for men’s shirting. This is the first commercial adoption of PUREPRESS™ technology.

• A Hong Kong-based garment manufacturer, with a production base in Bangladesh, had worked under the initiative of an online shopping company to produce an estimated 100,000 pieces of STORM COTTON™ technology woven bottoms. Fabrics were supplied by a Hong Kong-based woven fabric mill.
A Japanese fabric and garment supplier worked through different channels to develop products for the Japanese market. The supplier supplied both fabric and garments for the following developments:

- 20,000 pieces of TransDRY® tee shirts for a casualwear retailer in Japan.
- 10,000 pieces of TransDRY® tee shirts for a Japanese casual apparel brand.
- 9,300 pieces of TOUGH COTTON™ technology without resin kids’ leggings. The products would carry the TOUGH COTTON™ trademark and be marketed under a retail channel under the specialty store group.
- 93,000 pieces of TOUGH COTTON™ technology without resin half pants, culottes, and capri pants for women for the top mass merchant in Japan.

Several brands and retailers that have adopted multiple cotton technologies in 2019 have expanded the product offering into other categories. A significant U.S. online retailer is continuing their STORM COTTON™ and STORM DENIM™ technologies for men’s and women’s apparel. Several competing retailers have adopted the TOUGH COTTON™ technology on girls’ leggings. A large children’s brand has adopted TransDRY® technology on a cloth diaper that will be sold through multiple large retail stores and online. A women’s sportwear brand has adopted the TransDRY® technology on a performance tank top. An online retailer has adopted TransDRY® technology on ladies’ performance underwear.

Adoptions of cotton technologies included:

- A well-known U.S.-based fabric supplier launched the TOUGH COTTON™ technology on woven goods.
- A high-end U.S.-based brand/retailer launched the TOUGH COTTON™ technology on girls’ leggings.
- A men’s on-line retailer of upmarket basic clothing developed TransDRY® 100% cotton polos and tees poised to launch in early 2020.
- PUREPRESS™ technology trial work continued on bottom weight fabrications for a well-known apparel company. PUREPRESS™ technology trials on shirting fabrications were successfully conducted for a major brand.
- A famous designer name brand featured the STORM COTTON™ technology in 100% cotton sweater styles and continued the success by launching a STORM COTTON™ technology pant the following season.
- Two iconic brands feature the TOUGH COTTON™ technology in wrinkle resistant boys’ school uniform pants sold at mass retailers.
- A men’s workwear brand continued their STORM COTTON™ for fleece technology program in multiple styles including sweatshirts, pants, jackets, and robes.
- A Bangladeshi woven mill successfully adopted STORM COTTON™ (C6) technology on three different constructions of cotton and cotton/spandex fabrics. The fabrics will be presented to their U.S. customers.
- A Hong Kong mill successfully adopted STORM COTTON™ technology for hoodies for a U.S. clothing brand. They are awaiting confirmation for a bulk order.
- A Japanese trading company with a sourcing office in Hong Kong coordinated the adoption of PUREPRESS™ technology for a European men’s apparel brand. Development was done by a Chinese woven fabric supplier and a Hong Kong garment manufacturer.
- A leading Chinese denim fabric supplier developed TransDRY® technology denim fabric for a U.S. denim brand. Yarn treatment was done by their partnering mill in China.
- A Chinese manufacturer worked to develop WICKING WINDOWS™ technology fabrics to support development work requested by a European menswear brand.
- A large scale knit fabric licensed supplier in China successfully developed TOUGH COTTON™ technology without resin for a U.S.-based apparel company.
- A Hong Kong based sourcing company worked with a knit fabric supplier in China to develop TransDRY® technology fabric for distribution in the U.S. market.
- A leading U.S. casual apparel brand worked with a Chinese knit fabric supplier and a yarn dye manufacturer to develop TransDRY® cotton tees for the Australian and New Zealand markets.
• A leading U.S. casual wear brand worked with two Chinese woven fabric suppliers to develop STORM COTTON™ technology. The same brand worked with a sourcing company to develop TOUGH COTTON™ technology woven fabric for kids' pants.

• A leading Chinese textile company successfully developed SWEAT HIDING™ technology for knits which will be marketed to their Chinese brand customers.

• A leading textile company in China developed WICKING WINDOWS™ technology knit fabrics which will be marketed to their European Union (E.U.) customers.

• A leading denim company in China successfully developed TransDRY® technology denim fabrics for a denim apparel brand. Products will be distributed in Asia.

• A leading U.S. denim brand worked with a denim mill in China to develop TransDRY® technology denim fabrics for their U.S. and global markets.

• A U.S. based apparel brand sourced through a Hong Kong sourcing company to apply WICKING WINDOWS™ technology to knit fabrics. They worked with a knit fabric and garment supplier in China to develop cotton jersey tee shirts with the WICKING WINDOWS™ technology.

• A Taiwanese fabric supplier developed TransDRY® technology for a U.K. brand. The fabric supplier has been listed as a licensed TransDRY® technology supplier.

• A knit fabric mill in Hong Kong successfully developed TOUGH COTTON™ technology fabrics for a U.S. apparel company. Development included solid, printed, and foil printed fabrics for their children’s wear.

• Inspired by FABRICAST™ product developments, a knit manufacturer in Hong Kong successfully developed cotton/wool fleece.

• A leading textile company in Hong Kong with production facilities in China developed TOUGH COTTON™ products for a U.S. clothing brand.

• A leading Chinese textile company developed STORM COTTON™ technology for a U.S. company that designs, manufactures, and markets apparel lines. Products are for distribution in the U.S.

• A large shirting fabric supplier in China developed PUREPRESS™ technology shirting fabrics for a major British multinational retailer.

• A Japanese trading company worked with a vertical mill in Taiwan to develop TransDRY® technology yarns and fabrics for a U.S. outdoor recreation company.

Technical marketing and technical assistance continue to be essential for helping companies bring cotton products to market, several important activities were carried out to provide this type of technical assistance for marketing cotton:

• Staff assisted a U.S. brand/retailer implementing the TransDRY® technology on 100% cotton apparel and provided over 600,00 hangtags for these products.

• Staff assisted several U.S. brands using the STORM COTTON™ technology on fleece hoodies.

• Staff assisted a major U.S. brand using the STORM COTTON™ technology on woven jackets which also included CORDURA®.

• Staff provided technical support to a fabric manufacturer in Taiwan who worked under the initiative of a U.S. workwear brand to adopt TOUGH COTTON™ technology without resin.

• Staff provided technical information on cationic treatment and dyeing to two fabric manufacturers in Taiwan.

• Staff provided technical assistance to a Thai knitting mill on their adoption of Phase Change + WICKING WINDOWS™ technology. They were approached by a Thai denim brand for product upgrades to their existing WICKING WINDOWS™ technology collection.

• Staff provided technical assistance to a Thai knitting mill working under their Japanese customers’ request to develop TOUGH COTTON™ technology without resin fabrics for the coming season.
• Staff provided technical support to a fabric mill in Hong Kong that provided washed samples of WICKING WINDOWS™ technology samples for evaluation. Fabric was developed at the request of a U.S. clothing brand.

• Staff provided technical assistance to a Chinese woven fabric manufacturer to develop PUREPRESS™ technology for a U.S. clothing brand.

• Staff provided technical assistance to a Japanese fabric manufacturer in adopting TOUGH COTTON™ technology without resin for cotton workwear.

• Product technical information was given to one of the largest Japanese casualwear brands that distribute to the global market. Concept, mechanism, test methods, and cotton content on TransDRY® technology were explained.

• Staff provided technical information on STORM COTTON™ technology to a Thai fabric manufacturer working under the initiative of a Japanese chemical company. Technology was adopted on two knitted fabrics for a Japanese clothing retail company.

• Staff assisted a Thai fabric manufacturer in adopting TransDRY® technology on knitted fabrics for a Japanese clothing brand.

• Staff provided technical assistance to a Thai yarn manufacturer to develop TransDRY® technology knitted fabrics for a British brand.

• Staff provided technical information to a Thai fabric manufacturer on STORM COTTON™, TOUGH COTTON™, and TransDRY® technologies. They were interested in adopting the technologies for a Japanese clothing brand.

• Staff assisted a Bangladeshi fabric manufacturer on development of STORM COTTON™ technology with nonfluorine chemistry. Additional trial work will be conducted at their partner mill in Thailand.

• Staff assisted a Taiwanese TransDRY® technology yarn supplier to conduct trials to confirm the performance of XF-5005 supplied by a chemical company. The trials were successful.

• Staff provided STORM COTTON™ technology technical information to a Korean fabric supplier for development of woven fabric for a U.S. luggage and handbag brand.

• Staff provided technical information to a licensed TOUGH COTTON™ technology supplier on the concept of TOUGH COTTON™ technology without resin and how to proceed with the trials for development of socks.

• Staff provided technical assistance to a Taiwanese woven fabric supplier during the adoption trials for PUREPRESS™ and TOUGH COTTON™ technologies. The sales teams were provided technical information on the technologies so that they can better market the products.

• Staff provided technical assistance to a Hong Kong knitting mill to develop TransDRY® technology for a U.S. workwear brand. They also intend to market the technology to their other customers. STORM COTTON™ for fleece technology was also reviewed with this mill.

• Staff provided technical information to a garment factory in Sri Lanka on the application of STORM COTTON™ technology on woven pants. A leading U.S. casual wear brand requested for application of STORM COTTON™ technology in garment form.

• The same U.S. brand requested an Indian vertical mill to apply STORM COTTON™ technology at the fabric stage.

• Staff provided technical assistance to a Thai knit fabric mill to develop STORM COTTON™ technology on various fabrications, including, jersey, terry, and spacer. Development was at the request of their Japanese customer.

• A knitter and trader in Japan that successfully developed and commercialized TransDRY® technology in 2014 intends to promote TransDRY® technology knits to their customers again. Technical assistance was provided to assist in the development of a new TransDRY® yarn and fabric wet processing through a Chinese mill.

• Staff provided technical assistance to a major mill in Japan during their development of TOUGH COTTON™ technology without resin on woven fabrics.

• Staff provided technical assistance to a knitter and dyer in Bangladesh at the request of a Japanese fabric and garment supplier on the development of TOUGH COTTON™ technology without resin.
• Staff provided technical information to a Japanese fabric trader on TransDRY® technology for casual socks. They were seeking to improve color retention and reduce pilling performance.

The GSCM team also continued to focus on the digital supply chain initiative. GSCM and Product Development staff met with six hired consultants, six faculty at four different universities, interviewed 25 companies, and communicated with 12 technology suppliers to understand the technologies and the digital sourcing landscape. GSCM sees opportunity to use CottonWorks™ as a digital platform that can be implemented into existing product supply chains.

Nonwovens Marketing
Market trends remained favorable to using cotton. Sustainability is a way of life for companies. The E.U.’s Single Use Plastics Directive published a list of the first ten target products and wipes are on the list. Although it will take time for all countries in the E.U. to ratify this directive and put forth a plan to comply, major producers and brands of wipes and other single-use products including diapers and feminine hygiene products are already moving to determine compliance strategies for their businesses. Cotton is front and center at all industry events, keeping GSCM staff extremely busy working with companies around the globe. This trend will continue into the future as companies move away from petroleum based raw materials. Polymers made from agricultural raw materials such as polylactic acid are under pressure to prove biodegradability. Viscose and lyocell fall within the E.U. Single Plastics Directive definition of synthetic material.

