REPORT OF COTTON INCORPORATED

TO THE SECRETARY'S OFFICE

Mid-Year 2021

Cotton Incorporated

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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 2029/30
  - Cotton product innovation and implementation
  - Cotton sustainability
  - Global presence for cotton
- Growing U.S. cotton demand and production to 21 million bales by 2029/30
  - 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, Corporate Communications, and Brand Partnerships
  - Corporate Strategy and Insights (CSI)

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 *2021 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)

The 2020 and 2021 cotton growing seasons have been difficult for cotton growers. Extreme rain/drought and temperatures challenged even the most experienced equipment operator. The challenge of stand establishment is being addressed with a new Beltwide program to improve planting seed quality. This program combines multiple researchers with Extension Cotton Agronomists to both identify seed quality issues and to deliver tools for improving seed quality. Progress has been made in helping cotton breeders develop varieties that have higher oil content and thus better emergence under stress condition. The challenge of resistant weeds is being addressed with a significantly expanded program to control weeds in conservation tillage by preserving herbicide efficacy, managing weed seed bank, automation, innovative application technology, and new-to-cotton herbicides. The challenge of adverse weather at harvest is more intractable, without clear solutions in view. Research to apply machine learning (AI) to gin data and thus improve gin efficiency has started in collaboration with an advisory board from 13 gins across the U.S. Research to create proof-of-concept multi-pass harvesters continues but is many years from commercialization. Research to minimize leaf damage, boll rot, and hard lock from harvest rains has been expanded using leveraged funding and advanced modeling.

Four of the components that are less challenging for cotton growers are variety advancement, disease control, insect control, and cottonseed value. Long-term programs to develop and release germplasm and breeding tools continue to allow advancements in yield and fiber quality. Leveraged funding for the fungal and viral diseases (FOV4 and CLRDV) has expanded sentinel plots, detection tools, and model development to help growers avoid costly pesticide applications. Although insect resistance is expanding, integrated pest management (IPM) programs are also advancing and preventing widespread loss. Cottonseed value has benefitted from the marketing programs supported with dairy and feedlot research.

Cost of inputs continues to challenge cotton grower's bottom line. There is no room for pest outbreaks or unbudgeted input costs. Yield and quality gains are the front line to address input costs. Despite the disruption of the global pandemic, scientists and Extension specialists working on behalf of cotton growers are motivated and eager to address the many challenges the cotton industry faces. Included in this USDA report are many examples of their dedication to delivering beneficial impacts on producer profitability.

Sustainability Division

The Sustainability Division's main objective, to create an improved sustainability reputation for the cotton industry, is being accomplished through five major focus areas: 1) sustainable cotton production goals and the U.S. Cotton Trust Protocol, 2) research on microplastics and cotton biodegradation, 3) sustainability assessments, 4) engagement and leadership in non-governmental (NGO) sustainability organizations, and 5) cotton sustainability communications. Delivering on objectives within these five major project categories reveals cotton as a strong, trustworthy, and competitive sustainability brand to the entire supply chain.

To reach the U.S ten-year sustainability goals, the U.S. Cotton Trust Protocol (USCTP), Field to Market®, and the Cotton LEADS℠ program are key organizations for the Sustainability Division's efforts to reduce the environmental footprint of cotton production, to provide metrics for measurement, and to communicate to the supply chain. The division provides technical support and leadership to the USCTP through efforts to enhance and streamline the grower enrollment experience. For example, the full integration of the Fieldprint Calculator, the Field to Market measurement platform, into the USCTP platform has made enrollment easier for the grower. Software to connect the USCTP platform with other programs is being created to make data acquisition more robust as well. By serving on the Metrics, Verification, and Education and Outreach Committees within Field to Market, division staff not only help to lead this flagship commodity organization but ensure that the Calculator remains a relevant and useful tool for cotton. As an expert and information provider to the Cotton LEADS℠ program, the division is sharing vital progress with the brands, retailers, and manufacturers who need data to boost cotton consumption.

Sustainability has continued degradation and impact research on microplastics and microfibers in conjunction with the Product Development and Implementation (PDI) division. Feeding studies with microfibers are being conducted to determine how microfibers impact aquatic life outcomes. Previous work on laundering release and microfiber identification has been extended by other microfiber research cooperators, while biodegradation in new conditions and modeling of degradation is underway at other universities. The end goal is quantifying microfiber impacts in life cycle assessments and industry tools.

Expanding the division's activities into the standards arena has provided a new avenue for influencing and leading the conversation about cotton and sustainability, especially the circular economy. Working with the Agricultural and Environmental Research (AERD) and PDI divisions, Sustainability is implementing strategies to increase sustainable cotton and textile production. In coordination with the Consumer Marketing and Global Supply Chain Marketing divisions, communicating sustainability messages is being accomplished through online educational webinars and continued redevelopment of the CottonToday Website. The Sustainability Division has increased the visibility of Cotton Incorporated as a leader in sustainability and has gained important roles in sustainability organizations that create tools and metrics to judge the sustainability of cotton.

Research and Development Committee

Fiber Competition: *Fiber Quality Research*

Quality Research has 16 outside research projects for 2021, consisting of the renewal of 11 projects and the initiation of five new projects. The top priority for 2021 is dealing with contamination issues. Another key priority is the Fiber of the Future effort, which involves improving fiber length, uniformity, and fineness. The final key priority is traceability, and the staff has spent considerable time gathering information on available technologies and systems as part of this effort.

Product Evaluation Laboratory (PEL) activities continued to focus on regular day-to-day testing. Routine testing on two High Volume Instruments (HVI®) inter-lab evaluations involved two proficiency sets on each instrument and six-monthly check levels. The lab decided not to assist with USDA-AMS calibration cotton testing this year to ensure high priority testing for Fiber Processing and Agricultural and Environmental Research (AER) cooperators. A total of four proficiency tests for fabric were also run in the first half of the year. Testing services have been active for all areas of research and implementation for both AER and Product Development and Implementation (PDI) divisions.

The Cotton Management System (CMS) Product Development team supports all Engineered Fiber Selection® (EFS®) System software products, focusing on updates and enhancements for the latest version of MILLNet™ software. Updates and enhancements are also provided for the other programs as needed: Cotton Communicator Software™, MILLNet for Merchants™, and USCROP™ software program. Thus far this year, several significant updates were made for the MILLNet for Merchants™ package from working directly with several key clients.

The CMS Technical Service and Marketing teams continued to assist customers remotely via phone, email, text, and virtual meetings. Three new MILLNet™ software licenses were signed in the first half of the year, one in Vietnam and two in Mexico. Installation and training have been completed for two of these new licensees, with the third one in the scheduling and planning phase.

Product Development and Implementation (PDI)

Sustainability continues to be a top priority for PDI in 2021. Outside research was funded to focus on the degradation of cotton in different environments (aquatic and landfill) as well as examine what becomes of dyes and finishes associated with the degraded fibers. Textile Chemistry Research (TCR) is also supporting the Sustainability Division in their efforts to study the fate of fish that consume cotton and polyester fibers. Minimally processed fabric developments continue to support the Natural Narrative promoted by Product Development (PD). In the fabric development realm, research focused on promoting the natural qualities of cotton. The team explored performance through construction, taking advantage of cotton's properties and examining how different fabric structures can enhance these natural performance attributes. Synthetic fleece-alternative fabrics continue to resonate with the industry looking for sustainable options. Fully-fashion shaped products were developed for zero waste concepts. Recycled fibers in yarns, nonwovens, and no-waste construction continues to encourage the concept of circularity.

In the area of Product Improvement, Performance, & Implementation, contamination mitigation continues as Fiber Processing (FP) supports the industry using a Truetzschler T-SCAN TS-T5 contamination removal machine. A cross-divisional team worked to develop a new American Society of Agricultural and Biological Engineers (ASABE) performance standard for module wrap. Both TCR research and Technical Service and Implementation (TSI) works have been completed on a new application of TOUGH COTTON™ technology. It was released to enable the TOUGH COTTON™ finish to be exhausted onto yarns for engineered placement into garments. A process to enable TransDRY® technology to be combined with the PUREPRESS™ finish, while maintaining the properties of both, was developed, and released as well. New finish developments include both a durably soft finish and a quick drying finish for sheeting. In PD, woven fabrics engineered for breathability and knit fabrics developed for thermal applications were showcased in the latest FABRICAST™ 2021-1 collection release. Creating and promoting 3D digital twins of FABRICAST™ collection fabrics, enhance the digital communication of these collections. Denim and home product categories take priority this year with performance enhancing finishes and innovative fabric constructions.

Product Development and Implementation is seeking New Opportunities for cotton. The pandemic created opportunities to produce five digital tours which bring the labs of Cotton Incorporated to people wherever they are. Other focuses this year aligned with the Cotton Board recommendations and included continued research in additive manufacturing, injection molding, and e-textiles with integrated electronics via embroidery. Taking advantage of in-house equipment for trials, the entire division's research work incorporates the concept of circularity throughout. Nonwoven research, through FP, also supported Global Supply Chain Marketing (GSCM) and their efforts to displace single use plastics.

Global Supply Chain Marketing Committee

Global Supply Chain Marketing (GSCM)

The Global Supply Chain Marketing division is responsible for all aspects of communication and marketing to the companies and organizations in the supply chain—those responsible for manufacturing, sourcing, and marketing fiber products such as apparel, home textiles, and nonwovens products.

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 first half of 2021, GSCM staff conducted more than 268 meetings with companies in the manufacturing supply chain including key brand and retailer accounts.

In its eighth year, the Cotton LEADS℠ program continues to educate and inform retailers, brands, and manufacturers worldwide 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 688 partners by mid-year.

The GSCM division is responsible for messaging to the trade. In 2021, consistent messaging and imagery was implemented throughout, including tradeshows, tradeshow promotional items and outlets, and other publications. Messages focused on the CottonWorks™ website platform as a leading resource for cotton, performance, denim, digital fabrics, sustainability, and circularity.

In 2021, the GSCM division developed content and materials to address sourcing cotton issues out of China. Content was posted to the CottonWorks™ website including podcasts on cotton flow out of China, technology considerations and general facts about sourcing cotton.

The Digital Supply Chain initiative in the GSCM division is an effort to enhance the division's marketing capability by incorporating the latest and most widely used 3D textile design tools. Work in this initiative included several activities such as:

- Digitizing all FABRICAST™ fabrics as they are released.
- Collaborating with a 3D technology supplier to promote a capsule collection of minimally processed fabrics.
- Adding additional capability on the CottonWorks™ Website to view digital fabrics in augmented reality.

Technical marketing, technology commercialization, and technical assistance continue to be essential for helping companies bring cotton products to market. Several important activities were carried out to provide technical assistance for marketing cotton including:

- Commercialized Cotton Incorporated technologies with 24 new technology suppliers across five countries (Bangladesh, China, India, South Korea, and Vietnam).

Nonwovens technical development on two key projects was completed at the end of 2020, thus providing the input for marketing work in 2021. Both projects position cotton as a solution to plastic in wipes, feminine hygiene products, and as topsheet materials for feminine hygiene and diapers. The second technical project was targeted to prove that cotton, natural and purified, meets industry standards for being safe and plastic-free. Seven tests were conducted to evaluate biodegradability in soil, composting (industrial and home), aquatic environments; the impact of cotton on aquatic micro-organisms, and the presence of heavy metals and fluorine. Both natural and purified cotton passed all tests.

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 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. Twenty-two technical education workshops were held in the first half of 2021 with over 600 attendees from over 150 major brands and retailers.

CottonWorks™ webinars offer a unique way to reach the industry and amplify the Company's message. In the first half of 2021, 10 webinars were held. These webinars featured topics on cotton traceability, sourcing, cationic cotton developments, consumer behavior, and sustainability. A five-part sustainability webinar series has been developed and began in May.

Consumer Marketing Committee

Advertising

In 2021, Cotton Incorporated launched its new campaign "Your Cotton, Your Way" targeted to adults ages 18 to 49, with a female skew. "Your Cotton Your Way" aims to highlight the comfort of cotton, the confidence it provides, and reinforce The Fabric of Our Lives® message. The campaign comes to life in a modern, memorable way by featuring characters who share how cotton is the fabric of their lives while popular musician, Carnie Wilson, accompanies on the piano. This campaign is meant to reinvigorate and add a modern dimension to the original, The Fabric of Our Lives® jingle which is the cornerstone of the campaign.

This 360° effort reaches consumers through television, streaming video, digital media, search engine marketing, and social media, including the launch of Cotton's TikTok channel. By creating an emotional connection and improving brand health, the campaign aims to drive awareness of the benefits of cotton and increase desirability among consumers.

The primary objective for the first year of the campaign is to deliver reach to drive awareness. With the launch of the new creative, the strategic priority in media is to produce scalable programs to drive campaign awareness. This priority has shifted from the heavy custom content focus in 2020 when the campaign "Life Is Uncomfortable" was in its third year.

Another key objective for the campaign is to educate and engage consumers. Though there is a decreased emphasis on custom content programs, the department continues its sustainability and health & wellness initiatives by developing a robust and customized digital content plan across a variety of digital platforms. The department has partnered with key leaders in these spaces to create experiences such as infographics, podcasts, and articles to educate consumers. This will drive consideration and highlight cotton's key benefit messaging via engaging experiences online.

The department continues to support Brand Partnership initiatives with advertising support through organic social media, paid social media, TheFabricofOurLives.com Website efforts, and digital programming.

Additionally, corporate branding launched in January, in print and online, to reach textile and dairy trade, including promotion of the Blue Jeans Go Green™ denim recycling program and 35 digital ads have been placed. In the second quarter, corporate

branding took advantage of an added value, LinkedIn brand lift study, to gain insight into target and content. Overall, the total number of placements to date for the Cotton LEADS℠ program and macrotrade across print, digital, and LinkedIn is 51.

Corporate Communications

For the first half of 2021, the Corporate Communications department estimates there have been about 245 news items about the Company and its activities, representing a reach of 739.5MM, and an advertising value of $1.4MM.

Notable among the Corporate Communications Department accomplishments for the first half of 2021 were activities in support of the sustainability of U.S. cotton; the Corporate Strategy & Insights (CSI) department and its consumer and retail trends data; and consumer-facing corporate initiatives such as the Blue Jeans Go Green™ denim recycling program and the new The Fabric of Our Lives® advertising campaign.

Brand Partnerships

The year began with exciting new retail programs for Strategic and Retail Partnerships along with collection and distribution activities for the Blue Jeans Go Green™ program. In addition to returning retail program participants like Ariat and Madewell, other retailers, individuals, and organizations across the country got involved in denim recycling as well. Additionally, the Brand Partnerships department partnered with retailers Good American and Something Navy, both for the first time, to plan and execute integrated marketing campaigns aiming to drive sales of cotton apparel at each brand.

Corporate Strategy & Insights (CSI)

In the first half of 2021, CSI led efforts to identify opportunities and threats for cotton using market intelligence including ongoing research of U.S. consumers' attitudes from the *Lifestyle Monitor*™ survey, assessments of cotton's share at retail through the *Retail Monitor*™ study, and global market and economic research and analysis. CSI provided over 85 information requests; participated in over 30 meetings and presentations; authored 127 publications, videos, TV/radio segments, and podcasts; and worked on almost 15 projects.

Work completed by CSI during the first half of 2021 includes, but is not limited to: the collection and examination of data on more than 5MM products offered at retail in the U.S. and China; the evaluation of over 10K U.S. and 12K global consumers; the update of a comprehensive database of monthly apparel and home furnishing imports to assess sourcing patterns and tariff impacts; 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.

AGRICULTURAL AND ENVIRONMENTAL RESEARCH

Strategic Objective 1: Increase the profitability of U.S. cotton production.

Cottonseed

Two projects were initiated in 2020 that were designed to assess the benefits of feeding higher levels of cottonseed to lactating dairy cow and also investigate cottonseed inclusion in feedlot rations as a substitute for ethanol byproducts. Both projects were delayed due to the pandemic but are now back on track. Previous research with both groups of cottonseed users has been positive. At this moment there is an opportunity to further the use and demand for cottonseed products as we pass through the current situation of increasing commodity prices and uncertainty in the feed ingredient business. The beef research project that was delayed has just recently been able to acquire test animals and the feeding study is underway. To strengthen the beef research program, follow-up research in a cow/calf setting is being planned for 2022. The dairy cow feeding study has completed the animal feeding portion of the research and the data is being analyzed. Preliminary results indicated that feeding cottonseed at the maximum recommended feeding rate of 15% (about 7 pounds per day) significantly increased butterfat production.

Cottonseed oil research that is evaluating the health benefits of consuming a diet rich in cottonseed oil is back on track with both human and mice subjects. University researchers are returning to campus and will resume the clinical trial with "at risk" subjects, those adult males that have high cholesterol and are not on medication.

A high-protein cottonseed flour that is currently being produced on a commercial scale is showing promise in fish diets. Its utilization seems to be improved with a short termination period. The search for new uses and new markets for this product has been primarily focused on fish feeds where plant-based proteins that replace unsustainable fish meal in the diet have high value. Preliminary aquaculture feeding studies with this product were completed and are very encouraging. It was shown that cottonseed protein flour can effectively replace some of the fish meal in Red Drum and Hybrid Striped Bass diets. Follow-up studies are underway, and additional positive outcomes will provide a marketing opportunity for high protein cottonseed flour.

The utilization of cotton gin byproducts for the creation of value-added products is also the focus of a small portion of the cottonseed research budget. Cotton burs have unique physical and chemical properties that allow burs to be used in a wide range of products. Research is underway to evaluate cotton bur products as a carrier for nutraceuticals in poultry feeds and as an ingredient in asphalt, which represent two potential novel uses for burs.

The cottonseed processing research plant that was originally installed in New Mexico and subsequently moved and reinstalled near Lubbock was used to produce 1,200 pounds of glandless cottonseed kernels for use in an oil extraction study and subsequent use in a fish feeding study. Unfortunately, the oil extraction portion of the study did not have the intended outcome. Other oil extraction methods are being investigated.

An ACALA variety of glandless cotton has become somewhat popular with organic cotton producers due to its superior lint quality. A seed increase of foundation seed for this variety is underway. Progress was also made in the ongoing effort to increase the yield of glandless varieties and further study the molecular biochemistry of gland formation and development.

Crop Improvement

While cotton is a very drought adapted plant, it can still sustain yield loss during times of water stress. Studies have shown that even in the humid areas of the Cotton Belt, supplemental irrigation will increase yield most years even though annual rainfall exceeds cotton's water requirements, as the rainfall is not distributed evenly across the growing season. For example, a past study used a calibrated CSM-CROPGRO-Cotton of the DSSAT crop modeling system to predict the effect of irrigation on cotton fiber yield in North and South Carolina over a long-term weather record (1979-2015). The model predicted that non-irrigated cotton yielded less fiber by more than 10% in 70% of simulated site years. A challenge for many growers is access to affordable and sustainable water to supply an irrigation system. Historically, farm ponds have been one solution to providing that water and the increased variation in rainfall is making that an option more growers may need to consider. Two studies are currently funded by Cotton Incorporated to look at the amount of water that can be stored for irrigation. An ongoing study in Arkansas includes looking at the feasibility of shallow ground water storage to increase the water holding capacity of a pond without increasing land use. A new study in North Carolina is determining the quantity of water stored in a farm pond each year. Both

studies are also documenting the added benefits of farm ponds, including improvements in downstream water quality and potential impacts on flood control. Documenting the other benefits of farm ponds to society may allow future opportunities to offset the costs of building and maintaining a farm pond.

Harvest and Ginning

Cotton Incorporated has been working in collaboration with the National Cotton Ginners Association (NCGA) to determine if additional value can be captured from data generated at cotton gins, as a great deal of data is automatically measured during the ginning process. A pilot study was initiated in 2021 between Cotton Incorporated, NCGA, the USDA-ARS gin labs, Texas A&M, collaborating cotton gins, and the SAS Institute (SAS formerly stood for "Statistical Analysis System") to explore additional uses for data collected at gins. One of the first models tested was to attempt to predict the gin's production rate (i.e., cotton throughput in bales per hour) using five years of data from two gins. Cotton gin throughput is determined by machine capabilities and the raw agricultural commodity. To maximize ginners' throughput and provide insight into the upstream production chain, cotton ginning throughput was modeled against gin sensor, classing, and variety attribute variables. Sensor and timestamp outputs from two gins with two- and three-years' data each were appended together. Summary calculations were made for time per bale, defined as the minutes (or seconds) between module cutting and bale press, and for chokes, which were defined as the rare instances (3% of bales) taking between two and 60 minutes. Because initial models including detailed sensor and classing data suggested a high proportion of variability is explained by field attributes (which may include variety, agronomic practices, harvesting or weather), a set of variety attributes were defined and merged into the records, creating a data subset where variety information was also present. Three analytical procedures were employed to model minutes (or seconds) per bale against the sensor and classing data set, and separately the variety attribute data set. The procedures were: first variable identification through machine learning with interpretability procedures and generalized linear model stepwise selection. The second procedure was a Bayesian network which filtered significant variables and Bayesian mixed model that quantified impact on throughput. The third procedure was a time series model that quantified collective variable impact on the autoregressive (time-dependent) throughput component. The first two processes were additionally used on the variety attribute data set to identify chokes. The final analysis is still in process; however, the success to date indicates this project should be expanded in 2022 by increasing the number of gins involved.

The challenging weather conditions at harvest in 2020 resulted in an historic number of seed coat fragments (SCFs) in Alabama, Florida, and Georgia bales this year. SCFs are particularly challenging to study as they are only a significant problem in limited geographies every three to five years. Cotton Incorporated has had a long-term research program to better understand and address SCFs since 2003. To date, the results have found that there is a clear environmental component as illustrated by the wet weather at harvest this year. In some years it has also been determined there are some varieties more prone to SCF formation than others. SCFs can form throughout the harvest and ginning process, with the greatest number generated at the gin stand and the number of SCFs are increased if the gin stand is overloaded. Work at the USDA gin lab in New Mexico has identified grid bar designs that can improve SCF removal in the lint cleaner at gins. A group is working to develop a review paper that summarizes these past efforts and use that review to identify areas for future study. Additionally, the University of Georgia had variety trials at 25 sites across the state of Georgia in 2020, and data from those sites is currently being analyzed to better understand the factors that lead to so many seed coat calls.

Work to automate the cotton production process, including harvest and ginning processes, continues in 2021. A paper was published in the open access journal *AgriEngineering* to inform companies developing automated equipment on how they can provide services for the cotton industry. The paper considers how current and future advances in automation has, could, or will impact cotton production practices. The results are organized to follow the cotton production process from land preparation to planting to within season management through harvesting and ginning. For each step, current and potential opportunities to automate processes were discussed. Specific examples include advances in automated weed control and progress made in the use of autonomous systems for cotton harvesting.

Crop Improvement

Genomic Resources

TM1 is the historical reference used in Upland cotton research. As such it was chosen as the target to produce a high-quality reference genome 15 years ago. However, while TM1 is an excellent genomic reference for experimental work, cotton breeders have moved far beyond TM1 and are interested in knowing the genetic differences between TM1, pima (Gossypium barbadense), and elite upland lines widely used in their breeding programs. To improve the tools available to the breeding community, reference grade assemblies were produced using three important public sector lines. These are: 1) UA48, an early

maturity, determinate, excellent fiber quality, bacteria blight resistant variety from the University of Arkansas, 2) UGA230, a full season, indeterminate high yielding variety developed at the University of Georgia, and 3) CSX8308, a semi-okra leaf, medium/full season variety, with a full resistance package to commonly observed diseases in Australia developed at CSIRO. CSX8308 is one of only three parents used in the 2019 NIFA/Cotton Board supported project that has identified robust FOV4 resistance. These three are also key components in the pangenome project, the results of which will be a solid foundation for cotton genetic improvement over the next decade.

FOV4

A public and private research partnership formed for the first FOV4 Upland cotton resistant line as part of a 2019-21 jointly supported NIFA-Cotton Board research project. The line, U1, has been extensively tested and resistance has been confirmed and validated in uniform, high spore count fields in three screening seasons near Clint, TX. The public announcement of this discovery was made at the 2021 Beltwide Conference. Continued progress in the project has identified 40+ lines shown to be resistant during two years of screening trials. These lines have exhibited more elite type yield than does U1, and thus would be more useful in either a public or private sector cotton breeding program that seeks to incorporate FOV4 resistance without yield drag. Another screening trial was planted in early May and a third year of data will be collected on early cotyledon death, vascular root staining, and productivity. Breeding lines from multiple public sector breeders have been included in the Clint, Texas 2021 FOV4 screening site.

High Through-Put Phenotyping

The recent development and implementation of unmanned aerial vehicle (UAV, also known as drones) –based thermal imaging has enabled cotton scientists to rapidly collect canopy temperature data with minimal temporal effects associated with other collection methods, commonly seen in grown based systems. Such data can be used to monitor plant water usage and therefore, the plant's response to abiotic stress throughout the growing season. An Assistant Professor at the University of Arizona leveraged modest funds from Cotton Incorporated to win a $2.5M grant from the National Science Foundation. That research could help better manage irrigation and make cotton production more efficient in the face of reduced water availability. Future applications of this technology include its use as a screening tool to identify cotton germplasm with superior water use traits that could be leveraged for breeding more stress resilient varieties.

Plant Pathology

Fusarium Race 4 (FOV4)

Research to uncover the mechanisms that FOV4 uses to damage cotton, in addition to research into control strategies, is continuing at several labs. Although host plant resistance is the lead strategy to minimize yield loss from FOV4, experience with another major wilt disease, verticillium, demonstrates that genetic resistance needs to be augmented with management practices. For verticillium, continuing field research is uncovering the key role that high irrigation water amount plays in maintaining high soil infestation levels once verticillium wilt inoculum has built up in the soil. For Fusarium Wilt, investigations include how tillage shifts soil microflora from beneficial fungi to pathogenic fungi, such as FOV4 and on the accumulation of FOV4 spores in the soil. Understanding the mechanism through which FOV4 damages cotton and the diversity of FOV4 strains in cotton fields will assist breeders in maintaining a pipeline of tolerant or resistant varieties in the future.

Viral Pathogens (CLRDV and CLCuV)

A CIF supported post-doc at Auburn University gave a summary of the 2020 Cotton Leaf Roll Dwarf Virus (CLRDV) sentinel plots at the 2021 Beltwide Cotton Conference. Based on these observations and data analysis, 2020 had less incidence than in 2019 across much of the Cotton Belt. The virus did not appear to affect yield, probably due to the lack of overall disease pressure. During both 2019 and 2020, coastal areas from South Carolina to Alabama appeared to have higher incidence of CLRDV. This has prompted questions as to whether there are overwintering hosts/ aphid species that may be present in these locations but not further north. The 2021 CLRDV sentinel plots have been installed across the Southeast and Mid-South cotton growing regions. In addition, multiple virologists are assembling collections of CLRDV for sequencing to better understand why CLRDV causes economic loss in some fields but not in others.

The Cotton Leaf Curl Virus – Gezera (CLCuV) was identified in 2019 in Texas on okra. Although this variant of the virus appears to be non-threatening to cotton, the virus is capable of evolving and acquiring new hosts. Thus, an effort has been started to survey the infected region more broadly and uncover the genetic diversity of CLCuV in the U.S.

Foliar Pathogens (Target Spot and Ramularia, Aerolate Mildew)

The National Predictive Modeling Tool Initiative (NPMTI) completed its first year of collaborative work in 2020 and launched the second year in the first half of 2021. The USDA funds this initiative to create better tools for growers to anticipate costly disease outbreaks in time to take preventive action. Cotton Incorporated augments this funding with targeted projects to fill in gaps and expand to include additional pathogens. The foundation of the NPMTI is airborne spore sampling and advanced modeling tools. Both have been repurposed from the medical community where airborne pathogens are measured in hospitals and pandemic modeling is advanced. Currently, the NPMTI includes three crops: cotton, wheat, and corn, but may expand in 2022 to include soybeans and peanuts. Cotton collaborators represent ten states and include Target Spot, Ramularia, Asperfillus, and the seedling disease complex. This last disease was added in 2021 to include soil pathogen samples along with airborne pathogen samples.

Nematodes (RKN and Reniform)

Commercial varieties from multiple companies are now available with Root Knot Nematode and Reniform Nematode host plant resistance traits created by public scientists and broadly released to cotton breeders. However, the expanding acreage of these traits will increase selection pressure for resistance breaking nematode strains. Thus, additional host plant resistance traits are being developed at multiple university labs using the latest tools of genomes and gene editing. Several of these nematode traits have been field planted in 2021 and once efficacy is confirmed will be broadly released to encourage commercial adoption.

Agronomy

Numerous research and outreach efforts are continuing in the areas of soil nutrient management and soil health to improve soil stability, soil water holding capacity, nutrient cycling, and reducing soil compaction and soil erosion. These efforts involve 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 BMPs of these more complex cropping systems. Outreach efforts are being formed to support these areas to improve long-term adoption and collaborative opportunities to reach more growers. A new area of research includes the evaluation of living cover systems which create some challenges and opportunities with pest management and nutrient availability. However, these systems could have large sustainability benefits for suppressing herbicide resistant weeds and reducing herbicide applications. In nutrient management, Beltwide Nitrogen Refinement studies were initiated at over 20 locations to improve nitrogen use efficiency by better quantifying and crediting soil residual nitrogen. Similar soil testing and data collection will be performed at all locations for these trials to strengthen the impact.

In cooperation with the Extension Cotton Specialists, Cotton Incorporated continues to support the Beltwide, Large-Plot Variety Evaluation program. Ten to twelve new cultivars, of the widely grown and new cultivars, are grown with three replications in commercial fields, including planting, in-season management, and harvesting with farmer equipment. These will provide unbiased and timely information to the growers to make decisions on cultivars and traits. A Beltwide Seed Quality project at 15+ locations was continued in 2021 and data are currently being collected to determine the quality of seed sold and to identify seed quality characteristics important to stand establishment.

Weed Management

Reliance on a few effective herbicides, including pre-plant, at planting, postemergence, and as residual tankmix partners, has put tremendous selection pressure on a few herbicides. As a result, the Delta region has reported metolachlor, dicamba, and 2,4-D resistant Palmer amaranth. With ALS, glyphosate, and PPO herbicide resistance previously being documented, the growers were heavily relying on glufosinate. Seed collected from grower fields in the fall of 2020 were verified to be glufosinate resistant. With this broadspectrum weed resistance, it means that growers are receiving less and less value from the herbicide tolerant traits currently being planted. Applied research is being conducted to evaluate BMPs for various weed species to slow the development and spread of herbicide resistant weeds. On-going research efforts include alternative practices to herbicides, weed seed bank management, and a better understanding how herbicide resistance develops at a molecular and genetic level.

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, especially postemergence herbicides, continue to dwindle to just a couple and simultaneously increased selection pressure on remaining 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. On-going research is occurring in several of these areas across the Cotton Belt.

Pest Management

Southeast: 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. Members of the Southeast Row Crop Entomology Working Group (SERCEWG) involved with entomological research and Extension programming for cotton in the region continued to work collaboratively to address these issues with a 2021 regional study. New objectives were included this year to evaluate the non-target impacts of Lygus sprays on beneficial insect communities found in commercial cotton fields and to document the yield benefits of altered planting dates to escape Helicoverpa zea infestation using non-Bt cotton.

Mid-South: Cotton in the Mid-South is affected by a variety of insect pests that reduce yields and increase production costs. Tarnished plant bug, 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. Key objectives for 2021 include evaluations of: 1) thrips control with seed treatments, 2) impacts of Bt cotton oversprays for Bollworm control, and 3) standardized insecticide efficacy trials (Thrips, Aphids, Spider Mites, Tarnished Plant Bug, and Bollworm).

Southwest: Nozzle selection is one of the most important decisions related to pesticide applications. The type of nozzle affects the amount and coverage uniformity of the applied spray as well as the amount of drift. Because the need for insect and weed control occurs simultaneously, it is economically advantageous to farmers to apply insecticides and herbicides at the same time. However, with auxin herbicides, growers are restricted on the type of spray nozzles to prevent drift. New spray tip designs allow adequate spray patterns for weed control while producing large droplets. Such nozzles may not provide adequate insecticide coverage to achieve the desired level of control. Research in the Southwest in 2021 will help understand the impact of various nozzle tips and herbicide-insecticide tank mixes on insecticide efficacy.

Plant bug control efficacy of cotton cultivars varies to unknown degrees and is likely affected by cotton cultivar sensitivity to plant bugs. Recent research evaluated adjusting thresholds based on an observable cotton trait such as leaf hairiness, but there was no distinct relationship. Results showed that some cultivars withstood cotton fleahopper pressure by compensating with new bolls, but there were boll maturity delays which differed across cultivars. In growing areas where earliness is desirable, the issue of plant bug-induced maturity delays is very relevant to cotton profitability and is being addressed with new research in 2021.

Far West: Given their state regulatory system and unique desert environment, few IPM systems have advanced in their strategic use of insect control technology more than cotton in Arizona. Roughly twenty years of historical data on the impacts of many insecticides on non-target cotton arthropods exist but have not yet been analyzed. These data comprise more than thirty groups of insects counted and identified in replicated field trials with insecticides. Research in 2021 will analyze and synthesize these data in light of recent findings regarding key natural enemies in cotton, optimal plot sizes for non-target evaluations, and ongoing research on the selectivity of recently registered insecticides. This research seeks to increase awareness and grower and PCA knowledge of insecticide selectivity, degree of product selectivity, and the economic and environmental benefits of choosing them.

Crop Improvement

Germplasm Releases

Over the past several months a steady stream of public germplasm releases have been made by both USDA and university breeding programs across the Cotton Belt. USDA has had germplasm releases from the Mississippi State and Florence staffs while university releases have come from breeders from the University of Arkansas, University of Georgia, North Carolina State University, and Texas A&M. Many of these releases contain fiber quality and disease resistance genes of great interest to the larger cotton improvement community. Examples of germplasm releases include four from Texas A&M (TAM KJ-Q14 ESU, TAM 12J-39 ESU, CA 4009, and CA 4010) in the Journal of Plant Registrations and one from the University of Arkansas, UA248, in the same journal.

Cotton Winter Nursery (CWN)

Cotton Winter Nursery services in Liberia, Costa Rica, continue to be made available to public sector breeders. Breeders use these services to double the generations that can be advanced per year which brings new varieties and traits to growers faster and allows graduate students to work in cotton genetics. A novel use of the Costa Rica CWN was successfully implemented in 2020 and 2021 in the advancement of early breeding generations. Germplasm lines with tolerance to FOV4 were crossed with elite varieties and are being advanced to the point where the seed can enter advanced trials simultaneously for yield, quality, and FOV4 tolerance.

Strategic Objective 1: Improve the reputation of U.S. cotton production

Sustainability Goals and U.S. Cotton Trust Protocol

U.S. Cotton Trust Protocol

The U.S. Cotton Trust Protocol (USCTP) was fully launched in late July 2020. The CTP team has recently completed an updated grower enrollment interface featuring a streamlined cotton-centric version of Field to Market® Fieldprint Calculator integrated directly within the enrollment portal. The Sustainability Division is collaborating with the Agricultural and Environmental Research Division (AERD) and key National Cotton Council staff, and USCTP leadership to enhance the grower questionnaire experience. Application Programming Interfaces (APIs) with Field to Market® Qualified Data Management Partners (QDMPs) and other agriculture data systems are being explored to allow enrolling producers to connect the USCTP to other software programs. Creating these APIs will help streamline the grower enrollment process and increase the accuracy of the incoming data. To help track U.S. cotton and protocol credits through the supply chain, the USCTP has contracted with Textile Genesis to help with supply chain integration. Several pilots with apparel brands are currently underway with this new system.

University of Georgia and Peanut Council

The University of Georgia and Peanut Council collaborative research project continued in 2021 with the goal of exploring the environmental benefits of the cotton and peanut rotations using the Fieldprint Calculator. This project will continue to enroll Georgia growers who rotate both cotton and peanuts into the Fieldprint Calculator platform to date. Results gathered during 2021 will be compared to the 2019 and 2020 years 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

The Quail Forever project continues to be fruitful and deliver sustainability outcomes and grower profitability on cotton agricultural landscapes in Georgia. The project also continues to deliver new angles to communicate cotton's sustainability as it relates to biodiversity and wildlife habitat enhancement—and how those relate back to the sustainability goals. Most recently, the Sustainability Division and Corporate Communications collaborated with Quail Forever to develop a "project spotlight video," which was presented at the Cotton & Rice Conference in February. The video highlights how leveraging precision agriculture technology in the heart of Georgia's cotton and quail country can improve wildlife habitat conservation and farm profitability.

Quail habitat, such as field borders, pivot corners, and pollinator patches can improve farm biodiversity while simultaneously helping the U.S. cotton industry move closer towards the ten-year sustainability goals. Implementing conservation practices to promote quail habitat can positively effect goals such as increasing soil carbon, reducing greenhouse gas emissions, and improving water use efficiency. The use of precision technology tools helps demonstrate progress towards these goals and validate outcomes with real data.

Microplastics and Cotton Biodegradation

OceanWise Microfiber Partnership

The Sustainability Division and the Product Development and Implementation Division continue to support the OceanWise Microfiber Partnership. The partnership is a group consisting of business and government agency partners who sponsor microfiber research in support of science-based solutions to reduce microfiber pollution in the ocean. The project was started in 2020 and is investigating three core areas: 1) microfiber shedding from fabrics and the role of textile construction, 2) time-dependent variation in microfiber pollution in wastewater treatment plants, and 3) develop an ocean particle library using a novel database of infrared spectra of natural particles and microplastics obtained by FTIR technology from coastal and open-ocean environments. The goal of this research is to increase the understanding of fiber shedding mechanisms help inform industry and consumer best practices, textile design and wastewater treatment designs to mitigate microfiber flow to our oceans.

University of North Carolina Wilmington (UNCW) Fish Feeding Study

A microfiber fish feeding study comparing the effects of synthetic and cotton microfibers on growth performance and health in black sea bass is continuing in 2021. This study is testing the hypothesis that ingestion of synthetic microfibers by early juvenile black sea bass has an adverse effect on fish growth performance and health, whereas ingestion of cotton microfibers does not. A control diet was formulated with fish meal and other practical protein sources, including soybean meal and poultry byproduct

meal as a basis for comparison. Evaluation of growth performance and body composition is currently underway to determine the effects of these fibers on the health of the fish.

Texas A&M University Fish Feeding Study

A microfiber fish feeding study to assess the effects of synthetic and cotton fibers in the aquatic environment on red drum, shrimp, and oysters under controlled aquaculture conditions is ongoing at Texas A&M in 2021. The project will determine the fate of the fibers in water system and various tissues and metabolites of the cultured organisms using a mass balance approach. Additionally, a physical assessment of various organs and tissues of the organisms is being conducted to determine the overall health impact to the species considered in the project.

Sustainability Assessments

Cottonseed Oil Life Cycle Assessment (LCA) and Allocation Study

The Sustainability Division continues its effort to publish 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. A full comparative International Organization for Standardization (ISO) LCA report was completed in 2020. A publication highlighting the environmental benefits of refined cottonseed oil relative to other vegetable oils in the market identifies environmental hotspots in the production process and supply chain, as well as other areas of risk and has been accepted to publication in the Transactions of the ASABE journal.

Global Plastic Leakage Assessment for the Apparel Industry

In 2019, the Sustainability Division participated in the Plastic Leak Project (PLP), which was a collaborative, multi-stakeholder initiative designed to identify, measure, and develop scalable solutions to close the tap on plastic leakage and pollution. The group developed the first ever Plastic Leak Methodological Guidelines, which fill an important gap in managing the plastic pollution crisis by enabling companies to locate and measure plastic leakage along their value chains. In 2020, the Sustainability Division and the original project consultant applied the Plastic Leak Methodological Guidelines to the first Global Plastic Leakage Assessment for the apparel Industry. The project quantified the plastic leakage intensity from a few product categories in the major production and consumption countries. In 2021, the assessment is expanding the coverage with the goal of publishing in a high-impact, peer-reviewed journal.

USDA-ARS Conservation Cropping System Research at Judd Hill Foundation Farm

A conservation cropping system project was initiated in 2020 and renewed in 2021 to explore the long-term environmental and agronomic impacts of conservation practices in irrigated and non-irrigated cotton production. Studies on various conservation cropping practices such as minimum tillage, vegetated buffer strip, and cover cropping have shown to improve cotton growth and yield. Combining all these practices into one management cropping system will effectively assess the multiple benefits associated with conservation practices and affirm the recommendation of these practices for cotton production. The effects of using improved crop and water management systems that maintain or increase yield on greenhouse gas (GHG) emission reduction are being assessed. Baseline datasets of current GHG emission levels under improved conservation management systems and evidence of whether cotton production is a source or sink of GHG emissions are expected.

Pilot to Demonstrate Implementation and Benefits of the U.S. Cotton Trust Protocol (USCTP) and Better Cotton Initiative (BCI)

Demonstration field plots have been implemented at Agricenter International in Tennessee to show similarities between the U.S. Cotton Trust Protocol (USCTP) and Better Cotton Initiative field results. Additionally, more conventional approaches have been used to plant a second cotton field. This project also has a goal to help scale up awareness and adoption of the USCTP by demonstrating how USCTP impacts cotton production. The project provides educational opportunities for extension, researchers, producers, crop consultants, and other key segments of the supply chain to better understand CTP, which impacts overall adoption. Several other sustainability standards and assessments, including the Delta Framework and the Responsible Pest Management framework from The Sustainability Consortium, are being piloted at this test plot.

Sustainability Non-Governmental Organization (NGO) Engagement and Leadership

Collaborations with the textile NGO community remain strong. As an active member of The Sustainability Consortium's (TSC) Responsible Pest Management Task Force, efforts are focused on having the U.S. Cotton Trust Protocol best management practices questionnaire accepted as equivalent to the new Responsible Pest Management Framework that TSC is developing.

The Product Environmental Footprint (PEF) Technical Secretariat (TS) for Apparel and Footwear is another group that has required intensive effort this year. The TS has spent many hours discussing how to measure durability and how to quantify the effect on lifetime of a product. The first draft of the PEF Category Rule for apparel and footwear and the accompanying case study for 13 hybrid representative products was submitted to the TS for comment, and full two-day meetings were held virtually to review the results of the assessment.

Sustainability Standards

Cotton Incorporated has long been involved as a leader in standards development. To extend that position, the Sustainability Division has taken on new activities in circular economy standards as a U.S. expert in the ISO Technical Committee (TC) 323, which is working to describe and measure the circular economy. In May, a member of the division was elected as co-chair of the U.S. Technical Advisory Group (TAG) for ISO TC323. The co-chair is responsible for leading the U.S. TAG in discussions to develop a consensus position on any voting matters, acting as Head of Delegation to present the U.S. position to the ISO TC during meetings, and filing any votes with the American National Standards Institute (ANSI), the official member of ISO for the U.S. This election demonstrates Cotton Incorporated's commitment to leading in sustainability and recognition of circularity as a vital component of sustainability for cotton.