Market Development and Trademark Licensing
The GSCM Nonwovens Marketing team continued to work closely with an important global baby product company as their cotton branded baby care line was launched in new markets. The most important expansion in 2019 was in China. The China brand team elected to go to market with six products: wash/shampoo, baby body lotion, baby cream, baby facial lotion, baby oil, and baby facial cleansing water. They also rebranded their 100% cotton baby pads and positioned them alongside the cleansing water. All of the lotions, creams, and washes contain cotton powder. The oil contains cottonseed oil. The boxes for the baby facial lotion, baby cream, and baby cotton pads bear the Seal of Cotton trademark. Cotton is the centerpiece of the Chinese marketing campaign.

Other global consumer product brands also brought new cotton products to market. Cotton feminine hygiene product lines were marketed by three of the largest global players. Brands were rolled out in Europe, North America, Korea, and Mexico.

The GSCM Nonwovens Marketing team successfully completed new license agreements in the following countries: Belgium, Canada, China, Colombia, France, Germany, Indonesia, Korea, Spain, South Africa, Switzerland, Ukraine, United Arab Emirates, UK, and the U.S. The product markets included: nonwoven roll goods; feminine hygiene tampons, pads and liners; wipes and skin care masks; air filtration masks; baby diapers; and adult care pads. Trademarks included: Seal of Cotton, natural™, cotton enhanced™ and Cotton LEADS™. Product markets expanding the use of cotton in the second half of 2019 included, global nonwovens roll goods, feminine hygiene, wipes, baby care, skin care, air filtration masks, baby diapers, adult care pads, and hospital cleansing gloves.

Technical Development
The innovations team continued work to increase cotton content in additive manufacturing and injection molding. Golf tees injection molded with 25% cotton were produced. Development of apparel hangers injection molded with cotton in South America for a global outdoor apparel brand continues but has not yet been completed. Pilot trials with 30% cotton ran successfully but fell short when tested for strength and resistance to breaking. Development work will continue.

In conjunction with an important university with world class expertise and labs, two projects were initiated and completed in the Fall of 2019. One was directed at solving a clumping problem with cotton fibers in wet laying. The other was designed to prove the case for cotton in co-form technology now that the patent held by a global consumer products company has expired.

Marketing Communications
This group continued to be actively involved in several aspects of marketing communications. Trade advertising, print and digital, continues to be an important and effective platform for promoting cotton across industries and around the world. This work opens doors for input into feature articles which, in the second half of the year included sustainability, natural products, the E.U. Single Use Products Directive, and market segments. A new advertising program for 2020 was developed, which will include ads that cut across all markets as well as those specifically targeted for the global nonwoven products industry.
In addition, a brochure was developed about research into aquatic degradation. On the CottonWorks™ website, six lectures were updated, and two new lectures were developed.

In support of the industry and our need to continue developing market contacts and influence, this group participated in four industry committees, chaired one conference and set up a speaker from Cotton Incorporated to present about aquatic degradation at one conference and a researcher involved in this work to speak at another in the fall. Cotton information and new products from around the world were featured at tabletop displays at two conferences. Also, in the fall, the aquatic degradation research was presented to two major international consumer brand companies that are working to better understand the fate of their raw materials and products. The global baby care research was presented to another three companies with global baby care product lines.

**Fashion Marketing**

During the summer of 2019, Fashion Marketing (FM) staff worked on the production of the Spring/Summer 2021 season. While finishing production for the Spring/Summer 2021 season, FM staff was also starting production for Fall/Winter 2021/2022. In July, the Denim 2020/2021 presentation was taken to Asia along with the Active 2021/2022 presentation. Both the Denim and Active presentations made their rounds throughout the U.S. and Latin America in the second half of 2019.

The Seasonal Spring/Summer 2021 presentation was taken across the United States, Latin America, and Asia. Also, the presentations have been seen in various cities in Mexico, Colombia, China, Hong Kong, Korea, Japan, and Thailand, as well as dozens of cities across the U.S.

There were an additional 12 installments of the City Views Blog for the second half of the year. These blog installments covered research and trend ideas from: Buenos Aires, Sao Paulo, Lisbon, Berlin, Milan, Copenhagen, Bangkok, Tokyo, and local and world recognized areas such as Williamsburg, New York Fashion Week, the Meat Packing District, and Cobble Hill Brooklyn.

FM staff did research both locally and abroad in Brazil, Argentina, Uruguay, Holland, Iceland, New York, and Los Angeles.

**Strategic Objective 3: Conduct technical education and training to support cotton use.**

The GSCM division manages the Importer Support Program (ISP), which provides programs that meet the mission of Cotton Incorporated and specifically benefit the importer segment of the supply chain. The CottonWorks™ platform is the main marketing platform of the Global Supply Chain Division and is supported by the ISP program. The CottonWorks™ platform includes technical education workshops, webinars, education for emerging professionals, events such as the farm tours, and numerous other activities to increase and support the use of cotton in products.

Forty-four technical education workshops were held in 2019 with over 1,271 attendees. These individuals were from 128 major brands and retailers. The purpose of these workshops was to provide detailed technical information and training on relevant topics important for cotton. The table below summarizes the information for those workshops.

<table>
<thead>
<tr>
<th>Workshop (Topic)</th>
<th>Workshop (Location)</th>
<th>#of Companies</th>
<th>#of Attendees</th>
<th>Overall Program Rating</th>
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The CottonWorks™ website is a marketing tool and educational resource (www.cottonworks.com). It is the leading innovative education and information resource for current and emerging textile industry professionals who are actively seeking connections to cotton. New content, both educational and marketing, continues to be added on a regular basis. In 2019, two new nonwovens courses were added and new content on cotton biodegradability was also added. Additionally, cotton fabrics from Cotton Incorporated’s FABRICAST™ collection were digitized and added to the updated FABRICAST™ collection page, bringing the total number of digitally searchable fabrics to 1,027, and two new brochures were added: microfiber biodegradability in aquatic environments and NATURAL STRETCH™ technology. Staff also implemented a new resource on the site to learn more about cotton production terms. In 2019, there were 32,108 registered users, 183,479 sessions, and 1,028,067 page views.

CottonWorks™ webinars offer a unique way to reach the industry and amplify the Company’s message. In 2019, four webinars were held. Turning the Tides: Tackling Our Ocean’s Plastic Pollution Problem included presentations on plastic pollution for the Plastic Leak Project and the latest research on microfiber degradation in aquatic environments. The webinar reached more than 326 unique participants. Over 700 individuals from more than 350 companies registered for the event. Equally as popular was a webinar on the tariff dispute with China, with 850 people from 397 organizations registering, and 404 people attending live. Webinars are one of the most successful methods to share information with a large number of industry professionals from the global cotton industry.

In 2019, the “Cotton in the Curriculum” university education program was executed. This program includes two elements. The first is a grant program to increase cotton in the curriculum among universities nationwide. In 2019, 15 universities received grants. The second is a program to further educate professors teaching sustainability at leading textile programs, “Educate the Educators.” The three-day “Educate the Educators” event was held at Cotton Incorporated’s headquarters. Twenty-one professors learned the facts about cotton sustainability in a classroom setting and during a farm visit.

In October, staff hosted the Cotton Farm Tours. This event hosted 73 attendees on U.S. cotton farms in Marianna, AR. Attendees learned about U.S. cotton production as well as the tools and technologies that U.S. growers use to grow cotton more sustainably. The tour ended with a visit to the USDA classing office to learn how cotton is graded and classed.
CONSUMER MARKETING COMMITTEE

ADVERTISING, PUBLIC RELATIONS, STRATEGIC ALLIANCES, AND CORPORATE STRATEGY & PROGRAM METRICS

Strategic Objective: Use advertising, public relations, and strategic alliances to build consumer demand and trade awareness for cotton and cotton products as well as use market intelligence to assess opportunities and threats for cotton, influence corporate strategy efforts, and leverage program metrics to evaluate and improve tactics for fulfilling Cotton Incorporated’s mission.

Advertising
For the full year of 2019, Cotton Incorporated TV commercials were seen by 73% of women 18-49, 11.1 times. They were also seen by 66% of men 18-49, 7.7 times and 78% of all adults 18+, 10.6 times.

Television
A total of 5,107 television exposures appeared across broadcast networks such as ABC, The CW, and FOX in addition to 11 cable networks (BET, Bravo, CMT, E!, Freeform, Food Network, HGTB, MTV, TBS, TLC, and VH1). Units were scheduled during popular primetime programming such as The Masked Singer, Greys Anatomy, Dancing with the Stars, Empire, American Music Awards, Riverdale, The Good Doctor, Siren Finale, Chopped, Keeping up with the Kardashians, Property Brothers: Forever Home, Fixer Upper; and Diners, Drive-Ins and Dives.

The commercials also ran on Roku, an over-the-top (OTT) streaming service, in order to reach the younger, light-TV viewers, and those who do not have traditional cable subscriptions. The video buy delivered an additional 7.3MM+ impressions to women 18-34.

Digital Media
The Life is Uncomfortable digital campaign launched in April. At the onset, the campaign continued to promote the four previously used 15-second video assets Tattoo, First Day, Meme, and Anchor, distributing them through video network partners on desktop, mobile, and tablet, to build awareness and increase the emotional connection to the brand. New health and wellness videos were introduced in July to promote the health benefits of cotton sheets/bedding and underwear. The health and wellness videos ran across Hulu, EMX, Aki, and other partners. On Tremor, we continued to use a two-pronged video strategy to extend campaign messaging when Cotton Incorporated was on- and off-air with television advertising. The campaign garnered over 36.9MM video plays through November and had an average completion rate of 91% year-to-date (YTD). Additionally, the campaign drove traffic to TheFabricOfOurLives.com website.

Campaign promotion included HTML5 banner advertising on ad networks such as Undertone, Aki, and EMX Digital and in-banner rich media creatives, which were developed this year and launched in August/September. The rich media banners promoted the cotton connection to denim and sustainability by prompting users to take a quiz. The banner portion of the campaign garnered over 349MM impressions YTD. The campaign also utilized an audio partner, Spotify, to tap into an audience that is always tuned in and looking to connect during all moments of their day. Spotify alone generated 33MM impressions.

Cotton Incorporated teamed up with UrbanDaddy and Bustle, two top lifestyle sites with high reach against the desired target audience, to co-create the Check the Label Project. The Check the Label Project is a branded destination (microsite) where consumers can learn more about topics around sustainability, health and wellness, and lifestyle (denim) content. The destination encourages consumers to check the ingredients of the goods they buy so that they are more aware of what they put on their bodies. A mix of banner media, social, and email promotions were used to drive traffic to the destination. UrbanDaddy’s website also featured a custom navigation bar integrated into its homepage in the month of October. This homepage-feature alone drove nearly 2K users to the Check the Label Project microsite.

The site is currently live with more than 22+ articles developed on behalf of Cotton Incorporated. The articles cover a range of content themes from editor picks, such as style items to beauty and athleisure content. Since implementation, over 732K pageviews have been consumed. The interactive content on the site captured the highest amount of these pageviews with the Bustle Flowchart Which Denim Style Should You Try Next accounting for 67K pageviews. The average scroll depth is 79%, which means that the content is engaging enough for consumers to scroll down to view more content.
Cotton Equals Denim – Video Distribution Campaign

The digital efforts supported the Cotton Equals Denim campaign from October through the end of November. The objective of the campaign was to clearly link denim to cotton and establish cotton’s role as the fabric of our lives and times. It served a 30-second video targeted to ages 18-34, heavily skewed toward the female audience (80% women vs. 20% men). The success was measured based on video completions, specifically looking at a video completion rate of 85% or higher.

From a digital perspective, multiple partners were used to promote the video asset, including Hulu, VideoAmp, Tremor Media; and YouTube through Bustle and Zefr. The campaign contextually targeted relevant content areas including but not limited to denim trends, history of denim, women empowerment, etc. By the end of the campaign, it delivered more than 21MM video plays and 17MM video completions, yielding a strong video completion rate of 80%. In addition to the high completion rate, users exposed were also clicking through to the site to learn more. The campaign garnered a click-through-rate (CTR) 95% higher than benchmarks, driving 80K visits to TheFabricOfOurLives.com website.

Strategic Alliances Campaign

The Strategic Alliances Department continued their collaboration with Amazon this year to drive awareness and increase sales of cotton products. As part of the program, Amazon revamped the existing custom webpage: Amazon.com/ShopCotton, to feature new looks and re-categorize the selections by lifestyle categories. There were four key categories: Jetsetter, Show Stopper, Wellness Warrior, and On-The-Go Getter.

From a media perspective, the objective was to get qualified users exposed to the program, display banners, and drive them to the custom cotton shop for further brand engagement. The media campaign started in July in anticipation of Prime Day and concluded in August. The promotional activity ran across two digital channels – display and social. During the two months’ time, the campaign delivered 124.8MM impressions.

- Basing it on the historical learnings, the digital campaign prioritized mobile as a channel by adding in a mobile only vendor (Aki) as the second partner on the plan, in addition to Amazon. The campaign was targeted by behavioral segments to mirror the four lifestyle categories. For example, behavioral data from Amazon’s database was applied to target users who have bought or are in-market for fashion apparel. Retargeting data was used to re-engage with those who made it to the shop but did not end up making a purchase. The display banners ran on and outside of Amazon, extending the reach of the campaign to mobile only networks like Aki. The display campaign generated 91MM impressions resulting in a very strong CTR, 66% higher than the 2018 campaign.

- The social campaign featured event imagery and video and garnered over 33MM impressions and drove over 372K link clicks to Cotton Incorporated’s collection on Amazon.com.

Paid Search Engine Marketing (SEM)

Paid search advertising on Google and Bing continued to drive qualified visitors to TheFabricOfOurLives.com website, resulting in over 800K clicks to the site. Of these clicks, 393K landed on the Shop Cotton section, resulting in over 150K clicks on cotton-rich products to the respective retailers’ e-commerce websites. The top-performing paid search campaign was consistently “cotton care”; helping consumers with cleaning and care tips.

New tactics in 2019, including Gmail, MSAN, and YouTube, contributed to 193K clicks and 431K video views; increasing awareness for the brand. In addition to TheFabricOfOurLives.com website, the BlueJeansGoGreen.org and CottonToday.com websites accumulated 17K and 15K clicks respectively.

Social Media

Paid and organic social media was used to reach and engage with users across Facebook, Instagram, Twitter, Pinterest, and Reddit. Messaging included Cotton Incorporated program promotions (Blue Jeans Go Green™ denim recycling program, Amazon retail program), and fashion and lifestyle content (including benefits of cotton, cotton’s effects on health & wellness, claiming denim as a hero item, and promoting female farmers) as well as cotton sustainability.

In 2019, Cotton Incorporated produced the following campaigns:

- Cotton’s Blue Jeans Go Green™ denim recycling program on Facebook and Instagram. The campaign was optimized towards reaching as many unique people as possible over 17MM unique people with 118.7MM impressions. It drove over 35K clicks to BlueJeansGoGreen.org website to learn more.
Know Your Clothes was a video campaign promoted on Facebook, Instagram, and Twitter. It served over 31MM impressions to users who contributed to 7.6MM video views and 1.1MM completed views.

Health & Wellness was a video campaign that ran on Facebook, Instagram, Twitter, and Reddit promoting the benefits of cotton as it relates to health and wellness. It received over 107MM impressions, 15.4MM video views, and 4.1MM completed views.

Denim was a video campaign on Facebook, Instagram, and Pinterest that aimed to make the connection of denim to cotton, as most consumers were unaware of that. In total, the campaign had over 85MM impressions, 18.6MM video views, and over 6.4MM completed views.

Female Farmers ran until the end of the year. It garnered 10.4MM impressions, 953K video views, and 92K completed views. The creative has also driven over 110K clicks to a Facebook Instant experience which contains additional creative about the female farmers.

LinkedIn
  o Sponsored Content Traffic Campaign – drove users to Cotton Incorporated’s trade sites to learn more about cotton. It received over 8K clicks to sites this year and 481,301 video views.
  o Lead Generation Campaign – encouraged users to download Cotton Incorporated’s sales packet promoting retail partnerships throughout the years to potentially foster new partnerships. So far, the campaign has 514 leads.

TheFabricOfOurLives.com
Overall organic traffic grew 11% in January to November 2019 year-over-year, while page one keyword rankings grew 84% from 205 in January 2019 to 377 in November 2019. Much of this growth was assisted by page level optimizations and keyword targeting, which helped improve visibility for types of cotton pages, cotton care and stain removal tips, and more. Other recommendations were provided for YouTube, content creation, and blog content.

Search Engine Optimization (SEO) provided point-of-views and best practices for things like image tagging to assist with on-site optimization. Lastly, site migration has been a major focus for the organic team in the fourth quarter as they helped consult URL mapping and structure for efficient and smooth site migration. SEO will continue to assist in the post-site migration process consultation and quality assurance measures.

Production was completed on the following projects in 2019:

• Health and wellness campaign for digital and social media. The campaign consisted of three 15-second videos: Skin Irritation (hypoallergenic), Underwear (helps prevent yeast infections), and Sheets (better night’s sleep), along with nine social-specific assets, which were on video pre-roll, social media, and Hulu.

• Know Your Clothes social media campaign. The campaign consisted of three videos of varying lengths promoting cotton's natural origins and competitive advantages, all while reminding consumers to “know their clothes.”

• Several photoshoots that generated over 25 images to be used on Cotton Incorporated’s social media pages, websites, and banner ads. Using the images on Instagram allowed Cotton Incorporated to “own the feed” with original photography. The imagery created a clear brand voice and aesthetic, which is artful and purposeful, often highlighting cotton products and benefits, as well as the cotton plant, in interesting ways.

• Digital banner ads that served messages around health and wellness and denim. Over 40 unique banners were created, targeting women and men 18-34 online. Production also was completed on two interactive banner experiences that contained quizzes for consumers to test their knowledge on fibers’ origins and denim facts, both drove to TheFabricOfOurLives.com website to learn more.

• New trade assets, including a new Blue Jeans Go Green™ print ad; redesigned cottonseed digital banners and the development of a nutritionist-specific cottonseed banner; and ad resizes and translations for the China market.

• Two research projects: 1) an image and linguistics test related to cotton fields/plant imagery and social copy; 2) quantitative and qualitative Gen Z research to look at their motivations/attitudes/behaviors related to sustainability and apparel.
• CMS optimizations for TheFabricOfOurLives.com website, which enhanced technical performance and security.
• Influencer partnerships with 18 Instagram influencers, including Color Me Courtney, who showed how cotton is essential throughout all stages of their lives and communicating messaging points through three communication pillars: health and wellness benefits, cotton’s natural advantages, and further establishing the connection that authentic denim is made from cotton.
• The denim campaign for digital and social. The campaign highlighted how denim has been the fabric of our lives for generations and re-establishes its connection to cotton. The campaign consisted of one 30-second video and seven social-centric versions which were on video pre-roll, social media, and Hulu.
• The Female Farmer social content featuring Alabama farmer, Wendy Yeager. The video content captured a day of her busy life, communicating her passion for sustainable farming and helping to humanize the fabric, all while making the connection that cotton is natural.
• The redesign of TheFabricOfOurLives.com website consisted of an audit that prioritized educational information on cotton’s benefits, sustainability and ease of care, along with types of cotton fabric that drove a significant amount of organic search traffic. Additionally, the shop section evolved into a robust experience, making it easier to connect consumers to cotton-rich clothing and household items.
• Seventeen micro- and macro-influencers were contracted through influencer agency Popular Pays. All influencers have created content on behalf of Cotton Incorporated through October. Their content supported key 2019 messaging pillars: health & wellness, sustainability, and denim, and were shared across their own social pages.
• Courtney Quinn, aka Color me Courtney, was contracted to develop three stop-motion videos with accompanying post copy and blog posts on her channels that supported key 2019 messaging pillars: health and wellness, denim, and sustainability.
• Focus groups were completed on 2020 consumer campaign creative to provide direction on which advertising campaigns were resonating with the 18-34 target and what optimizations could be made to ensure the selected campaign drives an emotional connection that will ultimately motivate consumers to look for cotton.
• Production began on the Rosie Reborn campaign, which celebrates the resilience of cotton in the denim jumpsuit and the strength of the women (symbolized by fictional character Rosie the Riveter) who worked in male-dominated industries to support their families and country during World War II. At the heart of the campaign is the denim jumpsuit, designed by: female-owned company, The Great, which reimagines the jumpsuit for women who are breaking barriers today. Each jumpsuit incorporates a piece of denim from the 1940s as a reminder of denim’s durability and the women who made the fabric powerful through their actions. The campaign will launch the first quarter of 2020 and consist of digital and social videos and stills explaining cotton’s role in the denim jumpsuit, and will feature modern day “Rosies” (wearing the jumpsuit) in fields such as tech, architecture, welding, and professional sports to serve as a reminder to women everywhere to embrace their power and continue to break barriers.

Trade Media
A total of 12 macro trade print ads ran in 2019 in industry publications such as Textile Insight, International Fiber Journal, Ecotextile News, and Rivet. The print campaign was complemented by digital media on websites such as Ecotextile.com, SourcingJournal.com and Rivet, among others. The plan was heavily focused on newsletter placements and rotational media on some of the sites. Strong performance was delivered, garnering an overall CTR four times higher than the benchmark.

A total of 33 nonwovens-specific print ads ran in 2019 in publications such as Nonwovens Industry, Nonwovens Industry China, Nonwovens Industry South East Asia, Nonwovens Report International, Household Care & Personal Wipes, AVR, and Sustainable Nonwovens. The print campaign was complemented by digital banner ads on websites such as Nonwovens-Industry.com and SustainableNonwovens.net. The messaging focused on the sustainability aspect of cotton from its simple ingredients to being environmentally friendly.

A total of 43 cottonseed-specific print ads ran in 2019 in publications such as American Dairymen, Dairy Herd Management, Dairy Star, Feed & Grain, Progressive Dairymen, Farm & Dairy Magazine, Feedstuffs, Hoard’s Dairyman, and Milk. The cottonseed print campaign was complemented by digital banner ads on websites such as AmericanDairymen.com,

A total of six Cotton LEADS℠ program-specific print ads ran in 2019 in publications such as Ecotextile News. The print campaign was complemented by digital banner ads on websites such as Ecotextile.com and SourcingJournal.com. It ran a combination of newsletters and run-of-site placements across multiple ad sizes.

Public Relations
Support of Consumer Programs
During the 2019 year, the Public Relations Department supported key consumer-facing initiatives such as, the Cotton + Revolve pop-up shop, the Cotton Style House initiative, various Blue Jeans Go Green™ (BJGG) denim recycling program activities, and ongoing support of advertising campaigns and initiatives.

In collaboration with Strategic Alliances and their event agency, promotion of the Cotton + Revolve pop-up shop garnered 36 press mentions in widely-read media outlets such as, People and the Daily Mail. The total coverage reached an estimated 320.5MM people and had an ad value of more than $602K.