Additional standards development related to environmental aspects of textiles has occurred in ISO TC38 Textiles, ASTM International, and the American Association of Textile Chemists and Colorists (AATCC). Standards for measuring or identifying microplastic emissions are being elaborated in TC38 and in AATCC. A new terminology standard covering environmental terms in textiles is being balloted in TC38. Periodic revisions to current textiles standards also are tracked, and input is provided. All these efforts require participation in numerous meetings, comments on multiple drafts, and coming to consensus on the text.

Cotton Sustainability Communications

The Sustainability Division and Corporate Communications continue to develop a new CottonToday Website. The goal of this Website is to be the go-to resource for cotton and sustainability. The new Website challenges and dispels common cotton myths with credible, scientifically backed editorial content, which will be published to the appropriate digital platforms. The communications strategy has a focus on four key elements: 1) developing a cohesive narrative and content strategy, 2) updating the CottonToday Website, 3) creating editorial content and calendar, and 4) managing communications on the fly to address misleading and incorrect reporting. This increased communication effort will improve the sustainability reputation of cotton for key audiences making cotton decisions.

FIBER COMPETITION: *FIBER QUALITY RESEARCH*

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

Quality Research: Quality Measurements Improvement

Enhancing the Marketability of U.S. Cotton through Length Uniformity Improvement

2021 Objectives: Identify salient features of the fibrogram, which can be used to isolate pertinent fiber length distribution traits. Once identified, check for repeatability, stability, and reproducibility. Following that, obtain cotton bales to create standards to distribute to other fiber labs across the U.S.

Equipment was purchased to facilitate large-scale, rapid collection of fibrograms during normal testing operations. This equipment includes a computer, a secondary barcode scanner, and a serial tap to connect to the High Volume Instrument (HVI®). Due to supply availability and shipping timelines, there have been delays in getting the barcode scanners, so an alternative approach is being investigated. A Windows®-based application for extracting the fibrogram content has been created but needs further testing. Several different new methods have been developed to calculate length parameters from the fibrogram. At the early stages of this work, there is the promise that the measurements from these new hypotheses could potentially be used as reliable fiber quality parameters. This methodology will also be utilized to account for the within-sample variation in fiber length. The analysis will continue to progress this year. While researchers could currently provide the whole fibrogram to breeders, the goal is to provide one to three simple length measurement parameters that reflect the entire length distribution. The examination of a new method of calculating the within-sample variation in fiber length using the fibrogram curve is also underway.

Maturity and Standard Fineness: Determination, Calibration, and Use

2021 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. The goal of this project is to expand existing reference material for maturity and standard fineness based on fiber cross-section analysis.

The commercial survey of current U.S. fiber quality is ongoing, with the HVI® and Advanced Fiber Information System (AFIS®) testing of 2020 crop samples underway. Researchers are still working on the cross-sections of the fifth bale out of nine needed with a goal to complete the fiber cross-sections on bales five and six this year. Two additional bales have been carded and tested with HVI® and AFIS®. The coefficient of variation (CV) among samples within a bale is extremely low, revealing a very efficient blending protocol. At this stage, eight bales have been fully prepared and tested via HVI® and AFIS®. The target maturity ratio and fineness have been determined for the ninth bale based on the AFIS® results, but the research team is waiting to have cross-sectional data on more bales to target the best bale to complete the nine bales set.

Finding Ginning Methods That Improve Fiber Length Uniformity

2021 Objectives: To develop, test, and report on ginning methods that improve fiber length uniformity index.

Researchers reported findings from the previous year's data at two virtual research meetings: Beltwide Cotton Conferences and the International Cotton Conference at Bremen. Data analysis continued for the gin test that examined how length uniformity is affected by lint cleaners using a non-conventional method of placing ginned fiber on the cleaning saw. Delays on this occurred last year, with critical portions of the data inaccessible owing to remote work challenges. One additional hold up has been the concerns over the best statistical approach in analysis. There were differences in multiple variables between the different tests making traditional analysis approaches more challenging. However, researchers have consulted with statisticians to develop the appropriate model, and the publication should be forthcoming.

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

2021 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.

The reciprocating-knife gin stand, a necessary part of this study, was made operational in late 2020. Plans for a complete break-in of the machine are in process, and the formal gin test has been scheduled for June 2021. It is anticipated that this work will continue through the summer and fall. This project has been significantly affected by COVID-19 USDA protocols that limit staff in USDA facilities. The funding was adjusted based on the anticipated work that is feasible to complete this year.

Survey of Cotton Contamination at the Gin Stand Feeder Apron in Multiple Commercial Cotton Gins

2021 Objectives: The goal is to survey the extent of plastic contamination in sampling of cotton gins by deploying low-cost plastic contamination detectors, mounted at the gin-stand feeder apron. The gin stand feeder apron has been selected as it provides the only place in the gin where the cotton is presented in a thin stream of open-locked cotton and is at a position where contamination is easily detected.

The researchers have identified the need for a cut-down Lummus Feeder to enable on-site research progression. Cotton Incorporated is currently acquiring this equipment in a separate agreement with the provider. Additional work is underway on the laboratory version of the Visual Imaging Plastic Removal (VIPR™) to support validation studies on the final USDA version of that system and support future work examining advances in detection algorithms for challenging plastic colors such as black, white, and brown. And work has begun on a redesign of the Visual Inspection Single-Node (VISN) based on this past gin season learnings and will continue into next year to evaluate learnings gained in this coming crop's gin season with it installed at one commercial gin. Data from the gin will be available late in the year after the ginning season commences. It is noted that both VIPR™ and VISN systems will need clean airflow for the systems to function seamlessly at the gins.

Exploring Methods to Extract Plastic Contamination from Cotton (GoldenLion)

2021 Objectives: Investigate and evaluate modifications to the Handan GoldenLion Contamination Cleaner that will improve the removal of plastic contaminants from seed cotton. Investigate other techniques that capitalize on differences in physical properties between plastics and seed cotton to effectively remove plastic contamination from the cotton flow at the gin.

Analysis of the separated plastic pieces from the cotton samples collected during the 2020 testing comparing the GoldenLion to traditional seedcotton cleaning equipment was completed in early 2021. Video captured during the 2020 testing revealed that air currents inside the GoldenLion were stripping plastic pieces from the screen drum before the pieces were removed from the cotton stream. Modifications to the GoldenLion to reduce this issue has been planned for this year. These modifications will be completed, and testing will proceed as COVID-19 limitations allow. A manuscript detailing the side-by-side testing of the GoldenLion, and conventional seedcotton cleaning machines is being written. This project progression is affected by COVID-19 USDA protocols that limit staff in USDA facilities, and funding was adjusted accordingly.

Establish the Suitability of U.S. cotton for Vortex Spinning

2021 Objectives: To study the impact of fiber fineness on vortex yarn quality, specifically, friction among fibers.

Seven additional commercial bales have been obtained for this year's vortex spinning study. These bales include a Pima bale, brown cotton bale, green cotton bale and upland cotton bales, all with relatively high fiber qualities. All bales have been opened, and samples are awaiting fiber testing before spinning trials can commence. The same breeder materials as last year have been obtained from the 2020 season for testing this year. Those samples have been ginned, and fiber testing is complete. Comparative analysis shows good relationships in that sample set between the two crop years. Spinning is underway.

Measurements for Improved Cotton Quality

2021 Objectives: The objectives of this project involve the continued development of a robotic system to acquire fiber quality information at the gin, and to determine the relationship between seed strength and seed coat fragments (SCF).

Multiple camera systems have been evaluated for acquiring an image of the bale in the gin. Initial work for this project was performed with a Blackfly S USB machine vision camera. To lower costs, commercial-off-the-shelf (COTS) camera systems are being evaluated. The COTS cameras being evaluated are designed for the Arduino microcontroller or Raspberry Pi™ microprocessor boards. These cameras are small, lightweight, low-cost, and readily adaptable using S-mount or CS-mount camera lens. Researchers plan to install the system in at least one commercial gin this season which is equipped with USTER® Intelligin. Results from the robotic arm system will be compared with both Intelligin results and USDA-AMS classing results. The robotic arm assembly shall be fully assembled and function-tested by the end of the second quarter in anticipation of field deployment.

The 2020-21 cotton crop experienced record levels of SCF calls in the Southeast. Seed from the National Cotton Variety Test grown in 2020 is being collected to include in laboratory seed strength testing. Seed from the 2019 crop is still being tested. A control lot is being incorporated into testing, consisting of one large lot of the same variety that has been periodically tested to prevent drift in results due to instrument or environmental conditions. This project is still affected by COVID-19 USDA protocols that limit staff in USDA facilities.

Targeting Fiber Quality Attributes for the Fiber of the Future

2021 Objectives: Investigating a potential tool for high speed, novel fineness, and maturity measurement. The second objective is to identify novel fiber quality breeding targets.

Efforts to explore novel and applied technologies in morphological detection of fiber maturity, fineness and diameter were started in 2020. Holographic images from 2021 show promise in exploring the structural variation of cotton fiber fineness, which could eventually be translated into measuring abilities as the project progresses. Images are at the infancy of being structured before algorithms to read the images can be developed. Researchers have found convolutions in the fiber structures which have not been observed in other techniques before. Investigations are ongoing to determine if these convolutions are a holographic feature or due to twin imaging noise.

Genetic Effects of Exotic Genes on Fiber Quality in Upland Cotton

2021 Objectives: The objective of this project is to evaluate the genetic effects of the Gossypium Barbadense chromatin on Chromosome number 25, harboring quality information about fiber length (qFL-Chr.25,) and fiber micronaire (qMIC-Chr.25). Then elucidate the genes conferring fiber length and fineness, respectively. Fiber resilience to withstand fiber processing will also be tested to decipher any potential genetic abilities.

In 2021, researchers focused on seed processing activities, including ginning and delinting seeds needed for the anticipated field trial to be conducted at Gibbs Farm, GA and College Station, TX. The fiber samples from 2020 trials were sent to the Cotton Incorporated Product Evaluation Lab in early February. Results from the fiber data were received, analyzed, and presented in a virtual meeting with staff. Fuzzy seeds were delinted in early March, and seeds were packed and sent to the cooperator at the USDA-ARS at College Station, TX. A poster of the results from the 2020 study was presented at the virtual Cotton Beltwide Conference.

Genetic Dissection of Fiber Traits in a Subset of the Exotic Cotton Nested Association Mapping (NAM) Populations

2021 Objectives: The objective of this project is to identify quantitative trait loci (QTLs) associated with critical fiber traits and utilize AFIS® to attempt separating complexities from HVI® micronaire and HVI® length-uniformity measurements.

Fiber Testing for the Athens,GA location is complete for both HVI® and AFIS® and will be analyzed by the researcher after multiple location data is available. Researchers have prepared, packaged, and mailed seed to the three larger-scale U.S. trial locations. The first larger-scale trial locations at Weslaco and College Station, TX, and Arkansas have been planted.

Effects on Fiber Quality from Gin Variation and Field Trials for Genetic/Genomic studies in Fiber Properties

2021 Objectives: The objective of this project is to assess gin effects on fiber quality measured by HVI® and AFIS®. The secondary objective of this project is to provide location data and support of fiber quality research in genetic mapping populations.

Fiber samples were hand-harvested from the High-Quality variety trials in three lots per replication. Samples were ginned on three separate table-top gins located in Arizona, Texas, and Mississippi. Fiber testing for all three gins was completed, and data was sent out to the researchers. Year two of these trials experienced delayed planting in College Station, TX, owing to rains. Researchers have planted the NAM trials in Weslaco and College Station, TX. Rain and colder weather have impacted these locations leading to slower growth.

Research and Fiber Quality Meetings

Staff participated in various virtual meetings, including the Cotton Beltwide Conference, National Cotton Ginner's Association Technology Committee meeting, Precision Agricultural Research meeting, Cotton Council International meeting, USDA Gin Research meeting, National Cotton Council (NCC) annual meeting, NCC Quality Task Force meeting, Joint Cotton Industry Bale

Packaging meeting, International Cotton Conference at Bremen, Contamination Future Research Brainstorming meeting, Plastics in Cotton Seminar II meeting, and Contamination Future Research Priorities meeting. Staff met virtually numerous times with USDA gin lab staff and industry partners for discussions on round module wrap (RMW) standard development work. Staff conducted virtual meetings with researchers to get updates on the research progress with the USDA gin lab in Lubbock, University of Georgia, Fiber Biopolymer Research Institute, and Clothing Care Research Council meeting. A presentation was given on Fiber Quality to the Southeast Ginners.

In addition to the above research meetings, the team has also been highly involved in traceability efforts as part of the internal Traceability Task Force; has engaged with six technology company providers and done extensive background research on those groups; and has also engaged with a potential new technology provider. Support has been given to three retailers/brands seeking guidance on traceability options, developed a testing plan for one group, and has met extensively with the internal Traceability Task Force and the Cotton Board. In addition to doing background research on technologies, staff has aided with content on the CottonWorks™, including taking part in a Webinar titled Basic Information in Adjusting Sourcing Strategies, creating the Technology Considerations page, and providing input on the chain of custody listing page. The staff has attended multiple Webinars/conference sessions on traceability.

Strategic Objective 2: Provide accurate test data to support research and marketing efforts.

Product Evaluation Laboratory

The Product Evaluation Lab (PEL) acquired a new AFIS® Pro 2 in February for measuring cotton fiber properties, including length and length distribution, neps, seed coat neps, short fiber content, fineness, maturity, trash, and dust. With this new purchase, the lab was able to retire the AFIS® Pro. The lab maintains the 2006 model AFIS® Pro 2 running in the lab concurrently with the new AFIS® Pro 2.

Agricultural and Environmental Research

Testing for Agricultural and Environmental Research (AER) was focused on general Agricultural Research Initiatives, Agricultural Production, and Variety Improvement. Work continued on optimizing nitrogen use, evaluation of annual and perennial cover crops, target spot, transgenic lint test, comparison of gin saws by thickness, oil content improvement, investigations and comparisons of SCF calls, identifying and transferring resistance to emerging cotton diseases, studies to enhance upland cotton yield and quality, management of leafroll dwarf virus, nematode, evaluation of tri-species chromosome substitution lines, developing cotton germplasm with high yield and quality, and gene combinations for cotton improvement.

Fiber Competition

The Standards reference covers a variety of proficiency and calibration practices as follows. For fiber testing, the following routine HVI® studies were completed on each of the two HVI® during the first half of the year: six-monthly check level cotton tests, two Commercial Standardization of Instrument Testing of Cotton (CSITC) round robins, and two Bremen Institute round robins. The lab did not participate in the USDA-AMS 220 Calibration Sets in order to place a higher priority on breeder testing services. For fabric testing, three AATCC and one ASTM proficiency studies were completed. For yarn testing, the TestTex yarn proficiency study was completed. Under the Fiber Management Research reference, a project for the Engineered Fiber Selection® (EFS®) System software using a new handheld color measurement system was done using various cotton samples.

PEL continued work to create standard specifications for the Round Module Wrap (RMW). This has been a cross-division effort between PEL, AER, and Textile Chemistry Research (TCR).

PEL staff also created a virtual tour of the lab and participated in AATCC and ASTM virtual standard committee meetings.

Product Development and Implementation

Highlights of work are listed by department:

- Fiber Processing (FP): Research efforts involved typical support work for bale checks, recycled fiber research of cotton/denim shoddy blends open end yarns, TransDRY® technology ring spun yarns for TCR support, and yarn testing for performance comparison of old versus new FP equipment. Technical Service work was done to assist a company with AFIS® testing to characterize fiber properties. Technical Service work was also done on samples with SCF to determine the impact of SCF on different areas of processing, including a mini-card evaluation, bale testing, and open end yarn testing.

- Product Development (PD): Testing consisted of samples for the FABRICAST™ line, which were tested for basic fabric properties as greige and finished good states, including napped flat knits, mock lenos and warp knits. If the samples contained a technology, the performance of that technology was also evaluated. Yarns purchased for the FABRICAST™ line were tested to obtain characteristic profiles. Research covered efforts such as testing cotton bale twine versus traditional bale twine, cotton bale bag testing, air permeability on breathable bottom-weight fabrics, testing sweater knits made from dyed yarns with TOUGH COTTON™ application, and general fabric performance testing.
- Technology Implementation (TI): Testing services (often involving multiple trials for many different groups) were provided to support the implementation of all Cotton Incorporated technologies, including TransDRY®, WICKING WINDOWS™, STORM™, TOUGH COTTON™, PUREPRESS™, NATURAL STRETCH™, as well as dual technology treatments. Multiple rounds of testing were performed on fabrics made from TOUGH COTTON™ yarn trials run at a mill and evaluations of fabrics with StaySOFT treatment. A marketing study was performed on commercially available bed sheets of different fiber compositions. And testing was also done of a sweat hiding technology in the market for comparison to Cotton Incorporated's technology.
- Technical Services (TS): Testing services (often involving multiple trials for many different groups) were provided to support the implementation of all Cotton Incorporated technologies. Technical Service projects included evaluations of sweat hiding performance and moisture management for various customers.
- Textile Chemistry Research (TCR): Research efforts included work on non-formaldehyde flame retardant cotton fleece, QuickDRY sheeting treatments, WearCLEAN COTTON soil release research, colorfastness properties of biosynthetic indigo dyeing, property retention of PUREPRESS™ finish on fabrics after storage, moisture management work including evaluation of combining pigments with sweat hiding paste, TransDRY®, WICKING WINDOWS™, STORM™, TOUGH COTTON™, and PUREPRESS™ technologies. Work was performed on dual functionality technologies for the FABRICAST™ line and initial testing on PUREPRESS™ for knits. Implementation support and Technical Service continued to focus on PUREPRESS™ technology efforts.

PEL Testing Summary for 2021 as of June 30:

Cotton Incorporated
Activity Summary Report

Date Range: 01/01/21 - 06/30/21 Completed Projects

Department	Reference	Fabric (Projects/Samples/Tests)			Fiber (Projects/Samples)		Yarn (Projects/Samples/Packages)		
Agriculture Research	AG PRODUCTION				1	1			
Agriculture Research	AG RESEARCH				40	9,240			
Agriculture Research	VARIETY IMPROVEMENT				7	2,181			
Agriculture Research	Totals:				48	11,422			
Fiber Competition	AG PRODUCTION				1	148			
Fiber Competition	AG RESEARCH				6	784			
Fiber Competition	FIBER COMPETITION				15	837			
Fiber Competition	STANDARDS	3	5	38	16	40	1	1	4
Fiber Competition	Totals:	3	5	38	38	1,809	1	1	4
Fiber Management Research	FIBER COMPETITION				1	1			
Fiber Management Research	Totals:				1	1			
Fiber Processing	RESEARCH				7	43	13	13	102
Fiber Processing	TECHNICAL SERVICES				3	32	5	5	49
Fiber Processing	Totals:				10	75	18	18	151
Product Development	FABRICAST	56	125	1,036			2	1	7
Product Development	RESEARCH	6	29	105					
Product Development	Totals:	62	154	1,141			2	1	7
Technical Services	IMPLEMENTATION	16	61	139					
Technical Services	TECHNICAL SERVICES	3	20	35					
Technical Services	Totals:	19	81	174					
Technology Implementation	IMPLEMENTATION	123	430	1,148					
Technology Implementation	TECHNICAL SERVICES	2	5	49					
Technology Implementation	Totals:	125	435	1,197					
Textile Chemistry Research	FABRICAST	3	14	14					
Textile Chemistry Research	IMPLEMENTATION	4	25	94					
Textile Chemistry Research	RESEARCH	47	320	846					
Textile Chemistry Research	STANDARDS	1	4	12					
Textile Chemistry Research	TECHNICAL SERVICES	6	43	313					
Textile Chemistry Research	Totals:	61	406	1,279					
	Totals:	270	1,081	3,829	97	13,307	21	20	162

Strategic Objective 3: Develop and maintain software tools to buy, sell, move, and use cotton with improved efficiency and profitability.

Software Development and Maintenance

Updated Software

A new version of MILLNet for Merchants™ software,Version 9.0.1, was released. The new version consists of changes that include better high dots per inch (DPI) monitor support. Crop year was added as a constraint at the bale level when selecting bales for direct shipments. And general bug fixes were made for customers.

Report Programming

The current reporting software controls used for MILLNet™ software were not supported by the original vendor at the start of the year. Programing staff worked on how to convert the current reports to a new vendor's reporting controls. This process went well for pre-built reports, but the staff was still working on the code to build reports on the fly, as this is a lot more difficult in the new vendor's package. In the second quarter, staff was informed that the original vendor was resuming support for the reporting software controls. Staff are monitoring the situation to see how well support for the software continues in the short term to determine if extensive changes to convert all reports to use a different vendor's software should be made.

Portable Printer Addition

EFS® System software licensees that store bales outside in hot climates use non-fading tag media via direct thermal handheld printers. Both the handheld printer and the tag media became unavailable, so the team acquired a portable desktop printer with this capability. Options were added to the handheld code for both Windows® and Android™ devices to support this new printer. Further minor changes to MILLNet™ software are being added to complete the full functionality of this new printer option.

Web-based USCROP™

Programming is looking at the feasibility of creating a mobile Web version of USCROP™ using Raspberry Pi™ units as USDA data servers. The bottleneck has always been how quickly data can be retrieved from the millions of USDA data records. Having a group of cheap devices to use as data servers is a possible solution to the time lag concern.

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

New Licensees

Three new MILLNet™ licensees were signed in the first half of the year: one in Vietnam and two in Mexico. Virtual/remote installation and training have been completed for the first two. Installation and training for the third, in Mexico, will be scheduled as soon as the mill receives training materials.