Working in conjunction with the BJGG program, the external agency for the program, media coverage in widely-read media outlets such as The New York Times and the Washington Post reached an aggregate readership of nearly 453MM with a combined ad value of more than $864K. Additionally, the department has increased the frequency of posts on the corporate-facing social media channels and helped review press releases and material assets. In 2019, posts about the program have organically reached over 130K people across the channels.

The department also assisted in developing and obtaining approvals for press releases and media alerts for the BJGG program’s spring and fall college programs along with the #DenimStackChallenge social media campaign for America Recycles Day. The college program materials were developed with the help of student representatives from the schools.

Throughout the year, Public Relations has provided assistance in reviewing and editing collateral and press materials for other programs from Strategic Alliances such as the buybuy BABY program to raise awareness of the Seal of Cotton trademark, and the Cotton Style House program with Amazon, including its launch during an interactive weekend with influencers in Montauk, NY.

Trade Programs
In addition to the social media support of company trade activities featured in the Social Media section, Public Relations also sponsored the Sourcing Journal Summits in Hong Kong (185 local textile industry attendees) and New York (389 textile industry attendees); as well as the Rivet 50, a web page showcasing luminaries in the denim category that garnered 21,569 pageviews in 2019.

In China, the department oversaw three media partner programs, including the year-long China International Fabric Design Competition; and an in-store promotion with Beyond Home, an upscale Chinese home textiles retailer. The latter program generated visibility for the Seal of Cotton trademark in 766 doors from June until December and featured 800K Seal of Cotton trademark hangtags. The Shanghai Mart Workshops (trade events) earned over 140MM mentions in print, web, and social media; with the June workshop alone earning more than 20MM mentions. In total, there were 309 news items about cotton, with a combined advertising value of $572,403.

Sustainability
In April, the department supervised media outreach and management for the Cotton Sustainability Summit. Two embedded journalists led to five news items in traditional media; a combined audience of 266,489. In October, the department helped execute the Company’s support of the first-ever World Cotton Day at the World Trade Organization in Geneva, Switzerland (400 attendees from 30 countries). Participation included a booth highlighting cotton’s sustainability. Additionally, Public Relations conducted a communications outreach around the FDA deregulation of ultra-low gossypol cottonseed. The effort garnered 128 news items with a potential audience in excess of 92MM.
Public Relations worked with the Sustainability division to develop talking points and spokesperson quotes for a press release announcing a joint conservation program with Pheasants Forever/Doves Forever. The department also collaborated with Sustainability to develop and deliver a question-and-answer booklet on cotton sustainability, specifically for Cotton Incorporated and Cotton Board, Board members.

The dedicated sustainability website (CottonToday.com) underwent an overall redesign to improve aesthetics and navigation, and for search engine optimization. The frequency of social media posts linking to blog posts and other materials on the site was increased and made more robust by a more aggressive editorial calendar for the site.

The department sponsored three sustainability-themed activities with media partner Hertzman Media:

- Title sponsor for Sustaining Voices, a tribute site that showcased contributors to sustainability in the textile industry (205K page views)
- A survey, report, and webinar about transparency as a facet of sustainability (500 report downloads, webinar audience of 345, and over 2K social media impressions)
- Sponsorship and staff participation in the webinar Collaborative Effort: Banding Together to Make Responsible Sourcing the New Norm (attracted 688 registrants)

The department produced two new sustainability-themed animations in 2019: Cotton, the AND Crop which illustrates all the products that come from every cotton harvest; and Feed the Plants, Starve the Weeds which explains the potential advantages of emerging phosphite research. The animations will be distributed in early 2020.

Public Relations also worked more closely with the Agricultural & Environmental Research Department to review and push out their custom content across the corporate social media channels. The content of these posts spoke more directly to the growers and drove clicks to the Cotton Cultivated website for more information.

Related to sustainability, the department continued to work in concert with the Sustainability Department, the National Cotton Council, and Cotton Council International to develop and promote the U.S. Cotton Trust Protocol.

Cotton Incorporated Lifestyle Monitor™ Survey
The Lifestyle Monitor™ survey and other data resources within continue to attract interest in the media, as well as the industry. Public Relations continued to work closely with the Corporate Strategy & Program Metrics (CSPM) Department to promote all the analytical resources of the Company, and to integrate these data to support the direction of the Company’s cotton-promoting programs.

The Lifestyle Monitor™ articles were a popular feature in Sourcing Journal and in the denim-centric Rivet (as appropriate) throughout the year, where the articles were frequently the top reads of the week. Some of the most popular articles were about Gen Z and denim, private label brands, and America Recycles Day and textile recycling.

Public Relations also shared videos produced by the CSPM department that featured special data from the Lifestyle Monitor™ survey. These videos, shared on the corporate social pages, focused on the extended size markets, the global denim market, and online shopping around the world.

The department continued its editorial partnership with Robin Report in 2019 with articles promoting the Lifestyle Monitor™ survey and other analyses from CSPM, as well as cotton sustainability.

The department worked with the CSPM department to create more content that will be more cohesive across departments and channels. To help share the 2019 data about holiday shopping intentions, the department worked with a third-party contractor to create a graphically enhanced media unit (GEM), which featured the Director, Market Research, CSPM, where she spoke in detail about the highlights of the survey. The GEM was shared multiple times across all the corporate social media channels and custom social cards were also created to showcase the data even more. The total audience for the piece was over 103K and garnered more than 7K social media impressions.
Social Media
The department focused on organically growing their social media presence (separate from the consumer facing Discover Cotton pages). In 2019, the trade Facebook page went from 10,300 followers to 11,586. This number of followers may appear small, especially relative to the consumer Facebook page, which has close to one million followers. However, given the smaller size of the trade audience, the number of followers is quite good.

Video and animated posts have continued to perform significantly higher than static image posts. During 2019, videos posted to the Facebook page garnered approximately 22K minutes viewed and 63K video views. The top videos were: Textile Microfibers & Degradation (28,085 total reach; video posted two times), Jacey Duprie, Mom & Baby (13,215 total reach; video posted two times), and Billy Carter – Cotton Research & Promotion Hall of Fame (8,398 total reach).

The department continued to utilize and became more active on Twitter and LinkedIn, sharing articles and information pertinent to the cotton, agricultural, and textile industries – press releases, webinars, environmental videos, etc. While LinkedIn is still primarily for industry related information, the department has found that posting more consumer-friendly information on the page has been beneficial. Engagement and followers have increased on the page.

The department has also increased promotion of the CottonWorks™ website and FABRICAST™ collections across the social channels. The posts did particularly well on LinkedIn but received great engagement across all the channels.

Heading into 2020, Public Relations also decided to subscribe to a social media tool that will assist in scheduling posts across channels, reaching the right audiences on each channel, and also getting metrics on posts and campaigns.

Cottonseed Marketing
Beginning in 2019, the management of cottonseed marketing (wholeseed and oil) was shifted to Consumer Marketing, with Public Relations supervising. Over the course of the year, surveys of target markets for both primary categories were executed to better understand knowledge gaps and refocus the communications. For wholeseed, this has resulted in a shift in the advertising target and the creative, which is slated for implementation in 2020. Additional trade show and conference opportunities have also been identified and will be pursued in 2020. For oil, a new consumer-facing website aimed at ‘foodies’ is in development; and plans for the seasonal and calendar gifting opportunities are being explored. While the growth opportunity for cottonseed oil remains in the business-to-business space, the consumer programs are aimed to generate awareness, interest, and comfort with respect to cottonseed oil and consumers.

Strategic Alliances
Consumer Sustainability Initiative: Blue Jeans Go Green™ Denim Recycling Program
Cotton Incorporated’s Blue Jeans Go Green™ (BJGG) denim recycling program shifted messaging at the start of the year to focus on the natural quality of cotton with an emphasis on ‘Creating Change with Cotton.’ Since authentic denim is made from cotton, a natural fiber, it can be recycled and used to create something new. Not only does the new messaging celebrate the insulation that is made as a result of recycled denim, but it focuses on how cotton can help create a greener world. Updates were made to the BlueJeansGoGreen.org website and incorporated into all program materials.

In the first half of the year, a total of 25 contemporary brand and retail partners committed to recycling denim on behalf of the program. Ongoing consumer-facing retail partnerships include American Eagle Outfitters, Ariat, Levi’s, Madewell, ONS, and rag & bone. Some of the new partnerships established for select timeframes include Boot Barn, J.Crew Factory, FRAME, and Velvet by Graham & Spencer. These retailers offered incentives to their customers in more than 1.5K participating stores to recycle cotton and close the loop by keeping textile waste out of landfills. As a result, more than 300K pieces of denim were collected.

During the spring season, the BJGG program partnered with students at Florida State University and the University of Cincinnati to install collection bins on each of their campuses and educate this demographic on cotton sustainability with a focus on denim recycling. Student groups on each campus educated their peers and ran denim collection drives through the end of April.

On June 8, Strategic Alliances launched a new collaboration between Cotton’s BJGG program and Zappos for Good, the community outreach arm of Zappos.com. The collaboration makes recycling denim through Cotton’s BJGG program easier than ever with prepaid mailing labels that can be downloaded by logging into a Zappos customer account. As the media lounge
sponsor of Denim Days in New York City, NY, in early June, the announcement was made during the festival, a two-day indigo-soaked shopping event. The event saw approximately 3K attendees and there was great interest and engagement with the BJGG activation.

The mail-in program continued to be a successful collection channel receiving over one-thousand pieces of denim per month for recycling. In addition, several organizations throughout the country have contributed denim through the program’s Corporate Social Responsibility channel including Abercrombie & Fitch, Cone Denim, Harley Davidson, Phytogen, Unifirst, Vanity Fair, and more.

During the first half of the year, UltraTouch™ denim insulation was distributed to one grant recipient and more than six Habitat for Humanity affiliates, some of which include Alexandria, VA; Greater Los Angeles, CA; Wake County in North Carolina; and Washington, DC.

The second half of the year saw strong participation by multiple retailers including: Universal Standard, Garage, Theisen’s Shopbop, South Moon Under, Level 99, Opening Ceremony, and Beija Flor Jeans. The program was also incorporated into Levi’s press-generating pop-up store during Art Basel in Miami, FL.

The fall college program kicked off in September with two schools: Azusa Pacific University and University of Minnesota, Twin Cities – reaching a combined student population of over 61K individuals. Student groups led denim recycling campaigns both on campus and within their local communities, and each school saw impressive denim collections as a result of their efforts.

In recognition of American Recycles Day on November 15, Cotton’s BJGG program executed an awareness initiative entitled “Denim Stack Challenge” on social media. The #DenimStackChallenge invited people across the country to inventory their own closets, snap and share a picture of their denim, and give those items they no longer wear new life by recycling them. Retailers, brands, influencers, and individuals participated in the recycling-focused social media challenge, which ran from November 11 to November 18.

Distribution of UltraTouch™ denim insulation continued throughout the second half of 2019. Insulation was distributed to multiple Habitat for Humanity affiliates across the U.S. from Vail Valley, CO, to Wake County in North Carolina. Additionally, grants of insulation were provided to the NY Fuller Center for Housing; a Cary, NC, fire station; St. Paul Missionary Baptist Church in Missouri; and insulation was again provided to volunteer organizations continuing rebuilding efforts in Houston, TX, and the Panhandle of Florida.

Strategic and Retail Partnerships
The first half of the year saw the completion of a unique retail partnership with e-tailer, Revolve.

Revolve is an online fashion retailer and lifestyle brand that connects with the millennial consumer by providing premium trend-driven products from both emerging and established brands. Revolve has built its business on scrutinizing data, especially that derived from social media. Its social media footprint is substantial, with a following of 3.1M followers on Instagram alone. The retailer’s growth has been significant since its inception in 2003 and has amassed more than one-billion in sales last year alone, leading to its initial public offering (IPO) in early June.

This spring, Cotton Incorporated partnered with Revolve for an eight-week-long campaign that included a curated digital women’s collection, pop-up shop integration at the Revolve Festival, influencer content creation driving traffic, and awareness to @discovercotton, as well as efforts to educate consumers about the many benefits of cotton. This partnership allowed Cotton Incorporated to have a physical presence during festival season – a first for the organization. Revolve’s festival season is their biggest selling period of the year - greater than the holiday season.

The cotton shop on the Revolve.com website was live from March 25 through May 20. The curated online collection featured the season’s most-wanted styles and showcased the versatility of cotton; making it the most-wearable fabric for any shopper. The program was social media driven, with 16 fashion influencers participating in the program, amassing a combined total of 44M impressions. During the campaign timeframe, sales of cotton apparel on Revolve’s website increased by 24%. Additionally, the program generated more than 99M impressions.
Amazon x Cotton Collaboration

For eight weeks, beginning July 8, Cotton Incorporated partnered for the second time with global retail giant, Amazon.com. The Cotton Style House program featured a curated online collection, highlighting four key lifestyle categories: Jetsetter, On-the-Go Getter, Showstopper, and Wellness Warrior, to include resort-wear, casual-wear, dressy styles, and athleisure apparel categories respectively. Over 319 cotton-rich SKUs, ranging in price from $12-$397 were included in the shop. The program was largely influence driven, with eight influencers tapped to be the main representatives and a total of 44 participating. The online shop also included engaging videos and an easy-to-use click/tap to buy functionality where clothes featured on influencer images could allow the consumer to add the items to their shopping cart.

An exciting and new concept was also introduced to bring the online experience to life. For one weekend in July, Cotton Incorporated took over The Montauk Beach House in the Hamptons, where media and the eight main influencers from across the country, along with residents and visitors of the local area, were brought together to converge for an interactive weekend of style, shopping, wellness, and entertainment. Over 200 styles from the online shop were made available for purchase on the property. Customers were able to point their mobile device on any hangtag in the shop and quickly add the item to their Amazon.com shopping cart. Education and styling seminars were offered, as well as activities such as tie-dyeing and a group exercise class. The engaging shopping experience immersed the consumer in the world of cotton in a unique way.

An extensive paid media plan was managed by the Advertising department to include a significant display and social media campaign. A new mobile platform, Aki, was employed which utilizes proprietary real-time motion data offering a unique opportunity to identify Cotton Incorporated’s audience in key moments throughout their day when most are likely to engage with ads. Aki’s technology uncovers the best moments to deliver the ads using a combination of different data variables inclusive, but not limited to, the position of the phone, the location of the user, content/apps they are viewing, time of day, etc.

The program was successful in driving 79MM in traffic to the online shop, with 25% of the styles selling out. Eighteen media outlets covered the program in significant publications from Forbes to People. Cotton sales were up 122% compared to last year and total program impressions were 913MM.

buybuy BABY x Cotton Collaboration

For the first time, Cotton Incorporated partnered with national retailer, buybuy BABY in the fourth quarter. From October 9 to December 31, a curated collection of cotton-rich baby and toddler apparel and home goods (bedding, bath, nursing/feeding, mattresses, and pads) were made available in one convenient shop on the buybuy BABY website. The Seal of Cotton trademark was featured on each of the individual 4K+ products in the shop. Prices of the items in the shop ranged from $3.99-$399.99. Messaging was hyper-intentional, speaking to the natural, better night’s sleep, durable and breathable benefits of cotton, especially for little ones.

Digital advertising to include banner ads, e-blasts, and social media created awareness and drove traffic to the online shop. buybuy BABY has an email subscriber list of 3.4MM; thereby, allowing Cotton Incorporated’s dedicated messaging to reach a significant number of shoppers through this one tactic alone. Box stuffers were placed in the packages of all online purchases as well in an effort to increase visibility of the shop.

The program was also featured at buybuy BABY’s 121 brick and mortar stores across the country. All shopping carts were branded with cotton messaging and bag stuffers were placed in all customer purchases during the program.

Results are still being captured by the retailer; however, midway through the program 2.9MM social media impressions, 700+ shop views, as well as $1.2MM in cotton sales were recorded.

Retail Outreach Campaign

A new and unique approach was developed throughout the course of the year to connect with prospective retail partners. New digital and physical marketing materials were created, focusing on the services that the department provides to the retail industry.

Launching in November, Cotton Incorporated’s Advertising team developed a social media driven campaign utilizing the new marketing materials on LinkedIn to connect with the retail community in an engaging way. Banner ads and direct emails promoted cotton messaging and educated the user on the point-of-sale specific opportunities that exist with the organization. Results of the campaign are currently in review.
Corporate Strategy & Program Metrics

**Market Intelligence**

This area encompasses ongoing research studies that assist Cotton Incorporated in monitoring the supply chain for changes in cotton use and/or market perceptions.

**Lifestyle Monitor™ Survey**

Research results are used to better understand the attitudes of U.S. consumers toward cotton and competitive fibers, cotton made in the U.S., sustainability, denim jeans, back-to-school and holiday shopping intentions, as well as shopping preferences. Areas of research in the 2019 Lifestyle Monitor™ survey included, but were not limited to:

Performance features: Nearly half of consumers (49%) expect the clothing they purchase to have added performance features like wrinkle resistance, moisture management, etc. and the majority of consumers (57%) believe that performance features make their clothing better. Consumers are most likely to seek out performance features in their outerwear (66%) and activewear apparel (65%), followed by casualwear (58%), intimates (54%), dresswear (49%), and childrenswear (37%).

- **Holiday shopping:** Around 3 in 5 holiday shoppers say they plan to buy clothing as a gift this season (57%), followed by gift cards (52%), toys (48%, up significantly from 39% in 2018), and electronics (32%). On average, holiday shoppers plan to spend $291 on clothing this year (up significantly from $241 in 2018). The majority of clothing gift givers (51%) say they will be looking for cotton-rich clothing gifts this season.

- **The Fabric of Our Lives® tagline:** The majority of consumers say they have heard of ‘The Fabric of Our Lives®.’ More than 2 in 3 consumers (67%) who have heard the ‘the touch, the feel, the fabric of our lives’ understands what it means and can relate or feel a connection to it.

**Retail Monitor™ Research**

Retail Monitor™ research is used to better understand cotton’s presence at retail as well as the opportunities and challenges for cotton in major adult apparel categories in the U.S. Below are some highlights from research throughout the year.

- **Womenswear:** Cotton’s share (weight basis) increased in 2 of the 5 major womenswear categories, knit shirts (+3.1 percentage points) and athletic apparel (+2.0 percentage points) while remaining flat for dresses (no change). Increases in cotton’s share of women’s athletic apparel were driven by increases in both women’s athletic bottoms (+2.7 percentage points) and athletic tops (+0.8 percentage points).

- **Menswear:** Cotton’s share (weight basis) increased in 2 of the 5 major menswear categories including athletic apparel (+3.7 percentage points) and knit shirts (+1.0 percentage points), while remaining relatively flat for pants (-0.1 percentage points). Increases in cotton’s share of men’s athletic apparel were driven by increases in men’s athletic tops (+7.0 percentage points).

**Import Database**

Staff updated the U.S., E.U., and Japanese import databases that provide key data on cotton’s share of apparel and home furnishing products imported into these countries. The updated databases will allow for more timely analysis of the data.

**USDA-NASS Database**

Staff established user-friendly, Excel-based access to the complete set of USDA-NASS data relating to cotton. This includes an extensive set of maps for use in future presentations.

**Cotton Loan Calculator**

Staff updated a program that generates loan values for variety trials. Cotton Incorporated agricultural staff estimated that more than 90% of field trial researchers use the calculator to help them evaluate the relative value of varieties. The updated program should save researchers time and reduce user error.

**Corporate Strategy**

This area involves the analysis and dissemination of the market intelligence that has been collected through both proprietary and secondary research studies. This information is used to drive internal and external strategies.

**Industry Presentations and Meetings**

During 2019, staff executed nearly 160 presentations and meetings on fiber economics and market research with key global industry contacts which included delivering domestic and global market intelligence presentations in mainland China, Hong
Kong, India, Japan, Mexico, South Korea, Thailand, and the U.S. Key topics included the cotton economic outlook along with consumers’ attitudes toward performance features, denim, sustainability, activewear, health and wellness, extended-size offerings, and retail and consumer updates. Together the economic and market research presentations had a total of 1,300 attendees. Below are a few highlights:

- Staff presented three economic presentations at the Beltwide Cotton Conferences. These included a cotton market outlook presentation at the general session, a research talk on the relationship between USDA condition and progress data and yield, as well as a cotton market outlook talk at an engineering session.
- A presentation on risk management and the cotton market outlook was presented to a group of Virginia growers.
- Staff provided an economic outlook presentation at a Cotton Council International (CCI) trade fair in Cancun, Mexico. This meeting included over 150 representatives from the textile industry in the western hemisphere.
- Consumer and retail insight presentations were delivered in Mexico City to seven brands, one textile manufacturer, and during a group presentation to over 80 representatives from the Latin American textile industry.
- Staff presented a Consumer and Retail Insights presentation to a graduate level textile class at North Carolina State University.
- A Consumer and Retail Trend presentation was delivered to over 130 attendees at the MAGIC Trade Show conference in Las Vegas, Nevada.
- Staff participated in a webinar panel hosted by Sourcing Journal to discuss the issue of transparency in the clothing industry. A total of 475 industry members listened to the webinar either live or registered to receive the audio and report link.
- Consumer and retail insight presentations were delivered in Bengaluru and Mumbai, India. A total of 74 attendees and nine different brands attended. Staff also provided an interview with Fiber to Fashion on the Indian consumer research conducted in conjunction with CCI and included topics such as consumer shopping trends, sustainability, and circular fashion.
- Staff presented consumer and retail insights to a total of 225 people representing 96 textile industry brands, manufacturers, and exporters in Bangkok, Thailand; Seoul, South Korea; Shanghai, China; and Guangzhou, China.

Economic Publications
CSPM staff continually tracks cotton fundamentals and prices throughout the supply chain. Analysis of the cotton market is published and presented in a variety of formats:

- Twelve issues of the Monthly Economic Letter were published to inform participants in the cotton supply chain about developments in the cotton market in order to help them make better and more profitable decisions.
- Twelve issues of the Executive Cotton Update, which focus on the U.S. economy and is designed as a tool to inform clients about how changes in the U.S. economy might affect the cotton supply chain, were published.
- Twelve reports about how changes in cotton prices are “passed through” the supply chain were published and distributed.
- Staff provided weekly radio updates on the cotton market. These Weekly Cotton Market Updates are posted on the Cotton Board website and distributed to nearly 50 different radio stations across the nation.
- Staff provided weekly television interviews to RFD-TV, which garnered 11MM impressions weekly from a viewership of 45MM subscribers. An Agricultural Resource Management study revealed that RFD-TV is the number one source of information for farmers and ranchers.

Market Research Publications & Supply Chain Insights
Supply Chain Insights

Intimates: Based on the results of the 2018 Intimate Apparel Study, an infographic was created and disseminated to key accounts and retailers and made available on Cotton Incorporated’s website. Key findings show the importance of fiber content to consumers, especially 100% cotton and cotton blends, for this wardrobe staple.
• **Children’s wear**: Based on the results of the 2019 Children’s wear Study, CSPM created an infographic highlighting the negotiation between parents and children as they balance views on style and function of children’s wear. This infographic was disseminated to key accounts and retailers and made available on Cotton Incorporated’s website.