In addition to these new licensees, one mill group also added new facilities in China and Vietnam, and staff is working to install the software at those sites remotely.

HVI® Educational Workshop

A first attempt at providing a virtual version of the HVI® Educational Workshop was pursued in the first quarter. This workshop typically consists of bringing the lab manager and HVI® operator of an EFS® System client into the U.S. for a week-long session involving several days in the Cotton Incorporated Cary labs and a visit to the USDA Memphis classing office. Staff worked to create recorded presentations for several of the segments and used existing videos from the classing office to mimic the experience. This first effort was provided to one of this year's new licensees in Mexico and was well received. However, unlike training efforts for the MILLNet™ program, staff determined that aspects of the HVI® Educational Workshop need revamping if it will be as effective as the other virtual materials.

Technical Service Reviews Reports

Following last year's efforts to run a fine-tooth comb over the MILLNet™ program, the team focused on reviewing all reports in the program this year. Requests have been submitted to programming, but with the uncertainty of the reporting software controls support, updates on reports are temporarily on hold.

Marketing New Infographics

Staff developed two new EFS® System Infographics for marketing purposes. One graphic provides interesting statistics on the number of years of assisting the industry, the current count of licensees, total that have ever run the software, top locations, number of languages of content support, licensees added by year and bale usage. The second graphic is a timeline of critical events from when the software was first marketed in 1982, dates of the first international license, significant software changes over time, and other milestones. These new marketing materials are intended to convey the breadth of the EFS® System industry's reach and the company's commitment to ongoing support and programming updates.

Equipment Loaner Program

One delay that continues to slow activities down is the time it takes for a newly signed licensee to acquire needed handheld barcode reader and portable printers. In-person installation and training typically required a planning period for travel which often matched the shipping timing for acquiring the needed handheld units. With virtual installation and training, there is no holdup in scheduling if the mill has the equipment. Supply availability and shipping timelines are still impacted globally by COVID-19. To avoid future delays, the team developed an equipment loaner program and developed three complete loaner kits. Each kit contains all handhelds already programmed for the software with necessary cables and is enclosed in a padded hard case that can be shipped globally. While shipping may still be somewhat delayed, the lead time to get the equipment has been eliminated.

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 2021, Fiber Processing (FP) staff have performed package preparations on four projects totaling 276 pounds in support of Cotton Incorporated's TOUGH COTTON™ technology. One project was performed to evaluate a TransDRY® technology performance comparison of the outside, middle, and inside of wound packages.

Spun Yarns for Functional Finish Research

In the first quarter, FP staff spun 600 pounds of Ne 30s, combed, ring spun yarn in support of TCR efforts to further compare C6 and non-fluorine, TransDRY® finishes. Package preparation included backwinding yarns onto dye tubes for the TransDRY® finish application.

Spun Yarns for PUREPRESS™ Technology Developments

During the second quarter, a second iteration of yarns (Ne 40/1) began production on three spinning systems (240 pounds) to support PUREPRESS™ technology for PD and TSI fabric research.

Novelty Yarn Evaluation of Utilizing Recycled Fiber

Circularity remains at the forefront of concern for manufacturers and brands in 2021. Following up work begun in 2020, the FP team continued research on effective blend levels of virgin cotton and recycled fiber. In the first half of 2021, a blend level of 60/40, virgin/denim shoddy, was selected. Processing recycled fiber is a challenge and doing so efficiently while achieving acceptable quality standards is the goal. Thus far, FP has produced open end (OE) yarns in counts of 14s, 18s, and 22s that yielded promising results. Working in collaboration with the PD group, the 18s were chosen as a filling and warp yarn to produce chambray fabric aimed at creating interest in the market. Various blends, yarns, and fabric types will be explored throughout 2021.

Evaluation of Cotton with High Seed Coat Calls

In response to cotton from the Southeast growing region receiving high seed coat calls from the U.S. Department of Agriculture (USDA) testing labs, the FP team began a comparison study to determine severity. Six bales were purchased for testing. Ring spun and OE yarns have been produced in Ne 22/1 count with physicals captured from bale to yarn. Knitted fabrics have been produced to further compare the test versus control samples. A comprehensive, technical report to better inform the industry is complete and currently under review for publication.

Fiber Processing Nonwovens Technical Evaluation of Recycled Fiber using T-SCAN TS-T5 Contamination Detection

After discussion with a nonwoven manufacturer, FP staff developed a project to evaluate and determine proper settings on the FP Lab's new cleaning and contamination removal line. Recycled fiber from sources such as denim and T-shirt fabrics are in process of evaluation in the FP Lab. This work can help nonwoven manufacturers determine best practices and technologies to process recycled fibers in their own manufacturing lines. These evaluations will continue into third quarter 2021.

FABRICAST™ Information System – Textile Collection for Marketing Toolkits: FABRICAST™ Collection 2021 Part I

A new collection of fabrics for apparel and home cotton inspiration was launched in May. Both physical and digitally produced assets will provide numerous avenues for industry outreach. Fabric hangers and technical recipes were distributed to all account management staff in GSCM. Digital twins of each new fabric were created and uploaded to the CottonWorks™ Website for use by brands in 3D Apparel Prototyping platforms. Additionally, materials for corporate communications were supplied for online social media engagement. The 25 new projects fall into three main categories: Sustainability Focus; Performance; and Color, and Stitch & Weave. These developments support two of the strategic priorities in the PDI Division which are Sustainability and Product Improvement, Performance, and Implementation.

Deliverables in the collection include innovations for product improvement through construction, blends, and finishes. Four breathable, lightweight, woven outdoor shirting fabrics feature breathability due to their construction via pinholes created through deflected weaves. Robust woven bottom-weight fabrics, built with double twill lines, provide superior abrasion resistance solely

through their weave structure, while STORM COTTON™ technology adds water resistance and reduced absorbent capacity for faster drying. Cotton-rich novelty yarns, with recycled polyester thick spots, address reuse of fibers as well as provide avenues for interesting color effects. Surface interest through novelty yarns, knit and weave stitch effects, and print and dyeing techniques, translate to refreshing modern cotton ideas. The scouring process removes the pectin that binds wax and other impurities to cotton fibers. There are two scouring processes, enzyme scouring (bio derived) gives fabrics a soft hand, reducing the need for softeners; and enzymatic scouring is an alternative to conventional detergent scouring. A texture rich assortment of knit and woven fabrics was minimally processed with enzymes and left in their natural cotton color for a strong eco-friendly story.

New Blends to Challenge Competitive Markets

Graphene is a physical form of carbon that is only one atom thick and considered the thinnest material known to mankind. It is also an excellent conductor of heat. When covalently (chemically) bonded with nylon fiber, permanent thermal properties result, lasting the life of a textile product. Knitting cotton with graphene nylon, in a double face construction, built a successful combination of soft cotton comfort and lightweight thermally-conducting performance for active base layers.

Cotton and Cotton-Rich Alternatives to Synthetics

Studies have shown that synthetic fleeces are sending microfiber plastic to waterways, which is why cotton-rich fleece alternatives were developed as a step towards a natural solution. Included in the FABRICAST™ collection 2021 Part 1 are three-end fleeces with a low percentage synthetic blend as an alternative to the all-synthetic fleeces that are a main staple in the current apparel market. Pigment prints are combined with muted stripes in the pile for a novel and updated look.

In 2020, FP produced over 200 pounds of 80% cotton/20% wool yarn for PD internally. This was in support for the development of a synthetic fleece alternative-Sherpa knit, with the goal of offering an all-natural fleece fiber blend for outdoor wear. A sufficient percentage of wool in the fabric was required to pass Class I Flame Retardancy. This project is in the queue for knitting in-house during the second half of 2021.

Sustainability Focus in Fabric Development

The approach for minimally processed woven and knit fabrics in apparel and home, using no dyes or enzyme processing in place of other chemicals, is a logical method that has successfully been used to create product with a lower ecological footprint. Novel constructions in support of cotton's natural narrative, to eliminate or significantly reduce reliance on chemistries, has been a focal point of development work over the past few years. One of the most popular developments to date is a textural knit with a corrugated piping where tunnels of trapped air encourage insulative properties. The top requested knit and woven fabrics by brands continue to be of the minimally processed variety, illustrating the relevance of the work PDI has made in this area.

In development is twill bottom-weight fabric with a white warp and cationic treated heather yarn. This fabric was developed based off a trend fabric and includes a sustainability story with the use of cationic treated yarn in the filling. The fabric will be dyed with reactive dyes in a way where only the treated filling yarns will be affected. Cationic treated cotton does not require salt or alkali to dye the fabric and less effluent remains in the dyebath after the dye process. Additionally, new sweater knits are in development, building on ecofriendly lower-input processing methods.

TOUGH COTTON™ for Cotton Sweaters – Garment and Yarn Application

Research continues into applying TOUGH COTTON™ technology to sweater knit fabrics. Testing was carried out on a variety of sweater knit and circular knit substrates; and considerations towards suitable testing methods for fabrics that have looser, or larger stitches, may need to be made. Numerous rounds of testing have proven this application process successful for circular knit products. Efforts continue to determine how larger sweater knitting yarns can be successfully treated with TOUGH COTTON™ technology at the same time the yarns are dyed. Once achieved, these yarns will go into traditional knit structures such as Fairisles (float jacquards) and Intarsias (knitting technique to create patterns) to show the technology's purpose on classic knits.

Refocus on Key Markets – Denim

In the May collection, inspirational and fashion forward flocked denims were procured from a Japanese mill to show as is with innovative garment finishing effects. The denims included two that were 100% cotton with iridescent flock in a large twill pattern, one high cotton/linen blend denim with the same iridescent flock in the twill pattern, and a 100% cotton indigo-denim base with an allover blue rayon flock.

Work continues at the end of second quarter on a new denim collection that will feature interesting and innovative surface effects with every effort to use lower ecological footprint processes. Trends are beginning to move away from stretch in denim and PD has ideas for the industry that will push concepts in 100% cotton. Lighter weight denims for spring/summer and heavier weight denims for fall/winter will feature interesting slub effects. As more denim mills are moving towards 100% cotton denim with more sustainable finishing, PD initiated laser etching and ozone research trials to begin comparing their ecological footprints. Potassium permanganate spray (PP) has been used widely in the denim industry to achieve bleached-down effects on denim garments. The industry is now trying to reduce its use because of the negative impacts on textile workers and the environment. Laser and ozone are both viewed as less harmful processes for denim workers and the environment. Various denims have been submitted for initial trials, and thus far the results have been promising.

Refocus on Key Markets – Home Goods

In the May collection, a variety of home product-oriented fabrics included highly dimensional dobby weaves left in their natural cotton color and soft lustrous knits for blankets and throws. These fabrics speak to sustainability with the way PD processed them using substantially reduced chemistries. Product Development also developed 100% cotton bed sheets using Cotton Incorporated's TOUGH COTTON™ finish for added durability. These sheets are more durable than standard cotton sheets and will last longer, again showing how sustainable cotton is.

A renewed push to enhance brand engagement with cotton ideas in key markets began this year to enhance these areas through research and development (R&D) of innovative and inspirational targeted collections, featuring performance enhancing finishes, durable softness and cooling, and less harmful processes.

Cotton Warp Knit Initiative

With the durability of a woven and the softness and stretch of a knit, 100% cotton warp-knit fabrics were developed with a leader in warp knitting machinery. The development increased fabric strength, prevented snagging, and gave the knits more of a woven appearance. Warp knitting fabrics has been a great opportunity for expanding cotton fiber into active sportswear. The development experienced delays but will be completed during the second half of 2021.

Performance through Construction and Finishing

Several projects this year are building on engineering constructions for performance starting with yarns specifically developed by FP for higher strength and low fuzzing, then targeting polo shirt fabrics from PD. The fabrics will be finished by TCR with PUREPRESS™ technology for enhanced smoothness to compete with continuous synthetic-filament fabrics. As an addition to the project, TransDRY® technology will be researched to impart additional breathability and moisture management. Finally, three different spinning systems will be compared to assess their performance characteristics.

The Effect of Avitera® SE Multi-Functional Reactive Dyes on the Dye Uptake Differences Between Untreated Yarn and Yarn Treated with Non-Fluorine TransDRY® Technology

Designed to determine the cause of the dyeability difference between untreated yarn and yarn treated with non-fluorine TransDRY® technology and at a Peruvian mill, this project concluded that the number of reactive groups in the dye molecule had the biggest effect on the increase in dye uptake, with mono-reactive blue dyes, such as Reactive Blue 19, producing the most drastic differences. The results of that research were documented in technical report TCR20-14. This research project is a continuation of that research. The goal of this second phase is to research the effect that multi-functional reactive dyes, such as Huntsman's Avitera® SE dyes, have on the dyeability differences between non-fluorine yarn treated TransDRY® technology and untreated yarn. Lab trials and spectral readings were conducted, and the project was documented at the end of quarter two. The technical report entered the draft stage at the end of quarter two and will be completed in third quarter.

TOUGH COTTON™ Technology on Sweater Knits

To improve the performance characteristics of 100% cotton sweaters, trials were designed to develop a process to improve the durability and abrasion resistance of sweater knit fabrics by using TOUGH COTTON™ technology. The goal of this research was to establish a process for applying TOUGH COTTON™ technology to sweater knit fabrics utilizing the machinery capabilities typically found in sweater garment-finishing facilities. The fourth phase of this project, which was to exhaust TOUGH COTTON™ technology on garment forms, was conducted under GPPL#2020-045 and completed during fourth quarter of 2020. During the first quarter 2021, results of those trials were documented in technical report TCR21-03, *TOUGH COTTON™ on Sweater Knits,*

Part 4: Garment Exhaust Method. The results of this research were then shared with staff and additional trials were run in the second quarter to address concerns raised by staff after similar trials were run in Chinese mills.

TOUGH COTTON™ Technology for Yarn

Research has been conducted to provide a method for applying TOUGH COTTON™ technology to cotton yarns that can be knitted into socks or other substrates. Lab trials were conducted to overdye jersey-fabric samples that were knitted from TOUGH COTTON™ technology as well as untreated control yarns. These dyeings were conducted in the Mathis JFO. One dyeing was with a three-dye combination and the other dyeing was with Reactive Blue 19. The dyeings were level, on-tone, and the Martindale abrasions results (Trizact abrasive) were very good for the TOUGH COTTON™ technology samples. A set of trials was conducted to dye yarns for sweater knits while also treating the yarn with TOUGH COTTON™ technology while it was still in the package machine. Product Development is ready to move forward treating more yarn types, colors, and fabric constructions.

TOUGH COTTON™ Technology for Denim – Lasering

The goal of this project is to investigate lasering of denim prior to application of TOUGH COTTON™ technology (garment application) or after the TOUGH COTTON™ technology is applied (pad application). This could create new uses for TOUGH COTTON™ technology, as brand interest is on the rise for it, and laser etching of denim is a trending sustainable option. The TOUGH COTTON™ technology has been successfully applied to cotton chambray-denim fabric for shirting (pad-dry-cure). It has been found that fabric treated with TOUGH COTTON™ technology can be laser etched. The chambray fabric was included in the FABRICAST™ collection. At the end of the second quarter work was also in progress to apply TOUGH COTTON™ technology with an exhaust procedure to heavyweight denim garments. This procedure could provide substantial advantages, as compared to other garment procedures (garment dip, metered addition), because exhaust finishing could be performed immediately after garment washing.

Thermal Technologies on Cotton

The team is researching to improve the thermal behavior of a cotton rich substrate using resources that contain graphene or minerals. A wear trial needs to be completed to finish this project with the data collected in 2021.

Ozone Dischargability Characteristics of Reactive Dyes on 100% Cotton

This study is a preliminary segment of a much larger study to document and display the effect of more sustainable methods of discharging color on 100% cotton substrates dyed with reactive dyes. This study was designed to determine the optimum level of ozone needed to effectively discharge reactive dyes on 100% cotton-interlock knit using the Tonello G1 ECOfree garment dye machine, equipped with an ozone generator. Specifically, this study measured the effect that various levels of ozone exposure had on the amount of color loss of a 100% cotton interlock-knit fabric dyed with Novacron Super Black R. The results of this study determined the level of ozone exposure applied to various reactive dye primaries. The technical report documenting the results of this research will be drafted at the end of the second quarter.

Natural Finish for Cotton

To explore the feasibility of a natural finish concept for cotton fabric, research is underway to explore the concept of a natural topical finish which produces a measurable improvement in a property. Chitosan was co-applied with sodium alginate on bleached cotton-interlock fabric. Minimal color change was observed. Additionally, during this time, a multifunctional epoxidized soybean oil (ESO) was sourced from several chemical companies and an experimental emulsion was prepared by a partner chemical company. The ESO was also co-applied with chitosan. Before ascertaining physical properties, work is focused on the application and retention of the applied chitosan and co-reactants. Samples will be sent for Kjeldahl nitrogen analysis to have an analytical determination of the retention of the applied natural finish concepts.

Flame Retardants (FR) For 100% Cotton Fleece

The scope of this project is to develop an environmentally friendly flame-retardant system for 100% cotton fleece fabrics. Preferably, the flame-retardant system can be co-applied with STORM COTTON™ technology. After extensive work in 2020, a project request was submitted to Dyeing & Finishing Applications Lab (DFAL) to dye and finish several rolls of three-end cotton fleece obtained from a local knitting mill. Several options will be investigated: DMDHEU Control vs. Non-Formaldehyde FR Finish, pre-napping vs. post-napping, and buffer wash vs. water-only wash. The fabrics have been dyed and napped and trial work will begin in the second quarter.

PUREPRESS™ Finish Optimization on Cotton Knits

Optimization studies help determine the best overall parameters for applying recently developed non-formaldehyde resin technology to cotton knit fabrics. In addition to durable press (DP) performance, wicking and drying time performance will be examined. Several lab trials have been conducted to apply PUREPRESS™ finish to the first round of knits from PD. The first round of knit fabrics were somewhat hydrophobic, so post-scouring trials have been conducted prior to PUREPRESS™ application. Other trials were conducted to compare the different spinning systems/finishes, for effects on fuzzing/pilling, up to 20 Home Laundry Test Data (HLTD). All information is being pulled together into research reports in preparation for the second round.

WearCLEAN™ Cotton: Soil Release

The purpose of this research is to develop two dual-action STORM COTTON™ technology treatments; one to repel water and release oily stains after 30 HLTD and another wickable soil-release option, that does not repel water. Two technical reports are available describing the development of the WearCLEAN™ C6 STORM COTTON™ treatment (TCR20-05 and TCR20-58). A description of the wickable C6 WearCLEAN™ cotton treatment is available in TCR20-59. And lastly a large chemical company has released a one-of-a-kind non fluorine soil release option (TCR20-60) which is not as strong as the corn oil soil release that is provided by both C6 options. These reports were forwarded to consumer marketing to analyze consumer interest in the WearCLEAN™ cotton market.

Dual Technologies

Combining Cotton Incorporated technologies debuted in 2019, with a continuation into 2021. Combinations of technologies create cotton fabrics with additional levels of performance to better compete with synthetics. Various combinations are evaluated for strength, comfort, and increased levels of performance.

- WICKING WINDOWS™ + TOUGH COTTON™ Technologies: This ongoing project investigates the potential to combine WICKING WINDOWS™ + TOUGH COTTON™ technologies for improvements in both moisture management and abrasion resistance. The original formulation of TOUGH COTTON™ technology was successfully applied to C6 WICKING WINDOWS™ technology, printed on jersey knit fabrics. A new, modified TOUGH COTTON™ technology formulation has been established for both C6 and non-fluorine WICKING WINDOWS™ technology prints on woven fabric. A modified formulation of TOUGH COTTON™ technology has also been established for non-fluorine WICKING WINDOWS™ technology prints on knit fabrics. The TOUGH COTTON™ technology formulation for woven fabrics requires a lower amount of nonionic high-density polyethylene compared to the amount used on knit fabrics. The performance of non-fluorine print WICKING WINDOWS™ technology on knit fabrics was improved by reducing the amount of hydrophilic amino-functional silicone softener in the TOUGH COTTON™ finish compared to the amount used in the original formula of TOUGH COTTON™ technology. Substituting an anionic modified polyurethane crosslinker for the hydrophilic amino-functional silicone softener was also a viable option for the modified TOUGH COTTON™ finish on non-fluorine print WICKING WINDOWS™ technology on knit fabrics.
- Incorporating The NATURAL STRETCH™ of Cotton: The goal here is to develop new NATURAL STRETCH™ woven samples for the FABRICAST™ collection, in combination with TransDRY® and PUREPRESS™ technology. There are new opportunities for 100% cotton-stretch fabrics to replace blends of cotton and elastic fiber yarns, especially in view of the concerns about synthetic microfibers in the environment and issues around recycling fabric blends. Several new NATURAL STRETCH™ fabrics have been received by PD. Bottom-weight fabrics and shirting fabrics are part of the inventory. Some shirting fabrics contain yarns treated with TransDRY® technology. Fabrics have been selected for application of either TOUGH COTTON™ or PUREPRESS™ technology.

Bis-ether-di-quat (BEDQ) Cationization of Cotton

Pursuing development of a new cationization of the cotton platform, based on a newly patented cationization molecule from a major chemical supplier, is the goal of this project. A new cationic cotton webinar was completed in collaboration with the chemical supplier. The webinar was well received and generated several follow up inquiries. A major clothing retailer released their Color on Demand concept based on the utilization of the chemical supplier's new cationization chemistry ECOFAST™ Pure sustainable textile treatment. The chemical supplier has asked about a future collaboration to have a follow up webinar to provide further focus on the cationization process on cotton and subsequent savings obtained. Summaries detailing the cationization and dyeing of cotton with the new cationic chemistry ECOFAST™ Pure, and the traditional quat-188, were prepared for the Asian Team during the second quarter.