• **Back to School**: An infographic was created based on findings from the *Lifestyle Monitor™* survey focusing on how, when, and what consumers purchase during back-to-school shopping. Among the findings, 80% of parents said they prefer their children wear clothing made of cotton, and they expect clothing made of cotton to last 50% longer than clothing made of other fibers. This infographic was disseminated to key accounts and retailers and made available on Cotton Incorporated’s website.

**Video Insights**

• **Online Shopping Around the World.** Using data from the 2018 *Global Lifestyle Monitor*, this video explores how attitudes and behavior towards online clothes shopping vary by cultural context.

• **Extended Size Market.** With growing rates of obesity worldwide, this video, based on the results of the 2018 Extended Sizes Survey, showcases the demands of larger consumers for comfortable, stylish clothing to be widely available in their size.

• **Denim Jeans and Evolving Fashion.** Using data from the 2018 *Global Lifestyle Monitor*, this video highlights denim jeans’ place in consumer wardrobes as a fashion item to wear out to dinner and to work.

**Lifestyle Monitor™ email.** In collaboration with Public Relations, emails with trending topics from recent *Lifestyle Monitor™* research are disseminated monthly via email to direct traffic to the *LifestyleMonitor.CottonInc.com* website.

**Strategic Research and Program Metrics**

The Strategic Research projects enhance knowledge in areas that are critical for cotton opportunities or challenges as well as help measure corporate efforts to support the Company’s mission. The Chinese Consumer Survey and Chinese Retail Audit are ongoing market research studies conducted jointly by CCI and CSPM. The latest findings from these projects as well as additional results from other strategic research studies are provided.

**Nonwovens Baby Care Research**

CSPM conducted a survey of diapers and wipes purchasing and usage behaviors among 8,011 consumers in the U.S., U.K., India, Mexico, China, Brazil, Germany, and France to assess the importance of cotton in parents’ decision-making process. Highlights from the results include:

• Cotton is a familiar and trusted fiber that consumers connect with the attributes they most seek in diapers and wipes – namely comfort, hypo allergenicity, absorbency, and sustainability. 74% of consumers expect diapers and wipes to be made of cotton.

• Consumers use multiple brands of diapers and wipes simultaneously, using on average four diaper brands and five wipes brands either regularly or occasionally.

• Word-of-mouth recommendations from family and friends and from medical professionals (including samples provided by hospitals) have the greatest influence on consumers’ choice of diapers and wipes brands.

**Transparency Research**

CSPM conducted a survey of consumer attitudes about corporate transparency among 2,500 consumers in the U.S., U.K., Mexico, China, and Germany in order to understand how much consumers want to know about industry efforts toward sustainability. Highlights from the results include:

• Most consumers (77%) say it is important to them to know the environmental impact of the clothing they buy, and half (46%) think the clothing industry is doing this well. Consumers in Mexico (85%) and China (88%) are most likely to say that transparency is important and most likely to approve of the industry’s transparency.

• Consumers say they are willing to pay more for clothing they know is made in a sustainable way, with most (57%) saying they will pay between 1% and 20% more.
Chinese Consumer Survey
Below are highlights from the most recent results:

- **Purchase Drivers:** The top purchase drivers for Chinese consumers when shopping for clothing are fit (99%), finishing (99%), fiber content (98%), style (97%), and price (91%). Chinese consumers have a strong preference for cotton with the majority saying they prefer 100% cotton for the underwear (72%), sleepwear (68%), socks (68%), undershirts (53%), dress shirts (51%), and casual tops and shirts (50%).

- **Online clothing shopping issues:** The top issues for Chinese consumers when shopping for clothing online are getting what you ordered (99%), sizing issues (98%), quality issues (96%), not knowing fiber content (85%), and personal information privacy (81%). The majority of Chinese consumers when shopping for clothing online compare prices with different retailers (58%), browse styles at different retailers (58%), and read customer reviews about clothing items (55%).

- **Price and Quality issues:** Around half of Chinese consumers feel like the price of clothing has increased (60%) compared to last year, while the quality of clothing has declined (43%). Two in five Chinese consumers believe clothing purchased recently doesn’t last as long as it used to, and the fabric of clothing purchased seems to be thinner than before.

Chinese Retail Audit
Below are highlights from the most recent results:

- **Cotton’s share (weight basis) of major menswear product categories audited in Shanghai and Xi’an, China stood at 74% in 2019, down slightly from 2018 (75%).**

- **Over the past year, cotton’s share increased for men’s jeans (84% up from 82%) and woven tops (80% up from 79%).**

- **Cotton’s share (weight basis) of major womenswear product categories audited in Shanghai and Xi’an, China stood at 58% in 2019, up slightly from 57% in 2018.**

- **Over the past year, cotton’s share increased in women’s knit tops (71% from 62%), woven tops (61% from 58%), and activewear (37% from 32%). Cotton’s share for women’s denim jeans remained flat at 85%.**

Closet Study
Staff undertook qualitative research exploring consumers’ perceptions of durable clothing based on what was in their closets. Thirty respondents across three markets (Houston, New Jersey, Chicago) kept online clothing diaries over three days, where they video-recorded their closets and talked over their oldest, and most frequently worn, apparel items. These consumers included both men and women, those who work inside and outside of the home, and fashion-engaged and disengaged individuals, as well as several respondents who frequently exercise. One-third of items respondents wear most often are jeans and tees and most-worn classics are made up of 87% cotton. The learnings from this research will be used in presentations and will help develop a global quantitative study on cotton clothing and consumers’ perceptions of durability.

Brand Tracker
Staff conducted surveys among 5,600 respondents (men and women, ages 18-54) to track attitudes and to evaluate awareness of brand strategy activities. Results for the latest brand tracker showed the recognition impact of the television campaign was strong with the First Day ad reaching nearly two-fifths of target consumers. The emotional connection with cotton was higher among those who had seen First Day (92% love/like cotton versus 87% of those having not seen the ad). Several brand attributes for cotton are more favorable among those who have previously seen First Day including “cotton is comfortable,” 89% who saw ad agreed versus 83% who had not seen the ad. Most importantly label checking for fabric content and the degree of influence fabric has on clothing purchase was higher among those who have seen First Day, indicating the current campaign and supporting videos strengthened the cotton message and led to action.

Childrenswear Research
Conducted a hybrid study including qualitative focus groups with parents and their children and a quantitative, eight-country survey of parents about childrenswear preferences and shopping behaviors. Countries studied include the United States, Mexico, Brazil, the United Kingdom, France, Germany, India, and China. Results showed that parents and their children – especially those in Western countries – negotiate differing preferences as they purchase childrenswear. Despite their
differences, they agree on the primary importance of comfort, and parents rate cotton clothing highest in comfort. This research has been used in outreach materials including presentations for the industry in several Asian countries.

Customer Comments
Staff collected over 38,000 online customer review comments from 15 retailers on intimates, activewear, denim, and home textile products. Analysis of intimates’ comments revealed multiple ways consumers understand comfort in intimate apparel: soft to the touch, wearable over long days, superior fit, moisture and temperature regulating, and unnoticeable. Analysis continues on all comments from all products and will be used in outreach materials as well as to help develop quantitative surveys.

Quick-Turn Surveys
Staff conducted quick-turn surveys on topics of special interest, including changing norms in workwear (comfort and versatility are prized), trends in online and mobile shopping (younger generations welcome artificial intelligence innovations), awareness and willingness to pay for premium cotton varieties (awareness of Pima, Supima, and Egyptian cotton are very low), and use of secondhand clothing marketplaces (74% of consumers have purchased clothing secondhand). The ability to utilize the quick-turn survey format has led to more global analysis on topics for market research presentations and publications. The source will continue to be utilized as a way to augment larger research studies and to survey smaller topics as needed.
APPENDIX A: MEDIA OUTREACH COVERAGE

Generating press releases about noteworthy activities and accomplishments, as well as sharing information with the media, remain extremely successful means of securing press coverage. These proactive and reactive communications draw upon the knowledge of in-house experts and the full range of data and analyses generated by the Company. The following communications were disseminated in 2019.

**Trade**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 23, 2019</td>
<td>2018 Cotton Biotechnology Award Recipient – Dr. David M. Stelly</td>
</tr>
<tr>
<td>January 25, 2019</td>
<td>Jordan Elected New Cotton Incorporated Chairman</td>
</tr>
<tr>
<td>June 17, 2019</td>
<td>Gaylon Morgan Appointed Research Director for Agricultural &amp; Environmental Research Division at Cotton Incorporated</td>
</tr>
<tr>
<td>September 9, 2019</td>
<td>Cotton Research and Promotion Program Hall of Fame 2019 Inductees Announced</td>
</tr>
</tbody>
</table>

**Print Coverage**

The following is a list of some of Cotton Incorporated’s print coverage in 2019.

- The Corn and Soybean Digest: Mention of Cotton Incorporated
- Toronto Star: Mention of Cotton Incorporated
- Manhasset Press: Mention of the Blue Jeans Go Green™ Program
- Richmond Times Dispatch: Mention of Cotton Incorporated
- The Denver Press: Mention of Cotton Incorporated

**Television and Radio Coverage**

The following is a partial list of Cotton Incorporated’s television and radio coverage in 2019.

<table>
<thead>
<tr>
<th>Station</th>
<th>Affiliate</th>
<th>Market</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>My Lubbock TV</td>
<td>MyNetworkTV</td>
<td>Lubbock, TX</td>
<td>Mention of the Blue Jeans Go Green™ program</td>
</tr>
<tr>
<td>FOX 34</td>
<td>Fox</td>
<td>Lubbock, TX</td>
<td>Mention of the Blue Jeans Go Green™ program</td>
</tr>
<tr>
<td>FOX19 Now</td>
<td>Fox</td>
<td>Cincinnati, OH</td>
<td>Mention of the Blue Jeans Go Green™ program</td>
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<tr>
<td>RFD-TV</td>
<td>Rural Media Group</td>
<td>National/Syndicated</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>AM790/WNIS</td>
<td>Independent</td>
<td>Norfolk, VA</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>KTVK</td>
<td>Independent</td>
<td>Phoenix, AZ</td>
<td>Mention of Cotton Incorporated</td>
</tr>
<tr>
<td>FOX 8</td>
<td>Fox</td>
<td>Cleveland, OH</td>
<td>Mention of the Blue Jeans Go Green™ program</td>
</tr>
<tr>
<td>KXTQ-FM Online</td>
<td>Fox</td>
<td>Lubbock, TX</td>
<td>Mention of youth marketing program</td>
</tr>
<tr>
<td>WBOC-TV 16</td>
<td>CBS</td>
<td>Salisbury, MD</td>
<td>Mention of Cotton Incorporated (GEM)</td>
</tr>
<tr>
<td>FOX 40 News</td>
<td>FOX</td>
<td>Vestal, NY</td>
<td>Mention of Cotton Incorporated (GEM)</td>
</tr>
<tr>
<td>WICZ-TV</td>
<td>ABC</td>
<td>Henderson, NV</td>
<td>Mention of Cotton Incorporated (GEM)</td>
</tr>
<tr>
<td>ABC6 News</td>
<td>FOX</td>
<td>Providence, RI</td>
<td>Mention of Cotton Incorporated (GEM)</td>
</tr>
<tr>
<td>KVVU</td>
<td>FOX</td>
<td>Henderson, NV</td>
<td>Mention of Cotton Incorporated (GEM)</td>
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<td>107.9 The Link</td>
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<td>Charlotte, NC</td>
<td>Mention of Blue Jeans Go Green™ program (#DenimStackChallenge)</td>
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<tr>
<td>Sunny 98.1</td>
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<td>San Diego, CA</td>
<td>Mention of Blue Jeans Go Green™ program (#DenimStackChallenge)</td>
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<tr>
<td>98.7 FM KLUV</td>
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<td>Dallas, TX</td>
<td>Mention of Blue Jeans Go Green™ program (#DenimStackChallenge)</td>
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<td>WFFT (FOX)</td>
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<td>Fort Wayne, IN</td>
<td>Mention of Blue Jeans Go Green™ program (#DenimStackChallenge)</td>
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<tr>
<td>The Tulsa CW</td>
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<td>Tulsa, OK</td>
<td>Mention of Cotton Incorporated (GEM)</td>
</tr>
<tr>
<td>RFD-TV</td>
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<td>Nashville, TN</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>CW 23</td>
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<td>Buffalo, NY</td>
<td>Mention of Blue Jeans Go Green™ program (#DenimStackChallenge)</td>
</tr>
<tr>
<td>NBC2</td>
<td></td>
<td>Florida</td>
<td>Mention of Cotton Incorporated (GEM)</td>
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</table>
### Internet Coverage

The following is a partial list of the online mentions of Cotton Incorporated, or its initiatives or programs, in 2019.

<table>
<thead>
<tr>
<th>Website/Outlet</th>
<th>Mention of Cotton Incorporated</th>
<th>Mention of the Blue Jeans Go Green™ program</th>
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<tbody>
<tr>
<td>360 MAGAZINE</td>
<td>Mention of Cotton Incorporated &amp; Cotton Style House</td>
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<tr>
<td>Agri Marketing Online</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>All Ag News</td>
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<tr>
<td>American Eagle Blog</td>
<td>Mention of the Blue Jeans Go Green™ program</td>
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<tr>
<td>Better Homes and Gardens Online</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>California Apparel News Online</td>
<td>Mention of Cotton Incorporated</td>
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<td>Cotton Farming Online</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>Cotton Grower – Online</td>
<td>Mention of Cotton Incorporated &amp; Hall of Fame Release</td>
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<td>Dateline Carolina</td>
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<td>Delta Farm Press</td>
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<td>Ecotextile News</td>
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<tr>
<td>Farm Progress</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>FashionMag.com</td>
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<td>Fibre2Fashion</td>
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<td>Forbes</td>
<td>Mention of Cotton Incorporated</td>
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<td>Golf Industry Network</td>
<td>Mention of Cotton Incorporated</td>
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<td>Growing Alabama</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>Hamptons Magazine Online</td>
<td>Mention of Cotton Incorporated &amp; Cotton Style House</td>
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<tr>
<td>Haute Living</td>
<td>Mention of Cotton Incorporated &amp; Revolve program</td>
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<tr>
<td>Her Campus</td>
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<td>High Plains/Midwest Ag Journal Online</td>
<td>Mention of Cotton Incorporated</td>
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<td>HowStuffWorks</td>
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<tr>
<td>Innovation in Textiles</td>
<td>Mention of Cotton Incorporated</td>
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<td>Just-style.com</td>
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<tr>
<td>KOMU-TV Online</td>
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<td>Martha Stewart Living Online</td>
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<td>Men's Journal</td>
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<tr>
<td>Minnesota Daily</td>
<td>Mention of Blue Jeans Go Green™ program &amp; college program</td>
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<td>Nonwovens Industry</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>Nonwovens News</td>
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<tr>
<td>No-Till Farmer Online</td>
<td>Mention of Cotton Incorporated</td>
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<td>Ohio Farmer Online</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>Oyster Magazine - Online</td>
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<tr>
<td>PGA Magazine Online</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>Real Simple Online</td>
<td>Mention of Cotton Incorporated &amp; quote from staff</td>
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<td>Refinery29</td>
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<td>SeedQuest</td>
<td>Mention of the Blue Jeans Go Green™ program</td>
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<td>Southeast Farm Press</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>Southwest Farm Press</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>St. Louis Post-Dispatch</td>
<td>Mention of Cotton Incorporated</td>
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<td>Textile World</td>
<td>Mention of Cotton Incorporated</td>
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<td>The Daily News</td>
<td>Mention of Cotton Incorporated</td>
<td></td>
</tr>
<tr>
<td>The Kitchn</td>
<td>Mention of Cotton Incorporated &amp; quote from staff</td>
<td></td>
</tr>
<tr>
<td>THE NORTHWEST INDIANA TIMES</td>
<td>Mention of Cotton Incorporated</td>
<td></td>
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<tr>
<td>The Philadelphia Inquirer</td>
<td>Mention of Cotton Incorporated</td>
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<tr>
<td>Source</td>
<td>Mention of Cotton Incorporated + Revolve Partnership</td>
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<tr>
<td>TravelGrom</td>
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<tr>
<td>voiceoflouisianaagriculture.org</td>
<td>Mention of Cotton Incorporated &amp; Hall of Fame Release</td>
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<tr>
<td>Women's Wear Daily</td>
<td>Mention of Cotton Incorporated &amp; Cotton Style House</td>
<td></td>
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<tr>
<td><a href="http://www.dairybusiness.com">www.dairybusiness.com</a></td>
<td></td>
<td></td>
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<tr>
<td>Zappos</td>
<td>Mention of Blue Jeans Go Green™ program &amp; Zappos program</td>
<td></td>
</tr>
</tbody>
</table>
The Corporate Administration Division includes Board of Director Services, Human Resources, Corporate Office and Facility Services, and Intellectual Property, Contracts and Legal Departments.

The Corporate Finance Division is comprised of Information Technology (IT) and Accounting.

In February, new Board Members participated in a Multi-Region Producer Tour, which included a tour of the World Headquarters in Cary, NC, and presentations by staff and representatives from the Cotton Board. The second day of the Orientation focused on specific topics related to the Board of Directors, such as USDA oversight of the Program, Accounting procedures, an overview of the Board structure, and training for the dedicated Board of Directors Web site.

In March, the Board held an Executive Committee Meeting in Del Mar, CA, in conjunction with the Cotton Board’s meeting. Cotton Incorporated’s Executive Committee participated in many of the Cotton Board sessions, including Program Committee meetings, the General Session, and the Business Session.

The Officers of Cotton Incorporated and the Cotton Board held a joint Board Strategic Planning Session in Chicago, IL, in April. Topics of discussion included key issues affecting cotton markets and demand, sustainability strategy, future budgets, capital equipment needs, and cottonseed marketing.

In June, the Cotton Incorporated Board of Directors held a Directors Meeting in Dallas, TX, in conjunction with Cotton Board Members. The key objectives of the meeting were for management, staff, and Board Officers to:

- Provide Updates on 2019 Program Activities
- Present 2020 Budget Framework for Discussion and Board Recommendation
- Present 2018 Actual-to-Budget Report
- Provide a Response to the Cotton Board’s Program Recommendations

Regional Caucus Meetings were held in July to nominate Board Members to serve on Cotton Incorporated’s Board of Directors. Caucus meetings were held in 13 states and a total of 24 Director and 24 Alternate positions were up for nomination to serve on Cotton Incorporated’s Board.

Cotton Incorporated’s Board of Directors held a meeting August 6-8 in Durham, NC. This was a joint meeting with the Members and Alternates of the Cotton Board. The key objectives of the meeting were:

- Presentation of 2020 Plan & Budget
- Presentation of Goals and Deliverables
- Nominations for 2020 Governance and Executive Committees

Staff presented the 2020 Proposed Plan, Budget, and Deliverables to the four Operating Committees. The Chairman’s, Executive, Audit, Pension, Governance, and Joint Calendar Committees also met. During the Thursday Business Session, the Board voted to approve the 2020 Plan and Budget, and elected members to the 2020 Governance Committee.

The Board held its Annual Meeting in New Orleans, LA, December 9-12. Elections of Directors and Alternates for three-year terms beginning January 1, 2020, the Executive Committee, Administrative Officers, Standing Committees, and Operating Committees took place. Following are the Board Executive Committee members for 2020:

Chairman: Bernie Jordan
Vice Chair: Van Murphy
Secretary: James Johnson
Treasurer: Marvin Beyer
President & CEO: J. Berrye Worsham
Past Chair: Dahlen Hancock
Agricultural Research: Robert Englert
Consumer Marketing: Herrick Norcross
Global Supply Chain Marketing: Shane Isbell
Research & Development: Clint Webb
Member-At-Large: Steve Wilbur
The four Board Operating Committees met and staff presented the accomplishments of the program for 2019. The Board also conducted its 2019 Board Evaluation of Company Performance Survey during this meeting. The Chairman’s, Executive, Audit, Pension, Compensation, and Governance Committees also met.

COTTON INCORPORATED
BUDGET DATA THROUGH DECEMBER 31, 2019*

<table>
<thead>
<tr>
<th>Program Area Expenditures</th>
<th>Budget</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Research</td>
<td>$13,245,000</td>
<td>$7,822,328</td>
</tr>
<tr>
<td>Research &amp; Development</td>
<td></td>
<td></td>
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<tr>
<td>➢ Fiber Competition</td>
<td>$4,623,000</td>
<td>$3,714,446</td>
</tr>
<tr>
<td>➢ Product Development &amp; Implementation</td>
<td>$9,758,000</td>
<td>$8,188,325</td>
</tr>
<tr>
<td></td>
<td>$14,381,000</td>
<td>$11,902,771</td>
</tr>
<tr>
<td>Global Supply Chain Marketing</td>
<td>$16,832,000</td>
<td>$14,999,292</td>
</tr>
<tr>
<td>Consumer Marketing</td>
<td>$32,886,000</td>
<td>$32,099,537</td>
</tr>
<tr>
<td>Corporate Administration</td>
<td>$5,431,000</td>
<td>$4,974,867</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>$82,025,000</td>
<td>$71,798,795</td>
</tr>
</tbody>
</table>

*Final expenditures to be determined after fiscal closing on February 15, 2020.
EXPLANATION OF TERMS AND ACTIVITIES

Agricultural Research Committee

Cottonseed Marketing – The objective of this activity is to increase the value of cottonseed at the grower level through strategic, targeted marketing using print and radio advertising, trade shows, direct mail, and publicity (press releases and feature articles).

Cottonseed Research – The objective of this research is to eliminate the barriers to cottonseed usage. Activities include research to eliminate gossypol; test the cottonseed nutrient profile to determine natural variation in germplasm, and evaluate this germplasm for adding value and reducing input potential; and develop new products and utilize advances with low-gossypol cottonseed products.

Disease Management – The minimization of plant pathogens as significant economically damaging pests in cotton production.

Insect Pest Management – The objectives of this activity are twofold: (1) Develop management recommendations for insect pests that meet the needs of a changing farm landscape using integrated pest management (IPM) strategies, and (2) Support boll weevil and pink bollworm eradication programs with research and technical expertise.

Weed Management – The minimization of weeds as significant economically damaging pests in cotton production.

Research and Development Committee

Fiber Competition

Cotton Communicator Software™ – Provides merchants and gins options to create Electronic Data Interchange (EDI) files from three different input file types and uses the data to create EDI files in a format that when sent to cotton mills is easily imported into EFS® System MILLNet™ programs and databases using a third-party EDI import program.

Cotton Management System (CMS) – The Cotton Management System is a group of related software programs, including legacy applications such as the EFS® MILLNet™ System software, designed to work independently and cooperatively to manage cotton as a raw material and asset. By providing tools to manage most aspects of cotton’s life cycle, CMS seeks to improve the efficiency of cotton flow, increase the efficiency and use of cotton, boost the profitability of cotton, and increase the demand for cotton.