Newness Retention for Cotton

This project seeks to develop a finish application for cotton that will extend the as-new appearance of a cotton garment. This includes improving smoothness, abrasion resistance, and color retention. The focus of this project has changed to evaluate the effectiveness of various detergents and laundry boosters for their ability to maintain newness of laundered cotton. Numerous detergents and laundry boosters have been obtained. Product claims and SDS information of the have been compiled. The products will be evaluated using different types of knit fabrics that have been dyed different colors with reactive dyes. The products will be assessed on their ability to maintain color as well as other physical properties through multiple HLTD. The goal of this project is to uncover new chemistry that may be added in fabric finishing to prolong the appearance and life of a cotton garment.

Cotton-to-Sugar

Refining a process that allows cotton-based textiles to be enzymatically digested into sugar for the potential to further obtain ethanol, or other value-added products, is the goal of this research. A great deal of work was completed on this project in the second quarter. Kinetic studies were carried out on bleached and black-dyed cotton knit fabrics. By varying the level of enzyme and carrying the hydrolysis through a seven-day window, a thorough understanding of the kinetics of both types of fabrics was obtained. These studies will be repeated with the utilization of a high-pressure reactor to allow hotter pretreatment temperatures. Additionally, all the mechanically refined samples from the NCSU Outside Research Project have been hydrolyzed with various methods. It was found that in most all cases, a combination of the chemical pretreatment developed at Cotton Incorporated, and the mechanical pretreatment developed at NCSU, yields higher hydrolysis efficiencies than either process alone.

Seed Delinting with Enzymes

This research aims to explore if the enzymes and knowledge gained in the Cotton-to-Sugar project can be utilized, specifically to discover if cottonseed can be delinted without the use of acid. The possibility of adopting the methodologies and components of the cotton-to-sugar process to delint cottonseed is being explored. This approach would offer a more sustainable or green solution than the current method that utilizes inorganic acids.

Durable Thermal-Regulation Finish for Cotton

This project looks at researching a non-formaldehyde thermal regulation finish for cotton that is durable and incorporates a moisture management technology. During the second quarter, TCR worked with PD to have the phase change material (PCM) printed fabrics made available in the FABRICAST™ collection. New non-fluorine based PCM and WICKING WINDOWS™ prints were printed on the fabric and submitted for evaluation of the performance of the new designs. New prints screens for WICKING WINDOWS™ technology are being evaluated and PCM was directly padded on to fabrics and evaluated. Padding of PCM seemed to be satisfactory and will be scaled up in DFAL during the third quarter.

3D Printing and Injection Molding

This project focuses on continuing developments with cotton-rich 3D print filaments and injection molding resins. This growing market presents opportunities to introduce cotton. Several projects have been initiated. First, a new project with an outside company is underway to help improve the properties of a cotton rich filament. Paperwork was completed to initiate another project with a company in Mexico to make buttons that incorporate cotton fiber, thus displacing synthetic material. In addition, a trial was run with a partner in Michigan to enhance the adhesion between cotton and polylactic acid (PLA) in a bicomponent 3D filament.

Pre-Treatment for Disperse Dyeing of Cotton

This project aims to 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. Notification was received that a European patent will be granted from previous efforts in this area in collaboration with a major brand.

Outside Research: Recycled Textiles to Bio-based Building Blocks — Technology and Business Development Toward Pilot Demonstration

The goal of this study is to further evaluate the use of mechanical refining to pretreat cotton textiles for enzymatic hydrolysis. Work has continued to progress on this project. During this progression, a newer generation of enzyme was sourced and supplied to the NCSU team. The new generation enzyme substantially improves the hydrolysis yield, especially with respect to the amount of enzyme required for efficient hydrolysis as well as the time to reach efficient hydrolysis. The NCSU team also

believes they found methods to mitigate the issue seen with black-dyed goods inhibiting hydrolysis. These are emerging areas of research but could potentially be very important to increasing the efficiency of the hydrolysis of dark colors.

Outside Research: Anaerobic Decomposition of Cotton Fabric Under Simulated Landfill Conditions

This ongoing research was designed to evaluate the rate and extent of the anaerobic biological decomposition of three types of cotton fabric under simulated landfill conditions by comparing the decomposition behavior of cotton fiber to a synthetic polyester. After work restarted at NCSU in June 2020, samples were placed in the reactors for 223 days. A report, detailing results through 223 days in the reactors, was received and analyzed during first quarter 2021. The results indicated that the polyester fabric did not produce methane under simulated landfill conditions. Durable press was the only treatment on cotton that inhibited methane production after 223 days. Methane yields for bleached only, softened, or dyed cotton were all statistically equal after 223 days. Under the current plans, the experiment will continue until methane production stops, at which point the fabric samples will be removed for visual assessment.

Outside Research: Fundamental Studies of Cotton Fabric Dyes, Finishes, and Their Degradation Products in Aquatic Ecosystems

The goal of this study is the identification and quantification of degradation products generated in previous aquatic degradation projects. After extensive testing in 2020, work continues with testing being conducted on fabric samples laundered in an SDL Atlas Launder-Ometer® and then subjected to enzymatic treatment. The results from this testing were slightly different from those seen after the milder "washing" test conducted in third quarter 2020. The polybenzimidazoles (PBI) only finish lost most of its resistance to enzymatic degradation after laundering (80%) compared to washing (54%). Strangely, C6 + PBI and Wax + PBI showed more resilience following laundering (4% and 7% respectively) compared to washing (28% and 27%). Fabric residue samples were also analyzed after aerobic aquatic degradation in activated sludge. The aquatic samples contained a degradation product with a higher bond dissociation energy compared to a degradation product that was found in both soil and aquatic samples.

Outside Research: Detoxification and Fermentation of Dissolved Colored Discarded Cotton Fabrics

This project aims to develop a methodology to add carbon to purify heavily colored hydrolyzed-cotton fabrics to further produce value added products such as butanol. Work has continued to progress in this area. A large quantity of cotton fabric, dyed with a mixture of black-five and hydrolyzed at Cotton Incorporated, was provided to the principal investigator (PI) at the USDA. The PI has indicated that attempts were successful in purifying and further producing new products from the providing hydrolysate. A project update is scheduled in third quarter.

Outside Research: Synthesis of a Hydrophobic Cotton Finish Using Cottonseed Oil

The goal of this project is to develop a hydrophobic finish from cottonseed oil for application on cotton. The synthesized finish will be tested in the lab by padding on cotton and evaluated for its hydrophobic property. The initial set up and partial epoxidation of cottonseed oil was achieved and now the reaction conditions are being optimized. The epoxidized cottonseed oil was characterized using Fourier-transform Infrared Spectroscopy (FTIR).

Outside Research: Cottonseed-Oil Based UV-Curable Resins for Composites and 3D Printing

This research is to synthesize UV-curable resins from cottonseed oil then characterize the resin properties. To convert most of the cottonseed oil into a modified version, the process parameters must be optimized. 3D printing will be used to show proof-of-concept when developing final composite material. The coatings based on synthesized acrylate epoxidized cottonseed oil (AECO) were subjected to thermal analyses such as thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), and dynamic mechanical analysis (DMA). Based on the results, the thermomechanical properties of the thermoset systems are understood to help investigate the vitrimer behavior of AECO. The 3D print filaments were extruded from AECO and were evaluated at the end of the second quarter.

Outside Research: Developing Bioproducts from Low Maturity Cotton and Cotton Wastes

This project will explore ways to add value to low quality cotton fibers (low micronaire). The biodegradability study of the film is being repeated during spring and early summer 2021. Analyzation of the material left in the soil from the burial study was completed in 2020. The next steps will be a burial study focused on a controlled moisture level.

Outside Research: Microfiber Degradation in Aqueous Conditions

In the first quarter of 2021, the degradation of cotton fiber was compared with other products that are intentionally flushed into the wastewater treatment system, to determine the comparative degradation. Cotton was compared with toilet tissue, a flushable nonwoven wipe, and a non-flushable nonwoven wipe. The results of this study showed that after 100 days, the cotton fiber had degraded more completely (86%) than the other cellulose based products (78%). Only the cellulose portion of the non-flushable wipe degraded.

Outside Research: Ocean Wise Shedding Study

Cotton Incorporated is part of a research consortium funding Ocean Wise, Vancouver CA, as they evaluate different fabrics and their degradation performance. In Phase I, fabrics are subjected to various weathering situations. Several dyed and finished cotton samples were submitted and the evaluation is ongoing. In Phase II, the goal is to evaluate the shedding propensity of different polyester fabrics when subjected to accelerated laundering. The same denier size was used in all the constructions, but a different denier/filament was studied. For each yarn condition, virgin polyester was compared to recycled polyester. In 2021, the polyester fabrics were knit and finished. Then portions of the fabrics were submitted for napping or napping and shearing.

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

Evaluate and Purchase New Generation Smart Card

As 2021 began, FP sought the latest carding technology available to improve existing capability. After evaluating models from the three major suppliers of carding machines, the Truetzschler TC-19i "Smart Card" was selected. This card adjusts its settings to optimize fiber quality and minimize fiber waste. It monitors the amount of "good" fiber being removed and will adjust running parameters to minimize the loss. Layout, ductwork, electrical details, and the purchase order has been issued to purchase, receive, and install this card by the end of 2021. After installation, FP will run trials and provide information to the industry regarding waste reduction and quality improvements of cotton sliver.

Contamination / Ginning Research

In January, the FP team began evaluation of the eleven VIPR™ bales purchased after gin testing in Georgia at the end of 2020. Utilizing the new opening/cleaning/contamination detection system, the amount of plastic contamination remaining in these bales after gin stand testing was captured and quantified by color. The information was compiled, compared to the quantity removed by the VIPR™ Contamination Detection System, and reported to USDA Agricultural Research Service (ARS) staff. The ability to perform this testing was invaluable in supporting this collaborative effort and will continue to be a resource to Cotton Incorporated and the rest of the industry.

Another collaborative effort in contamination research involved evaluation of 72-lint samples (546 pounds in total) received from ginning researchers to determine the quantity of module wrap that was able to be removed from each sample, utilizing the T-SCAN TS-T5 in the FP lab. Each sample was processed through the contamination detection system two-three times, and the plastic was captured by color and then weighed using sample identification. Upon completion, a comprehensive report was issued to principal parties. Cotton Incorporated will be included in final reports compiled using the information provided by FP.

Technical Service Support with Yarn Spinners and Manufacturers

Throughout each year, FP staff support technical service efforts in collaboration with many of our division partners (EFS® System, Fiber Competition [FC], GSCM, PD, etc.). This has remained true for 2021, as FP team members have been involved in advising an international operation on the subtleties of avoiding barré and the importance of accurate fiber property selections. Another large yarn/knitting operation received input on the importance of length uniformity, reducing card waste, and optimizing card performance in the spinning mill. A large vertical international-shirting manufacturer received a detailed review on the importance of Rd and +b control in the cotton laydown. A well-known sock maker received support in their efforts to learn more about yarn spinning and its relationship to physical properties and garment performance. Most recently, the FP team along with GSCM and FC, have been providing guidance to a manufacturing operation in Central America currently building a large yarn spinning operation that will utilize more U.S. cotton. All efforts in this category are in support of increasing the efficient use of, or expanding the presence of, U.S. cotton.

NATURAL STRETCH™ Revitalization - 100% Cotton Mechanical Stretch

An interest in biodegradable apparel fabrics with a circularity opportunity continues to increase while stretch remains a key driver across apparel markets. Spandex and polyester are typically inserted into fabrications to produce varying degrees of stretch and recovery. However, if circularity is desired, the difficulty in separating the various fibers during recycling is suddenly illuminated. Cotton Incorporated's NATURAL STRETCH™ technology can provide comfort stretch in 100% cotton fiber and will be a focus of research in PD. The technology process for NATURAL STRETCH™ cotton involves specific weaving instructions and mercerization with a caustic solution to set the stretch. Research bypassing the mercerization process achieved surprising stretch with just the fabric construction and relaxation finishing. Analysis will continue this year comparing the stretch and recovery between a belt dryer and industrial tumbler. Product Development anticipates the recovery to be less robust in the non-mercerized fabrics; however, being able to bypass this chemistry intensive process in some cases will have benefits.

To showcase the NATURAL STRETCH™ technology, PD collaborated with Cotton Incorporated's Asian team to source and produce a renewed collection using a variety of weights and constructions. The collection is a range of lighter weight five-ounce shirting fabrics to heavier 11-ounce bottom weights in plain, oxford, twills, and a dobby. Most of these NATURAL STRETCH™ fabrics will be released in the second FABRICAST™ collection. For future releases, Cotton Incorporated technologies will also be considered for additional performance. For example, in collaboration with a South American mill, lightweight shirting fabrics combining NATURAL STRETCH™ cotton with TransDRY® technology were developed. The fabric quality, stretch, recovery, and moisture spread was impressive and will provide excellent 100% cotton options to share with outdoor active brands.

Recycled Cotton Content in Fabric Development

The PDI division has taken a measured approach in addressing recycled content in our research and fabric development activities. Studies show that the addition of short and reprocessed fiber causes weaker yarns and higher contamination in the textile factory. The push for using recycled raw material in apparel is picking up speed, and a mindful strategic approach is being taken from R&D. By utilizing recycled cotton and polyester content in novelty yarns, no developments that displace conventional yarns have been entertained.

Cotton-Bale Twine Research

A Cotton Incorporated team continues collaborative research from 2020, investigating a cotton alternative to synthetic hay-bale twine. The collaboration engages a team of researchers from PDI, FC, and the Agricultural & Environmental Research Department (AERD). Challenges for this project remain including strength, durability, and cost. In 2021, research exploring potential opportunities will continue to build a knowledge base of existing products in use. The PD team will serve in a support role for a related university proposed-research project, by providing materials for testing and analysis.

E-Textiles

Research and development continued into wearable electronics and smart textile technology. Ensuring cotton is included in the future of e-textiles is important as most of the work that is occurring is with synthetics. For an e-textile innovation project, PD partnered with a specialized materials company for printing electronic circuits onto thermoplastic polyurethane (TPU) film which could then be applied to cotton fabrics for wearable electronics. The goal is to have display quality cotton-rich fabrics, enabled with digital heating technology using printed conductive ink on TPU film, for future trade shows and other events. Fabrics with some degree of stretch have been used to take advantage of the printed TPU circuits pliability. This project is in the production stage with deliverables anticipated in the third quarter. Internal working samples included one-offs of a capacitive sensor keyboard, a sample with optical fiber embroidering, and LED sequins adhered to the surface of a cotton textile.

Cotton Knit Shoe Uppers

The development of 3D-knitted cotton shoes continues after a successful version was released in the 2020-2 FABRICAST™ collection. Yarn sourcing for adequate stretch and compression continues, and installation of stretch yarn devices was delayed due to COVID-19 restrictions. The first prototypes of cotton knit shoes with soles were completed and presented a variety of problems, as anticipated, notably bagging. Research continues into differing shoe upper styles, construction techniques, printing, dyeing, and technology applications.

Knitting Research Projects

A stitch length study is underway to evaluate and improve physical properties of knit fabrics for tee shirts and similar apparel types. Shrinkage, skew, strength, and hand feel are key factors for optimization. In support of the TCR Ocean Wise shedding

study, a comprehensive knitting project was completed. The fabrics contain different filament counts of polyester, and a series of tests will calculate the shedding loads. Knitting support was also provided to FP for the evaluation of high seed coat calls.

Weaving Research Projects

An evaluation of weaving loom setups, to maximize stretch, commenced on inhouse sampling equipment. Four different warping arrangements were woven consecutively for comparison. This work is intended to determine the minimum weaving setup to achieve mechanical stretch.

Cold Pad Batch (CPB) Bleach Wetter Evaluation

For CPB dyeing to be successful, the fabric must wet out thoroughly, evenly, and instantaneously in the dye trough prior to being squeezed through the pad nip rolls. The purpose of this research is to develop a CPB bleach formula that adequately prepares 100% cotton knit fabric for dyeing using chemical auxiliaries currently available in the market. Continuing this project from last year, 12 additional lab dip trials were conducted in the first half of 2021, varying the types and concentrations of various bleach auxiliary chemicals. The trials were submitted to the Analytical Laboratory (AL) and the results recorded. Additionally, the first large scale trial was conducted in the DFAL on production scale machinery. The fabrics from that trial were also submitted to the AL for testing and the results recorded. Further trials are ongoing to improve the wettability after bleaching. After-washing will also be investigated to understand its influence on fabric absorbency.

Exhaust Caustic-Peroxide Bleach Evaluation & Optimization

The bleach stabilizer and lubricant used in the exhaust bleach procedure is no longer available for purchase in the quantities required. In addition, recent observations have noted consistently poor re-wettability on fabrics bleached using the current bleach formula. As a result, this project was created to evaluate alternative stabilizers and other auxiliaries available in the market for purchase in quantities customary for operation. These trials were designed to provide the DFAL with a modern, optimized caustic-peroxide exhaust bleach formulation. Sample quantities of several products, from various chemical companies, have been obtained and their analytical analysis completed. Lab trials will be conducted upon completion of the Cold Pad-Batch Bleach Evaluation to determine best product options.

Non-Fluorine WICKING WINDOWS™ Technology Production Trials

The goal of this project is to validate alternative products for print applications of non-fluorine WICKING WINDOWS™ technology. Feedback from the Product Implementation team has indicated that supply chain issues are impacting the availability of our recommended non-fluorinated water repellent for WICKING WINDOWS™ technology. Alternative products from two suppliers, with global distribution, were identified and production scale print trials were conducted to validate the performance of these products. Both alternative products performed well, but the suppliers have temporarily halted production or outsourced it to other vendors. Further trials will be conducted to evaluate new alternative non-fluorinated water repellent products and/or rebranded products from new vendors.

SWEAT HIDING™ & Pigment Printing

To determine if SWEAT HIDING™ technology and pigments could be coapplied in the same printing paste, trials were conducted on cotton twill and cotton/spandex jersey. Trials included prints with SWEAT HIDING™ technology and prints with pigment; run independently, sequentially, or combined into a single paste. Sequential prints were run both wet-on-wet and wet-on-dry. Samples were submitted to the Product Evaluation Lab (PEL) for performance testing at 0x and 3x HLTD. Samples were also washed to 20x HLTD for an assessment of initial vs. long term appearance.

Wellness Chemistries Evaluation

This project was undertaken to evaluate wellness chemicals from different vendors for cotton substrate and determine which ones work well on cotton. In 2021, an in-house experiment was developed to screen the effect of a wellness chemistry and evaluate its performance. For this experiment a moisturizer was selected. The FTIR was used to help screen the presence of the chemistry on the fabric after laundering. The chemistry was padded on cotton, as per the procedure given by the vendor, and the durability to laundering evaluated. Results from FTIR showed that the chemistry was not durable to laundering. Next, new binders combined with the chemistry will be padded and the findings will be discussed with the company.

Bio-Based Plastic Development

The aim of this project is to develop bio-based plastic material from cottonseed flour and evaluate the properties of the new material. First, a procedure to help extract protein from the cottonseed flour was developed. Next, experiments were conducted

to make plastic material using the extracted protein from cottonseed flour. Additional experimentation with other raw materials to make new plastic material was undertaken, the new material formed is being studied. In second quarter, an agreement with an outside university was signed to help in the bulk protein extraction process.

Conductive Ink Printing & E-Textiles

The goal of this project is to print conductive ink material on soft substrate, evaluate available conductive inks and soft substrates that will be suitable on cotton for e-textiles. Thus far, samples have been prepared for display purposes at trade shows.

PUREPRESS™ Technology

Activity for PUREPRESS™ technology is primarily for one brand. The brand continues to run mill trials to diversify the product categories that PUREPRESS™ technology is used in. While the pandemic slowed or delayed some mill trials for additional brand activity, progress continues in the one brand adoption that continues to grow.

TOUGH COTTON™ Without Resin Technology

Brand interest remains very high in 2021 with the TOUGH COTTON™ technology. Several new brands have adopted the technology or incorporated it into various product categories. A new application for the TOUGH COTTON™ technology, application to yarns, was launched in the second quarter. This technology will be used to target socks and sweater segments. Three mills have been brought online as suppliers of the technology.

STORM COTTON™ Technology Implementation

The STORM COTTON™ technology remains a very strong technology with numerous trial samples requested for new brands. Large and popular American, Canadian, and European brands continue to run production on STORM COTTON™ technology in mills in the U.S., Latin America, and in Asia.

WICKING WINDOWS™ Technology Implementation

A major U.S. brand continues to run production on the technology at mills in Mexico, Turkey, and Asia. Adoptions and product launches that happened during 2020 in Mexico, South America, and Asian domestic markets remain strong in 2021.

TransDRY® Technology

Interest in the TransDRY® technology remains light. However, Cotton Incorporated is negotiating with a major U.S. athletic brand to incorporate the technology into a running line of shirts. Trials were conducted in Asia for this possible adoption and product testing begun in the second quarter.

NATURAL STRETCH™ Technology

A joint meeting among TSI, TCR, GCSM, and a major supplier in South America was held during second quarter. The mill has interest in running 100% cotton stretch fabrics for use in the Latin American market. The mills main interest in using the NATURAL STRETCH™ technology is to incorporate it into a sustainability story.

New Technology Releases

The TSI team worked closely with the division to release new technologies ready for mill implementation such as, Yarn Application of TOUGH COTTON™ technology, and PUREPRESS + TransDRY® technology.