EFS®-USCROP™ Software – Enables a user to review and analyze crop data using USDA high volume instrument classing information. Recap and Discount Premium reports are enhanced with a host of graphs and charts.

Engineered Fiber Selection® (EFS®) System MILLNet™ Software – Manages a mill’s acquisition and use of USDA high volume instrument-classed cotton. Integrated programs create transparency for the different departments within the mill.

Product Evaluation Laboratory – The objective of this activity is to provide accurate, reliable, and unbiased test data on fiber, yarn, fabric, and products from Cotton Incorporated’s research-to-marketing efforts and breeder initiatives to increase the global demand and use of U.S. upland cotton.

Software Development and Maintenance – The objective of this activity is to plan and execute the development of new software products for managing and improving the efficiency of cotton as a raw material, asset, and commodity. The Product Development group services and adapts the existing software products that are in the growth and maturity stages of the product lifecycle.

Software Service and Marketing – The objective of the service activity is to provide high-quality customer service that is critical to the success of the efforts to increase cotton competitiveness through innovative cotton management software. This is accomplished by providing EFS® System users with the documentation and customer service support that enables them to use the products efficiently. Frequent customer contact builds relationships with existing customers and helps gather feedback on the product to guide product maintenance and new product development. The objective of the marketing activity is to develop a competitive advantage for cotton by defining potential markets for the EFS® System and researching potential customers for
current products in the CMS family. This area communicates EFS® System benefits to potential licensees. By maintaining a high level of customer contact, this group works with all segments of the EFS® System product lifecycle by providing information for the maintenance of established products and developing product requirements for future projects.

**Quality Measurements Improvement** – The objective of this activity is to provide better tools, measurement systems, and data analysis techniques to improve quality measurements of cotton fiber, yarn, and fabric.

**Product Development and Implementation**

**Agricultural and Environmental Research Department (AERD):** A team of scientists that provide research and technical services to cotton growers, ginners and their support industries. The department is also a link between cotton production, the textile industry, and the research and extension communities.

**Color/Strength Value (K/S):** K/S value is an important parameter of modern colorimetry, which indicates the depth of the color of a dyed fabric surface. A machine called an absorbance spectrophotometer is used to measure the strength of a color by first measuring the amount of light visible through a colorant solution, than the amount of light that is able to pass through the sample as compared to the original amount of light from the source.

**Color Services Laboratory (CSL):** This laboratory is used to provide assistance to various departments within the company and to the industry in the areas of color matching, color evaluation, off-quality analysis, and small-scale applications.

**Crocking:** A transfer of colorant from the surface of a colored yarn or fabric to another surface or to an adjacent area of the same fabric principally by rubbing. In the crocking test, a small piece of white sheeting is rubbed back and forth ten times against the material to be tested. For the wet crocking test, the piece of white sheeting is first dampened with 65% of its dry weight with water, and it is then rubbed against the material to be tested in the same manner as the dry crocking test.

**DeltaE (ΔE):** Delta represents a Greek letter often used to denote difference, and E stands for Empfindung; German for “sensation.” This equation is being used to describe the difference between two colors by using the International Commission on Illumination’s (CIE) CI E L*a*b* graph; defining a Delta E of (one) as barely perceptible and a Delta E greater than (three) as two different colors.

**Dyeing and Finishing Applications Laboratory (DFAL):** This laboratory contains both production scale and lab scale equipment used for internal projects and for industry implementation trials. The machinery allows the application of dyes on textiles and mechanical and chemical finishes.

**FABRICAST™ Collection:** This is a collection of knit and woven fabrics used to provide the industry with direction and inspiration for product development. The fabrics also strategically market cotton performance technologies.

**Fiber Processing (FP):** A team of scientists dedicated to converting cotton fiber efficiently into yarn that will meet industry specifications, provide technical assistance, and develop innovative yarns.

**Fiber Processing Laboratory (FPL):** This laboratory contains opening, cleaning, carding, and spinning equipment for yarn manufacturing.

**Hand:** The tactile sensations or impressions, which arise when fabrics are touched, squeezed, rubbed, or otherwise handled.

**Home Laundry Test Data (HLTD):** A data set developed by AATCC Committee RA88, Home Laundering Technology, established to develop a consistent set of test conditions for all test methods involving home laundering.

**Industry Associations:** Cotton Incorporated maintains a presence and membership in several leading industry associations.

AATCC – American Association of Textile Chemists and Colorists
ASTM International – consensus-based standards organization, committee D13 covers most textile standards
SAC – Sustainable Apparel Coalition
**ISP Workshops**: Technical education workshops are funded under the Importer Support Program in Cary, NC, and in regional and international locations. Cotton Incorporated technical staff members often serve as instructors for the workshops and are heavily involved in the development of workshop materials.

**Life Cycle Assessment (LCA)**: A technique to assess environmental impacts associated with all the stages of a product's life (i.e. from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling).

**Noil**: Short strands and knots that are combed out of natural fiber before spinning.

**Polyactic Acid or Polyactide (PLA)**: A thermoplastic aliphatic polyester derived from renewable biomass, typically from fermented plant starch such as from corn, cassava, sugarcane, or sugar beet pulp. In 2010, PLA had the second highest consumption volume of any bioplastic of the world.

**Product Development (PD)**: A team of dedicated scientists and designers that provide the cotton industry with new, inspirational cotton fabrications, provide technical services, and collaborate with industry partners.

**Product Development and Implementation (PDI)**: The textile research division within Cotton Incorporated that consists of Fiber Processing, Product Development, Textile Chemistry Research, Technical Services and Implementation, and Product Integrity.

**Product Integrity (PI)**: The department within PDI that is responsible for gathering information on standards and regulations that may threaten cotton’s market share, as a liaison with other divisions on matters related to sustainability and acts as the Chemical Hygiene Officer to ensure a safe working environment for the researchers.

**Shibori Dyeing**: A labor-intensive dyeing technique, originating in Japan. This technique is a form of resist dyeing that involves shaping and securing fabric before dyeing to create patterns. Traditionally done using Indigo.

**Technical Services and Implementation (TSI)**: The department within PDI that is responsible for assisting global mill partners with the implementation of new technologies and maintaining quality production of those technologies, provide technical services, and support the marketing efforts of those technologies.

**TEMPO Oxidation**: 2,2,6,6-Tetramethylpiperidine-1-oxyl radical (TEMPO) is a stable and commercially available organic free radical reagent used to oxidize primary alcohols to aldehydes. Selective oxidation of primary alcohols are possible since secondary alcohols are much less reactive under these conditions.

**Textile Chemistry Research (TCR)**: Textile Chemistry Research is comprised of a team of researchers who investigate methods of cotton wet-processing improvement, sustainable wet-processing techniques, and who evaluate new dyes, chemicals, and application methods to enhance the performance and reduce the environmental footprint of cotton.

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**Global Supply Chain Marketing Committee**

**Global Supply Chain Marketing**

**Cotton Council International (CCI)** – CCI is responsible for the international promotion of U.S. cotton primarily, but not exclusively, through the COTTON USA Mark program. The majority of CCI’s promotion funds are from the USDA’s Market Access Program, which is administered by the Foreign Agricultural Service. Cotton Incorporated is the largest private contributor to CCI, and these private funds are leveraged an estimated two to four times the amount of government funds. Cotton Incorporated staff work closely with CCI to ensure that the funded programs are complementary to the international activities. In many cases, CCI’s programs are part of a joint effort with Cotton Incorporated staff.

**Cotton Incorporated Sponsored Events** – Cotton Incorporated is often the host or primary sponsor of industry trade events.

**FABRICAST™ Collection** – The FABRICAST™ collection is a collection of knit and woven fabrics used to provide the industry with direction and inspiration for product development.
Global Supply Chain – This refers to the network of companies and organizations involved with the manufacturing, sourcing, development, and retailing of textile products and related products such as chemicals and equipment.

ISP Workshops – These technical education workshops are funded under the Importer Support Program.

Suppliers – For each technology marketed by Cotton Incorporated, part of the marketing strategy often involves identifying and working with manufacturers in the supply chain who can market and provide products to interested retailers, brands, or other companies. Cotton Incorporated works with and through established industry manufacturers to further the company’s marketing ability and reach.

Tradeshows – This term refers to industry events that often involve formal conference programs as well as exhibit and booth space. Examples of some of the more prominent tradeshows include Outdoor Retailer, Shanghai Intertextile, and Premiere Vision.

Consumer Marketing Committee

Advertising, Public Relations, Strategic Alliances, and Corporate Strategy & Program Metrics

Chinese Consumer Survey – The Chinese Consumer Survey is an ongoing consumer survey in China that has been conducted quarterly since the third quarter of 2009 and is conducted jointly with Cotton Council International (CCI). Each year, the survey interviews 4,000 Chinese consumers between the ages of 15-54 who are primary shoppers for clothing in over 20 provinces and over 40 cities through random doorstep, face-to-face interviews. Results from the survey are representative of the urban Chinese clothing shopping population. The data are used both internally and externally for publications, presentations, and for strategic direction.

Chinese Retail Audit – The Chinese Retail Audit is an in-store retail audit of key retailers in Shanghai and Xi’an China that began in 2010 in Shanghai and is currently conducted each spring. In 2017, data were collected on nearly 30,000 apparel and home textile products from key brand specialty, hypermarket, and department stores as well as key specialty stores on Tmall (Tmall was added in 2016). Results from this audit are used to better understand the types of garments available at key retailers in China, pricing, performance offerings, and cotton’s presence in the market.

Click Through Rate (CTR) – CTR is a way of measuring the success of an online advertising campaign for a particular website. The click through rate of an advertisement is defined as the number of clicks on an ad divided by the number of times the ad is shown (impressions), expressed as a percentage. For example, if a banner ad is delivered 100 times (100 impressions) and receives one click, then the click through rate for the advertisement would be 1%.

Executive Cotton Update – The Executive Cotton Update is focused on the U.S. economy and is designed as a tool to inform clients about how changes in the U.S. economy might affect the cotton supply chain. Retail sales, clothing store inventories, consumer confidence and spending, and U.S. import data are among the many statistics that are followed in this report.

Lifestyle Monitor™ Survey – The Cotton Incorporated Lifestyle Monitor™ survey is an ongoing consumer survey that has tracked consumers’ product and fiber preferences and shopping habits since 1994. Recent surveys allow for the inclusion of additional questions to analyze specific product-related questions or timely issues such as the economy or holiday spending plans. The data are used both internally and externally for publications, presentations, and for strategic direction.

Monthly Economic Letter – Cotton Incorporated’s Monthly Economic Letter is a regular publication that is released following USDA updates to their supply and demand estimates. This publication is designed to inform participants in the cotton supply chain about developments in the cotton market in order to help them make better and more profitable decisions.

Retail Monitor™ Survey – The Cotton Incorporated Retail Monitor™ survey is a quarterly retail audit of apparel products at 25 major U.S. retailers, in store, and online. The data are used both internally and externally for publications, presentations, and for strategic direction.
Search Engine Optimization (SEO) – Search engine optimization is a methodology of strategies, techniques, and tactics used to increase the amount of visitors to a website by obtaining a high-ranking placement in the search results page of a search engine – including Google, Bing, Yahoo, and other search engines.

Supply Chain Insights – Supply Chain Insights is a publication focused on topics of current interest throughout the cotton supply chain, from fiber production to trade, sourcing and manufacturing, to retail and the consumer. This print publication has also been adapted to include digital video formats as a novel way to engage online audiences.