Routine Technical Service Projects for Mills, Brands, and Retailers

Technical service activity for mills, brands, and retailers has picked up in comparison to 2020. Projects to date, have been submitted relating to yellowing of white fabrics, dyeing issues, abrasion in socks, pilling, color retention, and analytical work related to fabric mercerization and chemical analysis.

Laboratory Activity

Activity in the AL and DFAL has almost returned to pre-pandemic levels. To date, the AL has processed 77 total projects, totaling 832 samples. The DFAL has processed 35 total projects in 2021, consisting of 4,235 lbs. of yarn and knit fabrics, and 825 yards of woven fabrics.

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

Nonwovens Marketing Assistance to Display Cotton-Containing Solution to Plastic-Free Wipes

The FP team assisted Nonwovens Marketing in the preparation of hundreds of swatches from the recently completed plastic-free wipes nonwoven project. These swatches were then used to make hundreds of nonwoven marketing booklets displaying cotton-containing, 100% cellulosic wipe options to replace synthetic wipes in the current market. The booklets will be shared with domestic and international wipes manufacturers visiting Cotton Incorporated's booth at World of Wipes conference in July and the INDEX Exhibition in October.

Technical Bulletin: Laser Etching on Cotton Textiles

To educate the industry about the developments in laser finishing technology on cotton textiles, a technical bulletin was written covering the general history of laser technology, the types of lasers and the categories of lasers. Additionally, the common uses of lasers for textile applications, focusing on denim garment finishing, were discussed. The bulletin also provides details on laser finishing techniques used in the Cotton Incorporated FABRICAST™ collection. An industry leader introduced new technology for automated alignment of designs on garments in fourth quarter 2020, which was included in the bulletin. Final editing and approval of this technical bulletin was completed and has been shared with our Importer Support Program consultants.

Test Method Development: Water Retention (WR) Dry Time Testing

The goal of this project is to accurately represent the phenomenon of saturating a garment with perspiration during exercise followed by subsequent drying. Water Retention Dry Time testing was presented to the RA63 subcommittee of AATCC in May 2021. This will be the second Cotton Incorporated test-method development presentation provided to RA63; WASR testing was presented Fall 2020. With the numerous moisture balances that are available, adianta testing of all three layers of the test specimens that are submerged in 100°F water has been implemented to provide average dry times, and dry rates on three moisture balances.

Technical Assistance to the Industry

Fabric specialists in PD provided industry support on knitting set-ups, bagginess in knit joggers, fabric weaving defects, low fabric strength, processing steps for building mechanical stretch, and sourcing assistance. Fabric swatches were provided to a chemical company for research into soft-finish elastomeric softeners used to enhance knits. Additional swatches were provided through a material transfer agreement to an aeronautics organization, for flame retardant research. An assortment of fabrics treated with Cotton Incorporated technologies were provided to a major brand for a *Supernatura*l display, used for internal merchandising and general cotton innovations education. More fabrics containing Cotton Incorporated technology were even provided to the American Association for Textile Colorist and Chemists (AATCC) for a new time capsule. Engagement with industry revolved around hemp and other natural fibers as well.

Research & Technical Center Virtual Tour

As part of a PDI division-wide effort to create a comprehensive virtual tour of Cotton Incorporated's Research & Technical Center, laboratory staff worked together to create a virtual tour of the Carding and Spinning, Dyeing & Finishing Applications, Knitting and Weaving, Color Services and Finishing, and Product Evaluation Laboratories. The resulting dynamic presentation included video, photos, and audio recorded by staff and can be shared digitally with Cotton Incorporated's constituents and other entities to enhance understanding of Cotton Incorporated's research and processing capabilities.

FABRICAST™ Collection Metrics Illustrating Support of Marketing Activities

The fabric and other product resources developed in the PDI division are considered vital to marketing efforts. The collection of metrics used to determine the reach and influence of physical fabrics PD achieves is possible due to a robust database system that can collect and aggregate data in a variety of formats. Overall, the first half of 2021 has seen 77 sample requests by 60 companies for a total of 1,660 fabric samples. Once travel resumes and staff can exhibit at trade shows and engage in in-person customer meetings, the volume is expected to increase significantly. As comparison, during the first half of 2019, (pre-pandemic) there were 313 requests by 221 companies for a total of 3,962 fabric samples.

Internal Swatch Cutting Services

The PD sample cutting area prepares fabric swatches and information for Cotton Incorporated's fabric marketing and technical activities. Examples of services include of the FABRICAST™ collection 2021-1, which consisted of fabric hangers and technical

swatch books, and was distributed to Cotton Incorporated offices worldwide. Additionally, fabric swatches were provided to the Fashion Marketing department for the Fall '22/Winter '23 General and Denim Trend Presentations, to GSCM for Importer Support Workshops which included Tarif Engineering and Active Outdoor; and additional swatches were used for targeted customer meetings and presentations. In total, the sample cutting room produced 778 fabric hangers and 8,253 swatches during the first half of 2021.

Garment Collections for Trade Shows

Product Development worked with U.S. Global Supply Chain Marketing colleagues to select some of the latest fabric developments for the next garment collection with an active wear theme. Once the garment prototypes are finalized, PD will provide fabric yardage for the project.

3D Digital Fabric Files for Marketing Assets

Even though there was a reduction of person-to-person interactions to date, the digitalization of the FABRICAST™ collections into 3D files, used in 3D-apparel design software and uploaded to the CottonWorks™ Website, substantially magnified the way cotton inspiration is marketed. Analytics collected from the CottonWorks™ Website showed 17,426 downloads of 3D fabrics since they were launched in 2020. In 2021 alone, there were 11,480 downloads from 414 unique email addresses, including numerous brands and retailers. Playing an active role in the digital transformation of the apparel industry, in the way garment design and pattern making is performed, keeps cotton highly relevant and forward thinking.

Digital Fabric Marketing Materials for Corporate Social Media Engagement

High quality photographs and non-specialist descriptions of new fabric developments were provided to support corporate communications on social media channels and Websites. The social media posts thus far resulted in a reach of 10,390 views on Facebook®; 15,365 impressions on Twitter; and 17,788 impressions on LinkedIn®. The Cotton Incorporated Corporate Website saw 2,700 page views and interactions.

Technical Conference Participation

In the division's ongoing effort to increase industry knowledge with peers and industry partners, team members maintain a membership with the Southern Textile Association (STA). This offers the opportunity to network with a broad mix of suppliers, textile operations, testing facilities, etc. In the first half of 2021, FP team members attended virtual seminars on the following: *Manufacturing & Textile Innovation Network*; *The Corona Virus Economy*; *People, Politics, and the Pandemic*; *Overview of the U.S. Cotton Trust Protocol; Fiber Update*; *The Economy During & After the Pandemic*; and the *Washington Update*.

The FP team also participated in a three-part webinar series presented by INDA Nonwovens Association. The series centered on three current nonwovens topics in particular: *ASTM performance standards for general-public facemasks*; *Plastic concerns for the nonwovens industry;* and *Spunbound, Spunmelt, Spunlace Capacity/Demand Scenarios*.

As part of FP's continued commitment to providing technical service and expertise to the industry, staff attended the virtual Beltwide Cotton Conference. The three-day live-streamed event included individual reports and panel discussions from technical sessions, along with poster presentations, and seminars designed to provide attendees with essential information needed to help producers make key cotton production/marketing-related decisions.

Industry Engagement

The PDI division pursues industry engagements to develop new ideas, source new cotton yarns, fabrics, finishes, and equipment as well as, meet with vendors to discuss possible collaborations or supply channels. Listed below are trade shows, conferences, and/or presentations the PDI team participated in.

- AATCC Virtual Product Safety & Compliance Seminar
- AATCC - Moisture Management Conference, Intro to 4D Textiles, Natural Dyes Conference
- University Consumer, Apparel & Retail Studies Program – Guidance meetings
- Outdoor Retailer Winter Show
- Bremen Cotton Conference
- Southern Textile Association – Lunch and Learn Series
- Dornbirn Asia Global Fiber Conference
- Kingpins Amsterdam Denim Trade Show

- INDA 3 Part Webinar Series
- Kingpins Transformers - Presentation on Regenerative Agriculture and Denim
- Material ConneXion – Presentation on Super-natural Performance
- Rethinking Materials: Innovations in Plastics and Packaging Webinar
- AATCC Natural Dyes for Textiles Digital Lab
- Advancements in Cationic Cotton Technologies' Webinar
- AATCC Flammability in Textiles and Polymers Digital Lab
- WTiN Discussing Digitalization Webinar
- WGSN Home Goods Trend Presentation
- Plastic Free: Proving a Natural Solution Webinar
- How to Deliver Sustainability with Non-Contact Spray in Textile Finishing Webinar
- WTiN How to Increase the Performance of Pigment Inks for Digital Textile Printing Webinar
- Waste Determination Requirements Webinar
- Infinite Enzymes for Dye Decolorization in Wastewater Webinar
- Digital Pigment Printing – Technical Service Meeting
- ASTM Webinar: Overview of the New ASTM F3502-21 on Barrier Face Coverings
- Create More Sustainable Water Repellent Textile with Dow's Textile Finishing Innovation Webinar
- Public School System – Teacher/Industry Exchange
- Woolmark Company Active Webinar
- Super-Natural Performance: A Talk with Allbirds Material ConneXion Webinar
- Spunbond/Spunmelt/Spunlace - Capacity/Demand Scenarios Prompted by the Pandemic INDA Webinar
- Solving the Plastics Problem Through Chemistry ACS Webinar
- Presentation of Water Retention Dry Time Testing to RA63 at the AATCC Spring Conference

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GLOBAL SUPPLY CHAIN MARKETING

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 goal of influencing the use of cotton versus other fibers. During the first half of 2021, GSCM staff conducted more than 268 meetings with companies in the manufacturing supply chain including key brand and retailer accounts.

As tradeshows remained virtual through the midpoint of 2021, Cotton Incorporated continued to support efforts in the home market by sponsoring Home Textiles Today Market Week and the Material Changes Conference. These conferences were focused on the latest market trends and initiatives within the home market. Key topics continued to be rooted in sustainability, circularity, sourcing, and the significant shift toward natural fibers in the home textile industry. Cotton Incorporated's virtual booth featured a brand-new buying guide for cotton sheets, the circularity model, resources available on the CottonWorks™ Website, and an informative session on the legacy and comfort of bringing cotton home. Cotton Incorporated staff also managed a virtual booth at the Outdoor Retailer show, and created an informative video featured at the Kingpins virtual show.

Staff worked with the Hong Kong Design Institute to provide support to the 2021 Hong Kong Denim Festival. The event was held both virtually and live in Hong Kong and consisted of webinars, workshops, and a forum and exhibition. More than 1,200 participants from the local textile industry joined the event.

GSCM sponsored the Mexican Textile Chamber´s annual luncheon and CAMTEX's Central American regional event on sustainability where the GSCM Senior Vice President participated as a speaker. It secured the promotion of the Seal of Cotton trademark and the Cotton LEADS℠ program as well other initiatives, including the CottonWorks™ platform and cotton's circularity model in both events.

During the first half of 2021, Mexico City staff continued extending the virtual connection with the industry by holding 13 presentations covering topics from fashion marketing to cotton price outlook and consumer apparel shopping trends.

Participation in industry events included:

- Staff presented digital fabric at the CLO Users Conference and Sourcing Journal's Hong Kong Summit.
- Staff hosted an informative digital supply chain webinar for the Outdoor Retailer market and had more than 150 views.
- Staff participated in the virtual Home Market Week and had nearly 400 booth visits.
- Staff attended the Kingpins virtual show.
- Staff presented at the American Apparel and Footwear (AAFA) Executive Summit.
- Staff hosted a virtual session on the principle of merchandising and new markets in conjunction with Washington State University for emerging professionals with more than 60 attendees.
- Staff virtually attended the China Cotton Forum, Zhangjiang, China. The event was attended by more than 40,000 attendees.
- Staff virtually attended the 2021 CNCE Cotton Industry Development Conference, Shanghai, China. Roughly 300 participants attended the live event while more than 3,000 participated virtually.
- Staff virtually attended "How Virtual Sampling Transforms Supply Chains of the World's Fashion Industry," Hong Kong.
- Staff virtually attended "Sustainability Solutions-Big Ideas to Make a Big Difference," Hong Kong.
- Staff virtually attended Sourcing Journal Summit, Hong Kong.
- Staff virtually attended "Cotton Market Updates and Sustainability Opportunity in the Pandemic", jointly organized by the Clothing Industry Training Association, Sustainable Fashion Business Consortium, and Cotton Council International.

- Staff physically attended Intertextile Shanghai YarnEXPO, Shanghai, China, attended by more than 30,000 participants.
- Staff physically attended CIDPEX Conference and Tradeshow, Nanjing, China.
- Staff physically attended Intertextile Shanghai Apparel Fabrics (Spring Edition), Shanghai, China.
- Staff physically attended China International Clothing & Accessories Fair, Shanghai, China.
- Staff presented STORM COTTON™ Technology to more than 110 distributors at JEEP's Sales Meeting FW21/22 in Shanghai, China.
- Staff virtually presented "Global Retail Market Report" at China Textile Information online platform, Shanghai, China.
- Staff virtually presented and hosted a panel discussion "Is Digital Prototyping the New Normal" at Sourcing Journal Summit, Hong Kong.
- Staff attended and managed a virtual booth at COTTON USA's virtual COTTON DAY events in Taiwan, South Korea, and Japan.

In its eighth year, the Cotton LEADS℠ program continues to educate and inform retailers, brands, and manufacturers worldwide 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 688 partners by mid-year. Two *Partner Post* newsletters were sent to partners in five languages in the first half of 2021. A new Partner Engagement Kit was created to enable partners to better communicate their partnership within their supply chains and through consumer facing hangtags and point of sale programs. During the first half of 2021, a total of 19 new partners were added from the U.S., China, Mexico, Japan, and Pakistan.

The GSCM division is responsible for messaging to the trade. In 2021, consistent messaging and imagery was implemented throughout, including tradeshows, tradeshow promotional items and outlets, and other publications. Numerous print and digital assets were created to focus on multiple messages in the most effective platforms for the apparel, home, and nonwovens markets. Messages focused on the CottonWorks™ Website platform as a leading resource for cotton, performance, denim, digital fabrics, sustainability, and circularity. Publication channels included *Textile Insight, WSA, EcoTextile News, Sourcing Journal*, and tradeshow magazines and Websites. A significant effort was made to promote cotton through LinkedIn social channels to reach the industry who may be on the site to network and seek new opportunities.

The Director of the Mexico City Office was interviewed by the most widely distributed textile publication in Latin America, *Textiles Panamericanos,* on Cotton Incorporated's initiatives for the region such as sustainability, the circularity model, the CottonWorks™ digital platform, and cotton technologies.

In 2021, the GSCM division developed content and materials to address sourcing cotton issues out of China. A plethora of content was posted to the CottonWorks™ Website including podcasts on cotton flow out of China, technology considerations and general facts about sourcing cotton.

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

GSCM continues collaborating with Product Development to feature garment collections which highlight creative innovation. The staff continued working with a design studio in Portland to create an engaging collection of cotton garments which feature technologies and innovative structure. These garments are photographed and featured in virtual meetings and tradeshows in addition to being showcased on the CottonWorks™ Website. These garments are also being utilized to show a connection between the digitized fabrics in the FABRICAST™ collection and the actual sample garments timelining the process from concept through production.

Based on the inspiration from Fashion Marketing trends and FABRICAST™ developments, staff worked with leading manufacturers to commercialize and digitize some of the most requested fabrics:

- Commercialized a 100% cotton woven terry fabric identified by Fashion Marketing trends. Fabrics were digitized, including fabric scan, 3D simulation, and garment samples. Both digital and physical garments were produced.

- Worked with a Hong Kong-based woven fabric converter to commercialize a 100% cotton velvet collection from a FABRICAST™ development idea.
- Staff worked with a Hong Kong-based fabric manufacturer to commercialize 100% cotton "Mock Leno" collection based on a FABRICAST™ development.
- Staff worked with a Taiwanese manufacturer to commercialize an 80% cotton 20% wool herringbone fabric based on a FABRICAST™ development.

The Digital Supply Chain initiative in the GSCM division is an effort to enhance the division's marketing capability by incorporating the latest and most widely used 3D textile design tools. Work in this initiative included several activities such as:

- Digitizing all FABRICAST™ fabrics as they are released.
- Collaborating with a 3D technology supplier to promote a capsule collection of minimally processed fabrics.
- Adding additional capability on the CottonWorks™ Website to view digital fabrics in augmented reality.
- Creating 3D assets to support marketing goals.
- Presenting digital cotton fabrics at two virtual conferences.

Ten new Seal of Cotton trademark licensees were added in the U.S. in the first half of 2021. The Seal of Cotton trademark promotion continues to be a key tool in Latin America to secure cotton market share within selected accounts for which two new brands were added while another five brands extended its use reaching over 450,000 garments tagged. Talks initiated with the third largest mass merchant in Mexico to tag over 500,000 denim garments in a year with the Seal of Cotton trademark with the aim to support the launching of a growing brand that wants to communicate its cotton content. Also, at the beginning of 2021, Mexico City staff launched the digital Seal of Cotton trademark label initiative, which allows the shopper to have a digital experience at the sales floor when interacting with a cotton rich garment by watching a video on his/her cellphone, aiming to position cotton as a natural fiber and to support retailers' sales.

Additional trademark adoptions included:

- A U.S.-based upholstery supplier was licensed to use the Seal of Cotton trademark on high-end cotton-rich performance fabrics for the home market.
- A U.S.-based handbag manufacturer was licensed to use the Seal of Cotton trademark on 100% cotton handbags and travel bags as part of a new product launch.
- A U.S.-based fabric retailer was licensed to use the Seal of Cotton trademark on 100% cotton fabrics for apparel and crafting.
- A U.S.-based manufacturer of socks was licensed to use the Seal of Cotton trademark.
- A U.S.-based tie manufacturer was licensed to use the Seal of Cotton trademark on their men's tie program.
- A U.S. apparel brand distributed 250,000 units of cotton apparel products, carrying the Seal of Cotton and Cotton LEADS℠ trademarks, through their Chinese licensee. Products were put on sale in the Chinese markets.
- A Taiwanese baby product retailer adopted the natural™ trademark on 100% cotton baby wipes. Products were on sale in the Taiwanese market.
- A Taiwanese cosmetic retailer adopted the natural™ trademark on 100% cotton facial masks. The masks were on sale in the Taiwanese market.

Adoptions at retail for international brands included:

- An Australian undergarment brand commercialized one million units of TOUGH COTTON™ technology underwear. Products were available in the Australian market and their global online store.
- The same Australian brand commercialized 2.5 million pairs of TOUGH COTTON™ technology socks for the Australian market and their global online store.
- A Japanese apparel brand worked with a Chinese textile company to commercialize 136,000 pieces of TOUGH COTTON™ technology products for the Japanese market.

- A major Chinese sportswear brand commercialized 130,000 units of WICKING WINDOWS™ technology cotton tee shirts for the Chinese market.
- A Chinese outdoor brand produced 12,050 units of WICKING WINDOWS™ technology cotton golf shirts for the Chinese market.
- A U.S. shoe brand commercialized 1,375 units of WICKING WINDOWS™ technology cotton tee shirts for the Chinese market.
- A Chinese urban activewear brand produced 7,382 units of WICKING WINDOWS™ cotton tee shirts for the Chinese market.
- An international sports brand worked with their Chinese licensee to adopt 19,266 units of STORM COTTON™ technology apparel in the Chinese market. The products included cotton tee shirts, jackets, and pants.
- A U.S apparel brand, through their Chinese licensee, worked with a leading textile company in China to produce 30,000 units of STORM COTTON™ technology apparel, including hoodies, jackets, and pants.

From the beginning of 2021, Mexico City office staff has been assisting five mills in Mexico and Guatemala either producing or developing programs on WICKING WINDOWS™ and STORM COTTON™ technologies for a large international brand based in the U.S. Staff initiated a comprehensive project with a new high-level Mexican active brand to offer different product lines featuring WICKING WINDOWS™, STORM COTTON™, and TOUGH COTTON™ technologies. The project involves all stages from design using the FABRICAST™ collection as an inspiration base and the 3D digital technology, to sourcing and marketing the high cotton content of the collection.

Technical marketing, technology commercialization, and technical assistance continue to be essential for helping companies bring cotton products to market. Several important activities were carried out to provide technical assistance for marketing cotton including:

- Commercialized Cotton Incorporated technologies with 24 new technology suppliers across five countries (Bangladesh, China, India, South Korea, and Vietnam).
    - TransDRY™ technology = 3
    - PUREPRESS™ technology = 3
    - WICKING WINDOWS™ technology = 1
    - STORM COTTON™ technology = 4
    - TOUGH COTTON™ technology = 10
    - NATURAL STRETCH™ technology = 3

Commercialization of cotton technologies also included:

- A major U.S.-based workwear brand has continued to feature both TOUGH COTTON™ and STORM COTTON™ technologies across their men's product categories and is now expanding into ladies' product categories.
- A U.S.-based high-end apparel company has applied the PUREPRESS™ technology on a back-to-school boy's and girl's pant program.
- A high-end apparel company has adopted the PUREPRESS™ technology on men's dress slacks.
- A well-known U.S.-based menswear brand is featuring TransDRY® technology on their sock program.
- A U.S.-based upscale menswear brand has adopted TransDRY® technology on their men's polos and tee shirts.
- A U.S.-based performance men's line has adopted TransDRY® technology on their men's polo shirts.
- A U.S.-based retailer has adopted the STORM COTTON™ technology on their ladies' jacket program.
- A U.S.-based workwear brand has adopted TOUGH COTTON™ technology on their men's woven shirt products.
- A U.S.-based workwear brand has adopted TOUGH COTTON™ technology on their men's outerwear products.
- A U.S.-based outdoor apparel manufacturer has adopted STORM COTTON™ technology on their men's and ladies' outerwear products.
- A well-known U.S.-based apparel company has adopted STORM COTTON™ technology on their men's hoodies.

Technical marketing and technical assistance continue to be essential for helping companies bring cotton products to market. In 2021, several important activities were carried out to provide this type of technical assistance for marketing cotton:

- Staff provided technical assistance to a leading U.S. denim organization on their TOUGH COTTON™ and STORM COTTON™ technology programs.
- Staff provided technical assistance to a U.S. innerwear company for TransDRY® and WICKING WINDOWS™ technology wear trials.
- Staff provided technical insight to a well-known U.S. sock brand on their cotton-rich sock program.
- A U.S. workwear apparel brand worked with a Chinese woven fabric manufacturer to develop STORM COTTON™ technology products.
- A leading German based retailer worked with two fabric suppliers in Bangladesh and an Indian fabric mill to develop STORM COTTON™ for fleece technology fabrics for their sportswear collection.
- A U.S.-based casual wear brand worked with a Hong Kong fabric supplier to develop 100% cotton twill fabric treated with STORM COTTON™ technology for men's bottoms and outerwear.
- A U.S. casual wear brand worked with two suppliers, one in Taiwan and one in South Korea, to develop French terry fabrics for kids' hoodies.
- A leading German based retailer worked with a vertical knitting manufacturer in Germany to adopt TOUGH COTTON™ technology on French terry.
- The Chinese arm of an international sportswear brand worked with a Hong Kong knitting mill with a production base in China to adopt STORM COTTON™ technology on French terry for their hoodie collection.
- A U.S. specialty store worked with an Indonesian knit fabric mill to develop STORM COTTON™ for fleece technology.
- A leading German retailer worked with an Indonesian knit fabric mill to adopt STORM COTTON™ technology on cotton/polyester double knit fabrics.
- A Chinese fabric manufacturer developed STORM COTTON™ for fleece technology for a U.S. specialty retailer.
- A South Korean woven fabric manufacturer adopted STORM COTTON™ technology on woven fabrics as part of their marketing initiative.
- A U.S. clothing company worked with two fabric manufacturers to develop STORM COTTON™ technology on French terry.
- A leading woven fabric supplier in China, produced 8,800 yards of TOUGH COTTON™ technology on canvas for a U.S. outdoor brand. The same brand also worked with a Hong Kong woven fabric supplier with production based in China to produce 23,000 yards of TOUGH COTTON™ technology on canvas.
- A large-scale trading and garment manufacturer in China developed knit fabrics with TOUGH COTTON™ technology for an U.S. retailer.
- A leading German based retailer worked with two knitting mills in India to develop TOUGH COTTON™ technology treated cotton/spandex jersey fabrics for leggings.
- The same German retailer worked with a woven manufacturer in Bangladesh to adopt TOUGH COTTON™ technology on stretch twill.
- A leading French apparel brand worked with a woven fabric supplier in Bangladesh to develop TOUGH COTTON™ technology twill fabrics for woven chino pants.
- A U.S. multi-channel workwear brand worked through a Hong Kong sourcing company to develop 100% cotton woven flannel treated with TOUGH COTTON™ technology. Fabrics were supplied by a Hong Kong fabric company with production base in China.
- The Chinese arm of an international sportswear brand worked with a Hong Kong knitting mill with production base in China to develop TOUGH COTTON™ technology fabrics for their apparel collections.
- A U.S. retail chain worked with a South Korean fabric and garment manufacturer to adopt TOUGH COTTON™ technology on knits at their fabric production plant in Vietnam.

- A U.S. retailer worked with a South Korean fabric and garment manufacturer with productions based in Vietnam to develop TOUGH COTTON™ technology on knit fabrics.
- A Japanese retail store worked with a dyeing and finishing plant in Bangladesh to develop TOUGH COTTON™ technology fabrics for tee shirts for the Japanese market.
- A large-scale woven fabric supplier in China developed PUREPRESS™ technology shirting fabrics for a U.S casual wear brand, which had previously commercialized the same products.
- An Indian woven fabric mill developed PUREPRESS™ technology on cotton/spandex twill fabric at the request of a U.S. casual wear brand.
- A U.S. multi-channel workwear apparel brand worked with a leading Hong Kong textile company with production base in China, to develop TransDRY™ technology knit fabrics.
- A U.S. ladies' apparel brand worked with a fabric supplier in Sri Lanka to develop WICKING WINDOWS™ technology knit fabric for cotton/spandex yoga pants.
- A U.S. undergarment brand worked with two suppliers, one in Thailand and one in India, to develop blended knit fabrics applied with the WICKING WINDOWS™ technology for their F/W 2022 collection.
- A U.S. sportswear brand worked with a Hong Kong woven mill with production in China, to develop WICKING WINDOWS™ technology on printed woven shirting fabrics.
- A fabric manufacturer in Malaysia developed WICKING WINDOWS™ technology on Oxford fabrics to promote to their Japanese accounts.

Nonwovens Marketing

The first half of 2021 has been a continuation of business as usual under COVID restrictions. Market development has been conducted strictly via email, phone, and web conferencing as no one has permission to travel domestically or internationally. Work has continued albeit at a slower pace as important technical contacts have very limited access to labs and marketing professionals are working from home around the world. The nonwovens marketing team established an internal meeting schedule to keep projects moving forward. In this way, staff has worked with companies, labs, and resources around the world. The ability to travel domestically began to open at Cotton Incorporated late in the first half, but many companies still do not permit travel nor accept visitors in their offices.

The nonwovens world is focused keenly on the problems of plastic pollution. The EU passed a Single Use Plastics Directive to be implemented in the second half of 2021. Wet wipes and feminine hygiene products are among those items to be impacted in the first wave. Staff has been contacted by companies in many countries about the use of cotton as a solution.

Nonwovens technical development on two key projects was completed at the end of 2020, thus providing the input for marketing work in 2021. Both projects position cotton as a solution to plastic in wipes, feminine hygiene products, and as topsheet materials for feminine hygiene and diapers. The trial project produced cotton and pulp blend materials targeted for plastic-free wipes, feminine hygiene products, and topsheets for feminine hygiene products and diapers. Not only do the results show that cotton and pulp together meet the haptic requirements, but also the technical requirements for strength, absorbency, and rewet measurements. Results of flushability testing indicate good possibilities for cotton and pulp blends, with additional process developments on breaking apart in flushing. This work will be presented at conferences and at individual company meetings.

The second technical project was targeted to prove that cotton, natural and purified, meets industry standards for being safe and plastic-free. Seven tests were conducted to evaluate biodegradability in soil, composting (industrial and home), aquatic environments; the impact of cotton on aquatic micro-organisms, and the presence of heavy metals and fluorine. Both natural and purified cotton passed all tests with flying colors. Marketing these strong results, which apply to all uses of cotton, is a top strategic thrust in 2021. This body of work is strategically important to the positioning of cotton as a natural solution to concerns about plastic persistence in the environment. These problems cut across all market boundaries in the Global Supply Chain Marketing division. As such, there is a 360-degree plan for marketing this body of work in 2021. For the first half of 2021, several marketing activities have been undertaken:

- January: Submitted data to a European certification agency for five certifications.
- February: Completed marketing packages of trial materials and technical data produced with cotton (staple and short cut) and pulp for plastic-free wipes, feminine hygiene, and topsheets for diapers.

- March: Lab testing work was introduced and results discussed as part of a panel held during the Bremen Cotton Conference.
- April: A CottonWorks™ webinar was held presenting the background that drove the development of this project, the results, and implications for a variety of cotton markets impacted by the EU Single Use Plastics Directive and / or concerned about the persistence of plastic in the environment and working to reduce that impact.
- May: Work was done to produce a talk to be given at the World of Wipes Conference in Atlanta in July. This presentation will include the analytical testing proving cotton to be biodegradable in all environments and the performance of the trial materials developed as potential solutions to current nonwovens for wipes, feminine hygiene, and topsheet, which includes plastic fibers.
- June: Work will be completed on a marketing package for promoting this work at the World of Wipes Conference. It includes a trade ad in both print and digital, banners for a tabletop, and a brochure. The trade ad is being developed to have messaging, images, and text that can be used for apparel, home textiles, and nonwovens trade advertising.

Market development has continued virtually. Staff has worked with a variety of companies plus colleagues covering Latin America and Asia including nonwoven producers, converters, brands (small and global), retailers and consultants working with clients interested in cotton. Activity with Europe is particularly strong due to the EU Single Use Plastic Directive. Work is not limited to the key markets of wipes, feminine hygiene, baby care, and adult care, but also includes innovation with respect to short cut cotton, cotton flock, and cottonseed oil.

Cotton Incorporated's trademarks continue to grow in awareness and respect around the world. The global nature of the nonwovens industry is revealed in the geographic diversity of licensing projects. Through the first half of 2021, nonwovens marketing reached a record total of 232 licensees adding eight new companies and four new amendments to the program. Further evidence of the push in Europe to be more plastic-free, eight of 12 new licensees are European companies including two firsts: Greece and Bulgaria. Two new agreements are with companies based in North America and the other two in Asia. Markets are diverse including baby care, feminine hygiene, skin care / cosmetics, and wipes. Half of these completed licenses were for the Seal of Cotton trademark and two were for the natural™ trademark, again driving home the importance of 100% cotton. The other four were for the cotton enhanced™ trademark. Lastly, although not yet complete, the nonwovens marketing team has seven licensing projects in the works in six different countries: Poland, Germany, Turkey, Canada, U.S., and Korea. Latin America is becoming a fertile nonwoven market for licensing different cotton trademarks. One new Seal of Cotton licensee was added, a large brand of personal care products, while another brand extended its use to personal care products. During the same period, the largest regional feminine hygiene manufacturer in South America extended the use of the cotton enhanced™ and natural™ trademarks reaching 300,000 packages labeled.

Marketing communications in the first half of 2021 has taken a variety of forms. Trade advertising, print, digital, and social continues with the campaign begun two years ago. One new advertisement was developed as a cornerstone of the campaign to market cotton as a solution to plastic. This will be a theme for the entire year with accompanying materials to support specific event needs. Staff also is working with trade publications on sponsored content opportunities and contributions to issues featuring fiber developments, innovations, sustainability, and other topics in which cotton can contribute to the discussion. In the first half of this year, staff participated virtually at three events: one in Germany, one in the U.S., and a third in China. Staff also led an industry conference committee for the fifth consecutive year planning program, speakers, networking, and other events that are a part of this global, annual conference.

Fashion Marketing

The first half of 2021 has been extremely busy for the Fashion Marketing (FM) team. Staff saw a record number of presentations while in production of three upcoming seasons, yet staff remain on schedule with the completion of all program projects. Staff has continued meeting with clients virtually throughout the first half of the year, with January – March culminating in the busiest quarter ever! The number of presentations requested and given surpassed that of all prior first quarter performances.

In January, staff worked on the production of the Fall/Winter 2022/2023 season. The presentation, micro site, and materials all came out in the first part of the year. While finishing production for the Fall/Winter 2022/2023 season, FM staff also started initial production for Spring/Summer 2023. Production for Denim 2022/2023 continued in the first half of the year with the presentation, micro site, and materials officially rolling out in May and June of this year.

Production of Active, Spring/Summer 2023 and Fall/Winter 2023/2024 also were underway, having been completed with the presentation, micro site, and materials officially coming out in June of this year. Staff developed a specialized presentation for the Mexican market which will be utilized on the CottonWorks™ Website for clients in Latin America. FM has continued with their travel blog by utilizing already existing images and information from the archives.

FM has continued its digital access for clients by providing all our previously printed color cards in digital format, complete with a QR code for easy access via cell phone. FM also has created small batch quantities of a scaled-down printed color card. This card will be sent to clients accompanied by swatch packets. Each card will be presented with a packet containing approximately 100 cotton fabrics.

Strategic Objective 3: Conduct technical education and training to support cotton**'s** 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™ site is the main marketing platform of the Global Supply Chain Marketing 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.

Twenty-two technical education workshops were held in the first half of 2021 with over 600 attendees from over 150 major brands and retailers. As of June 2021, workshops remain virtual. Staff is beginning to think about in-person workshops to be held later in the year. Several new workshops were introduced: tariff engineering, lab dips, and introduction to digital prototyping. The purpose of these workshops was to provide detailed technical information and training on relevant topics important for cotton.

Two virtual ISP workshops were held for Asian audiences, one in Hong Kong and one in Shanghai.

- Hong Kong – 26 attendees from 18 retailers and sourcing companies. Topic – Seamless Knitting
- Shanghai – 25 attendees from 15 retailers and sourcing companies. Topic – Laser Application

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 2021, new content was added on traceability, sourcing cotton, home textiles, and digital fabrics. Cotton fabrics from Cotton Incorporated's FABRICAST™ library were digitized and added to the FABRICAST™ page as well. The Mexico Office staff worked during the first half of 2021 to enlarge the CottonWorks™ in Spanish section of the Website aiming to gain more access to the Latin American market.

CottonWorks™ webinars offer a unique way to reach the industry and amplify the Company's message. In the first half of 2021, ten webinars were held. These webinars featured topics on cotton traceability, sourcing, cationic cotton developments, consumer behavior, and sustainability. A five-part sustainability webinar series has been developed and began in May. Each webinar reaches between 70 and 400 individuals. Webinars are one of the most successful methods to share information with many industry professionals from the global cotton industry.

The 2021 "Cotton in the Curriculum" university education program is underway. Specifically, 18 university projects across the U.S. were awarded grants. The objective of the university grants is to increase the awareness of cotton in the classrooms. Many grants include visits to the Cotton Incorporated headquarters and cotton farms.

Planning for the "Educate the Educators" event has begun. This event is designed to educate university faculty about cotton sustainability and to arm them with facts and materials for them to teach their classes. About 15 professors travel to North Carolina to visit a cotton farm and learn about cotton sustainability. During the two-day event, there is open discussion on how to better educate over 4,000 students in their classrooms.

A portion of the efforts at the university level include an influencer program. The program identified approximately six emerging professionals on campuses across the U.S. to promote cotton on campuses. The influencer program was focused on social media platforms of Instagram and LinkedIn.

ADVERTISING, PUBLIC RELATIONS, STRATEGIC ALLIANCES, AND CORPORATE STRATEGY & INSIGHTS (CSI)

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

Television

Within the media budget, television was prioritized given the channel is the main driver of awareness supporting the new "Your Cotton, Your Way" campaign. The campaign launched across TV and streaming video services on April 12 and ran for a 7-week flight from April 12 through May 30. During that period, a total of 2,700 television exposures (spots) and 106MM impressions ran across ABC, CW, and FOX broadcast networks, and nine cable networks (BET, Bravo, E!, Freeform, Food Network, HGTV, MTV, TLC, and VH1). Units were scheduled during popular primetime programming such as The Masked Singer, 911, Grey's Anatomy, Station 19, All American, Walker, The Good Doctor, Flash, Real Housewives, 90 Day Fiancé, Chopped, Guy's Grocery Games, and Below Deck.

The campaign also ran on Hulu and Roku to extend the reach of the campaign and to reach the younger audiences who are either light-TV viewers or do not have traditional cable subscriptions. In addition, some of the TV budget was allocated toward full episode players (FEP); these include ABC, FOX, and CW and have helped the brand follow consumer consumption which has shifted towards online premium primetime inventory over the past few years. The video buy delivered more than 11.82MM impressions against women 18-34.

Digital Media

The primary role of the digital efforts is to promote the video creative developed for "Your Cotton, Your Way" to increase brand favorability and drive message association. The campaign is planned to deliver more than 269MM impressions. Thus far it has delivered 49MM impressions and 16MM video completes. There are four main video assets used throughout the campaign – all featuring iconic cotton-rich pieces - *Jumpsuit*, *Blazer*, *Cotton Tee*, and *Plaid Shirt*. These video assets are being rotated across a mix of new and tried and true partners. Pandora, Buzzfeed, and Verizon Media are among the historically performing sites whose partnerships have been renewed for 2021. Other video platforms include Tremor Media, Zefr, and Viral Gains. Tremor Media is helping to drive brand reinforcement by re-messaging those consumers who have been exposed to the commercial on TV. Zefr's inventory runs exclusively on YouTube where there is a high composition of the millennial audience. Finally, Viral Gain's video strategy is intended to learn more about the consumers while qualifying them for further engagement later in the consumer journey based on favorable responses or ambivalent responses.

This year's Cotton campaign includes a mix of data driven platforms and endemic partners, specific to fashion, health and wellness, and sustainability to maximize reach and generate relevant content alignment across the target audience.

Digital Media: Custom Content

Custom content programs are currently being developed across proven custom partners, Buzzfeed, MindBodyGreen, and Well+Good. In summer 2021, custom content is intentionally being developed to support and amplify the benefit messaging around health and wellness and sustainability. As in 2020, the department has partnered with MindBodyGreen, a leader in the sustainability-focused content, to create an interactive infographic and two podcasts, both rooted in learnings from the 2020 campaign. The podcasts will continue to feature a Cotton Incorporated internal resource talent, and this year will feature the Vice President of the Agriculture and Environmental Research Division. From the health and wellness perspective, Well+Good will continue to create content supporting this pillar including two interactive quizzes; one that is focused on beauty and the second focused on style to engage users of the brand on the platform.

New partner, Nativo, will take on the role of content syndication. Nativo will aid in promoting and extending the life of top performing content pieces that resulted from the robust production of unique content in the 2020 campaign. This will take shape in the form of native display ad units driving to both content that lives on TheFabricOfOurLives.com Website and the respective

partner site (i.e. Well+Good). All branded assets (videos and banners) will drive users to the Website for continued brand engagement.

Paid Search Engine Marketing (SEM) and Organic Search (SEO)

Organic Search has driven 26% of traffic to TheFabricOfOurLives.com Website to date in 2021. A competitive market analysis was conducted in April to establish where TheFabricOfOurLives.com Website currently sits in the fabric environment. This analysis included a heavy focus on the current sustainability interested content space. Out of this came key takeaways related to content and optimization opportunities for current and future initiatives. Ongoing content assessment and opportunity identification have been occurring in monthly reports.

Paid search media on Google and Bing platforms continued to drive qualified visitors to TheFabricOfOurLives.com Website, resulting in over 510K clicks to the site. Of these clicks, 168K landed on the Shop Cotton page and 218K landed on the Benefits of Cotton page, the two largest segments of traffic. The top-performing paid search campaign was consistently "Cotton Care" helping consumers with cleaning and care tips. Tactically, the paid search program improve performance this year by enabling auto bidding to maximize clicks which has helped reduce the Cost Per Click (CPC) by over 50% while nearly doubling traffic.

TheFabricOfOurLives.com

Production was completed for TheFabricOfOurLives.com Website's optimizations, which improved page load speed globally across the Website by removing and simplifying animation, converting the imagery to Web formats, updating video modules to include YouTube playlist support, and craft/plugin updates.

The department continues to write news articles in the "Cotton News" section covering a range of fashion and lifestyle topics such as seasonal trends, wellness, and sustainability; always including corresponding cotton-rich shop items. To date, the site has featured 12 unique shop collections.

The year-to-date site traffic is 1,807,250 pageviews and 1,124,720 sessions. The top five pages (based on pageviews): Women's Shop Section, Stain Removal, The Shop Landing Page, Cotton Fabrics Landing Page, and the Homepage.

Paid Social Media

During the first half of 2021, paid social media is utilized to reach and engage with users across platforms such as Facebook, Instagram, LinkedIn, and TikTok. As of June 2021, there are four live campaigns across Facebook, Instagram, and LinkedIn, all with measurement appended to achieve learnings beyond the metrics from the user interface that can be scaled across channels and future buys on those platforms.

On April 12, the "Your Cotton Your Way" paid social media campaign launched on Facebook and Instagram to coincide with the broadcast launch. The Facebook and Instagram campaigns consisted of two components. First, the "male/female test campaign" which has a brand lift study appended and will run through June 12. This test campaign is split 50/50 between the male and female demographics (ages 18-34) with an overall goal of gaining brand lift learnings (e.g. How effective is the creative at driving ad recall, brand lift, awareness, etc. across the male vs. female demographics/overall) that can be scaled across the remaining "Your Cotton Your Way" social and digital buys to maximize performance. The second component will launch on June 13 and run through September 15 and will apply learnings from the first phase.

On June 7, the department will be activating the first TikTok paid execution with influencer, Madilyn Bailey, that will prompt users to submit their favorite cotton product for which she will create a personalized song. The objective of the campaign will be video views with Key Performance Indicators (KPI) of Video View Rate (VVR). The campaign was accepted into an OpenSlate alpha (a third-party brand safety verification platform), which is the only and most effective way to ensure that content is running against brand safe content on TikTok. In addition to running through OpenSlate, the campaign will have a brand lift study appended to gain a better understanding as to how effective this type of influencer content is for Cotton on the platform.

Strategic and Retail Partnerships

The department continues to support retail efforts and the Blue Jeans Go Green™ denim recycling program. To date, Good American, Vera Bradley, and Something Navy have been supported with this campaign's objective to drive traffic to the respective retailer's site. Additionally, Vera Bradley's new product line made with 50% recycled cotton had the primary Key Performance Indicator (KPI) to maximize the Click Through Rate (CTR) for the segmented female demographics of 18-34 and

35+. Cotton plans to restart the Blue Jeans Go Green™ denim recycling program with paid social media support in the second half of 2021.

Production
With campaign production for "Your Cotton Your Way" completed in 2020, the department focused production across digital and social and influencer efforts.

In May 2021, the department launched @discovercotton on TikTok. The channel was launched with newly completed organic content for four different concepts, #AnimatedCotton, #CottonRecrafted, #JustMakesSense, and #CottonChats, some of which utilized content creators on the platform and shows the versatility and prominence of cotton in everyday life.

In the paid influencer activation with Madilyn Bailey as noted above, Madilyn asks her audience to comment their favorite items of cotton clothing on her TikTok video. From there, Madilyn will be collecting her favorite comments and will create personalized The Fabric of Our Lives® jingles about each one. This activation launched in early June with a call-to-action (CTA) video from Madilyn, supported with paid social media support outlined above. The personalized jingles will launch in early July. The department also is supporting this effort with public relations outreach to relevant media outlets to occur in July.

Production was completed on additional The Fabric of Our Lives® campaign banners, which included revising the CTA of the existing health and wellness and sustainability banners from "Shop Now" to "Learn More" to encourage engagement and education on TheFabricOfOurLives.com Website.

Production was completed on six of The Fabric of Our Lives® video assets for the Buzzfeed and Snapchat media buy. Three of the videos were adapted from existing assets and three were created to support messaging around cotton's natural benefits.

Social Media Production
Organic social media continues to focus on thematic lifestyle content created for Instagram (with extensions on Facebook and Twitter) around Sustainability, Health & Wellness, and Fashion & Comfort. In addition, the department supports Brand Partnership's efforts for the Blue Jeans Go Green™ denim recycling program and retail programs to date (Good American, Something Navy, and Vera Bradley) and the "Your Cotton Your Way" campaign with in-feed stories and videos.

Production was completed on paid social videos for the Vera Bradley retail program promoting their newest collection of recycled cotton bags in bright, solid colors.

Production began on the 2021 influencer support program, which will utilize a mix of mega, macro, and micro influencers and a variety of social channels, including Instagram and TikTok to communicate how cotton is The Fabric of Our Lives® and all its benefits.

Youth Marketing
Advertising continued working with Young Minds Inspired, an educational site geared toward educators. To date, one e-blast was sent to educators of fourth through eighth graders across the country around STEM-focused learning regarding the cotton lifecycle as it relates to fashion. Additional e-blasts are planned for June, August, October, and November. As of May 2021, the program materials saw over 140K downloads since its inception in the fourth quarter of 2019.

Additionally, digital efforts with Buzzfeed and social media efforts with TikTok reach a key younger demographic (18-24) within our media target.

Trade Media
There were 35 placements across the Cotton LEADS℠program and macrotrade digital placements. Overall, the total number of placements to date for the Cotton LEADS℠ program and macrotrade across print, digital, and LinkedIn is 51.

MacroTrade uses three top performing partners, Ecotextile News, Rivet, and Sourcing Journal. The MacroTrade campaign utilizes a variety of creative asset sizes and placement locations throughout 2021 to deliver messaging in trade media. A total of three MacroTrade print ads ran in the first half of 2021 in industry publications.

Two MacroTrade campaigns are live on LinkedIn driving to the CottonWorks Website in the first half of 2021. The first campaign launched on February 15 with a focus on General Knowledge, Circularity, and Pending Opportunities. The second campaign, Digital Initiatives, recently launched on May 3. Each campaign has its own specific messaging. This campaign has generated 118 leads from the registration page.

Cotton Incorporated was also offered an exclusive opportunity to participate in LinkedIn's new brand lift study beta at no additional cost. Currently, the brand lift study is appended across both campaigns and will gain a better understanding as to whether the campaign is driving ad recall and brand favorability.

Running in tandem with MacroTrade is the Cotton LEADS℠ campaign. Like the Mactrotrade campaign, Cotton LEADS℠ is also utilizing Sourcing Journal and Ecotextile News as partners. This campaign is running a different creative called "Cotton Truths." This creative asset is going to be used throughout 2021. The print and digital activity are synced to provide additional presence on key properties.

Corporate Communications

Support of Consumer Programs

Corporate Communications supported key consumer-facing projects in the first half of 2021, including the Blue Jeans Go Green™ (BJGG) denim recycling program, as well as ongoing support of advertising campaigns and initiatives in support of the Blue Jeans Go Green™ denim recycling program. The department has increased the frequency of posts on the corporate-facing social media channels and helped review press releases and material assets. To date, posts about the program have organically reached approximately 50K people across the channels.

In April 2021, the Advertising department launched the new The Fabric of Our Lives® campaign with digital as well as television and streaming components. Corporate Communications assisted in reviewing materials for promotion and also sent out targeted media pitches for awareness and promotion.

Trade Programs

Notable media sponsorships in the first half of 2021 include:

- The Rivet COVID: One Year Later Roundtable, which offered an opportunity to share later waves of the Ccompany's COVID-related surveys. The online event had 550 attendees.
- The Sourcing Journal Sustainability Reporting Report, which examined gaps in the credible reporting of environmental metrics. To date, the report, including an interview with a spokesperson and an ad, has been downloaded 600 times.
- The Sourcing Journal Hong Kong Summit, which included a breakout session specific to the company's 3D FABRICAST™ initiative. The session was attended by 119 individuals, more than half of the total event audience.
- The Denim Look Book, in collaboration with Rivet, aims to fill the void of canceled denim trade shows by allowing denim designers a showcase for their work. This is slated for release on June 24 and will be promoted through social media and dedicated eblasts.
- 2021 Spring/Summer Apparel Retailing Market Survey Report was held on May 27 as part of a webinar series with the China Textile Information Center. The event had a live audience of more than 4,000; and the presentation has received more than 650 views, post-event.

Sustainability

The department continues to promote the research about sustainability in the cotton industry. The main sustainability focus of the department in the first half of 2021 is the redesign of the CottonToday sustainability Website, in collaboration with the Sustainability Division. The site is nearing completion and expected to launch in late June. The department is also working with the Sustainability Division to prepare for a Sustainability FAQ Workshop, an online event with Sourcing Journal expected to take place in late June.

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. Corporate Communications works closely with the Corporate Strategy & Insights department (CSI) 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 continue to remain a popular feature in the *Sourcing Journal* and in the denim-centric *Rivet* (as appropriate), where the articles are frequently the top reads of the week. Some of the most popular articles were about apparel brand loyalty during COVID, how consumers have changed during COVID, and performance cotton activewear.

Corporate Communications has also shared data and infographics about special surveys conducted by the CSI department. Special surveys were conducted about consumers and COVID in the U.S., China, and Mexico and these results were shared on the *Lifestyle Monitor*™ Website and shared across all the corporate social media platforms.

The department continued its editorial partnership with the Robin Report in 2021 with articles promoting the *Lifestyle Monitor*™ survey and other analyses from CSI. The most popular article featuring *Lifestyle Monitor*™ data for the first half of 2021 was about brand loyalty during COVID.

Custom social cards about *Lifestyle Monitor*™ data were created specifically for the corporate social media pages (Facebook, LinkedIn, and Twitter) about online shopping, durability, and denim. A total of ten cards were posted across the channels during the first half of 2021 and all linked directly to the *Lifestyle Monitor*™ Website and they garnered a total of over 21K impressions.

The department worked with MultiVu to create an animation to showcase the results of a special survey about cotton and durability. This animation was posted across all three corporate social media channels.

Social Media

The department has also focused on organically growing their social media presence (separate from the consumer-facing "Discover Cotton" pages). From January 1 through June 1, the corporate Facebook page grew from 11,878 followers to 11,945. This number of followers many appear small, especially relative to the consumer Facebook page, which has close to one million followers. However, given the smaller size of the trade/corporate audience, the number of followers is quite good.

Video and animated posts have continued to perform significantly higher than static image posts. The top three videos posted to Facebook were "More Quail Per Bale" (10,450 people reached), the new The Fabric of Our Lives® campaign (7,098 people reached; posted twice), and the "Cotton is Everywhere" animation (4,355 people reached; posted twice). The videos on Facebook garnered a total of almost 11K views during the first half of 2021.

The department utilizes Twitter and LinkedIn as social media tools, sharing articles and information pertinent to the cotton agricultural and textile industries – press releases, webinars, environmental videos, etc.

The department has become increasingly more active on Twitter and LinkedIn. 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 corporate Twitter page now has 6,061 total followers, and the LinkedIn corporate page now has 17,414 followers.

The department has also increased promotion of the CottonWorks™ Website and FABRICAST® collections across the social channels. The posts do particularly well on LinkedIn but receive great engagement across all the channels. The FABRICAST® posts alone have garnered almost 44K impressions alone across all three channels during the first half of 2021.

Using trivia and information about the cotton industry and Cotton Incorporated that had been approved in 2020 for posts about the 50th Anniversary, custom social cards were created to share across all the channels (Facebook, LinkedIn, Twitter) weekly on Sundays.

Corporate Communications is continuing to use a subscription social media tool to assist in scheduling posts across channels, reaching the right audiences on each channel, and also getting metrics on posts and campaigns.

Cottonseed Marketing

In wholeseed, a new print ad was released with digital components, an Advisory Board representative of target audiences was assembled, and two quarterly meetings occurred. In addition, promising independent research on the use of wholeseed for beef cattle has spurred additional knowledge gap research that is currently in process.

For cottonseed oil, a consumer-facing Website was developed and is expected to launch later this year. In addition, a curriculum for target audiences is being developed. This will help fill knowledge gaps about both the health and performance benefits of cottonseed oil. This curriculum will now be delivered remotely, in light of the cancellation of in-person educational conferences.

Brand Partnerships

Consumer Sustainability Initiative: Blue Jeans Go Green™ Program

At the start of the new year, on January 1, Cotton's Blue Jeans Go Green™ program (BJGG) launched a dedicated Instagram handle @BlueJeansGoGreen to help form a more personal connection with consumers interested in cotton sustainably, specifically, denim recycling. Through Instagram's visually-driven and engaging social experience, @BlueJeansGoGreen launched to help spread awareness and educate followers on a range of topics from cotton sustainability to the denim recycling process. The handle reached over 1,000 followers in the first quarter.

To remain connected with the college coeds while many continued to live and learn remotely, BJGG joined forces with the number one media site for college women, Her Campus, in an effort to reach college students online who are interested in cotton and sustainable living. Dedicated components included a dedicated newsletter, native article, e-blast, and social posts. Check out the Instagram reels video *live* on the Her Campus Instagram.

A variety of K-12 schools began to reach out as well to incorporate denim recycling content and activity as students began to return to school, in many areas of the country, in the spring. Educators were directed to Young Minds Inspired (YMI) materials about BJGG and denim recycling and often hosted school and district-wide collection activities.

Throughout the first half of the year, the Blue Jeans Go Green™ program continued to work with a variety of brands and retailers that are committed to cotton sustainability through recycling denim. Participants included Ariat, Artisan Deluxe, EVEREVE, Industry Standard, InJeanious, Levi's, Madewell, O.N.S., Seven for All Mankind, Still Here NYC, and Zappos. All brands and retailers offered incentives to their customers in-store and online to recycle denim made from cotton and close the loop by keeping textile waste out of landfills.

Additionally, frozen seafood purveyor Vital Choice Wild Seafood & Organics®, out of the Pacific Northwest, joined forces with us to promote to their customers how they keep their frozen seafood shipments fresh and temperature controlled by using recycled denim insulation in their shipping boxes. Due to cotton's extraordinary thermal properties, the recycled denim insulation protects the customers package, all the way to their doorstep, a journey that can often take up to 48+ hours. Launching in early June around World Ocean's Day, to demonstrate Vital Choice's commitment to sustainability, they are communicating to their customer base by inserting information about the Blue Jeans Go Green™ program and the insulation for recycling in all outbound frozen seafood packages through the end of the year. The program includes social postings, influencer integration, email promotion, and Web content on both VitalChoice.com and BlueJeansGoGreen.org.

As the United States began to open back up during the beginning of 2021, many businesses, organizations, and individuals across the country began hosting their own denim drives to collect denim for the program. One individual in particular worked with the Blue Jeans Go Green™ program to organize a denim drive in the Yonkers, NY area as part of their Eagle Scout Community project. As a result, the individual collected over 700 pairs of jeans to be contributed through BJGG's mail-in program with Zappos for Good. Some of our other community and Corporate Social Responsibility (CSR) contributions include Habitat for Humanity Vail Valley, Texas FFA, and FabScraps.

As a result of all program participants' efforts, over 125K pieces of denim have been contributed for recycling during the first half of 2021.

Strategic and Retail Partnerships

The department kicked off the year with a new partnership with women's contemporary brand, Good American. The program, originally scheduled for 2020, was postponed until this year due to the pandemic.

Good American debuted with its signature denim fits and has expanded into an inclusive fashion line of ready-to-wear, dresses and activewear. The brand focuses on female empowerment and supports women in looking and feeling their best; therefore, they offer an inclusive size range from 00 to 24. They also "invented" jeans in size 15 since industry standards offer straight patterns ending in size 14 and plus-size patterns beginning in size 16. They found that an entire group of women was overlooked, thus born the size 15 Good American jean.

Cotton teamed with the brand because of its similar-minded core values and extensive cotton-rich apparel offerings. The brand is backed by Khloe Kardashian, allowing for an extensive reach to a broad audience. Good American is sold via its e-commerce site, has brick-and-mortar pop-up shops, and has a large wholesale business with department stores such as Nordstrom and Bloomingdales. The Cotton program was an 8-week campaign that launched on February 18 and ended on April 1. It consisted of a 520+ SKU dedicated shop on GoodAmerican.com. The Seal of Cotton trademark was prominently featured on the product description pages for each item in the shop. Cotton benefit messaging and product featured on a diverse cast was not only found on the dedicated shop but was also prominently placed on the site's homepage. E-commerce packages included a cotton insert and a large social media effort featured 15 popular fashion influencers.

The beginning of the second quarter began with another new partnership with women's contemporary brand, Something Navy. Something Navy was launched by mega fashion influencer, Arielle Charnas, who is based in New York City. Arielle was tapped by Nordstrom in 2018 to launch a line with their private label brand, Treasure and Bond, which resulted in the most successful brand collaboration to date. The Something Navy launch day netted $4MM in sales for Nordstrom. After a couple of years, Arielle Charnas ended her licensing deal with Nordstrom, raised $10MM from investors, hired the Nadaam brand co-founder to be her CEO, and started her very own Something Navy lifestyle brand. Cotton was excited to be one of the brand's very first partnerships. Still currently in-market, the 12-week program started on April 12 and will end on July 12. There are multiple layers to the program including a dedicated cotton shop comprised of 85+ SKUs on SomethingNavy.com as well as a curated shop found within their first brick-and-mortar store in Soho, NY. The cotton-rich collection not only includes the brand's namesake line, but also features various other contemporary brand apparel items for women and kids. The Seal of Cotton trademark is prominently featured on each thumbnail image as well as on each product description page on the site. The social media component is quite significant which includes a live virtual style session, an online Mother's Day event, sustainability focused video content, and there is more to come! Arielle Charnas and a few of her influencer-style team members are featured in much of the campaign which has allowed for an extensive reach across the Instagram platform.

Plans for the balance of the year are currently underway for potentially two more retail partnerships as well as a year-two continuation of the Small Business Initiative that launched last year.

Corporate Strategy and Insights (CSI)

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

Recent research results will be used to better understand the attitudes of U.S. consumers toward cotton and competitive fibers, online shopping, sustainability, microfiber pollution awareness, denim jeans, and shopping preferences. In the first half of 2021, subject areas of research in the *Lifestyle Monitor*™ survey included, but were not limited to:

- Cotton Perceptions: The majority of consumers say cotton clothing is the most sustainable (78%), highest quality (71%), and lasts the longest (56%) compared to manmade fiber clothing.
- More Online Shopping: Over 2 in 5 consumers (43%) say that the pandemic has caused them to buy more of their clothing online. Consumers who prefer to purchase clothing online do so because it is convenient (60%) and a way to avoid crowds (54%), followed by it being easier (53%), and they avoid going to the stores (50%).
- Microfiber Pollution Awareness: Over a third of consumers (35%), up from 30% in 2020, say they are aware of the concerns that microfibers from clothing are polluting our oceans and waters. Over two-thirds of consumers (68%), who are aware of microfiber pollution, say that awareness will affect their future clothing purchase decisions.

- Denim Jeans: On average, U.S. consumers own six pairs of denim jeans. The majority of consumers (55%) say they wear denim jeans or shorts at least three times a week. Nearly two-thirds of consumers (59%) say they prefer their denim jeans be made of cotton or cotton with spandex.
- Back-to-School (BTS) Shopping: Among those with a need to do back-to-school shopping, almost 9 in 10 plan to buy clothes (89%), followed by shoes (80%), supplies (77%), fashion accessories (30%), electronics (29%), and sporting equipment (18%). Back-to-school clothing shoppers plan to spend about $368 (up 8% from $340 in 2020 and up 18% from $312 in 2019) on clothes per person. Almost 2 in 5 parents (39%) say they plan to purchase clothing for themselves when shopping for BTS clothing for their kids this year.

Retail Monitor™/WGSN Retail 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. For the first half of 2021, staff are establishing a new methodology for cotton's share and will be able to analyze findings in the fourth quarter of 2021.

Census-Based Import Database

Staff maintains a comprehensive database of U.S. textile imports by source country. Analysis of these data describes changes in sourcing patterns under apparel tariffs and the ban on Xinjiang-grown cotton.

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, Webinars, and Meetings

During the first half of 2021, staff executed 27 economic and market research presentations to global audiences including focused presentations to U.S., Latin American, and Asian regions. Key topics included cotton economic outlook, Chinese cotton and U.S. import regulations, economic and consumer response to the COVID-19 pandemic, sustainability, and retail trend updates. Together the economic and market research presentations had over 2K attendees. Below are a few highlights:

- Staff presented on the effects of COVID on cotton supply chains at the Beltwide Cotton Conferences.
- Three webinars were presented on the CottonWorks™ platform addressing the effects of restrictions and the eventual ban on cotton grown in Xinjiang province.
- Regular cotton market outlook Webinars were held with interested companies.
- Due to the pandemic, an extended trip through Latin America and Asia were not possible. As a replacement, staff prepared presentations covering the cotton market situation and how it has been affected by the pandemic.
- Staff participated in a panel discussion held by Rivet/Sourcing Journal on the denim supply chain that included a denim manufacturer, brand, and retailer. Staff provided insights on consumers' denim usage during COVID and expected usage in the future.
- Staff provided *Consumer and Retail Insights* presentations for two Webinars held in the Hong Kong and mainland China markets. Account Executives in China used the market research presentations for multiple Webinars in the domestic market reaching over 10K viewers.
- A keynote presentation was given at the AATCC Natural Dyes conference by staff and viewed by over 700 unique visitors.
- Staff provided *Consumer and Retail Insights* presentations to key brands, retailers, and manufacturers in the U.S., Mexico, and Peru.

Economic Publications

The Corporate Strategy & Insights 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:

- Six 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.

- Six 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.
- Six reports about how changes in cotton prices are "passed through" the supply chain were published and distributed.
- 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:

- *COVID-19*. Based on the results of Waves 5 and 6 of the 2020/21 Coronavirus Consumer Response Survey, six infographics were created and disseminated to key accounts and retailers and made available on Cotton Incorporated's Website. Key findings show consumers cautiously emerging from the pandemic and looking to buy new clothing for resuming activities.
- *Durability*. Based on the results of the 2020 Global Durability Study, one infographic was created and disseminated to key accounts and retailers and made available on Cotton Incorporated's Website. Key findings show that durability is important to global consumers, and they find it in cotton clothing, keeping clothing longer the more cotton it contains.
- *Seal of Cotton*. Based on the results of the 2020 Seal of Cotton Study, two infographics were created and disseminated to key accounts and made available on Cotton Incorporated's Website. Key findings show that the vast majority of U.S. and Mexican consumers are aware of the Seal of Cotton trademark and that it helps them identify cotton clothing.

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

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 Retail Audit are ongoing market research studies conducted jointly by Cotton Council International and CSI. The latest findings from these projects as well as additional results from other strategic research studies are provided.

COVID-19 Research

CSI conducted two additional waves of a survey on consumers' responses to the COVID-19 pandemic. The fifth wave was conducted in March with 1,500 consumers in the U.S., China, and Mexico, while the sixth was conducted in May with 3K consumers in the U.S., China, and Mexico. Highlights from the results include:

- The percentage of consumers in all countries who were very concerned about how the pandemic rose in Mexico and China between Waves 4 and 5, then fell with expanding vaccination efforts by Wave 6. The U.S. saw a drop in concern earlier, from 65% of consumers very concerned in November 2020 (Wave 4) to 59% in March 2021 (Wave 5) and 55% in May 2021 (Wave 6).
- The percentage of consumers in all countries who are spending more or the same amount on clothing increased in Wave 5 and again in Wave 6. Over 3 in 4 consumers in each country expect to spend more or the same amount on clothing in 2021 compared to 2020.
- Consumers shopped online during the pandemic out of necessity as stores closed and online shopping felt safer. Many of these consumers expect to continue shopping online for at least some of their clothing even as communities open up and in-store shopping is once again possible.

Online Fiber Content

CSI conducted a survey of consumers' online clothes shopping experiences and preferences for information in retailer listings. The survey was conducted with 3K consumers in the U.S., Mexico, and China in April. Highlights from the results include:

- A majority of consumers (61%) say it is very important to know fiber content when purchasing clothing online. Those with more experience shopping for clothing online are more likely to say this information is important to have.
- If they cannot find fiber content information when shopping online, 83% of consumers say they will shop in a physical store to get this information.
- Half of consumers (47%) actively seek out certain fibers or fabrics when shopping for clothing, and of these, most (80%) seek cotton. Far more consumers seek cotton than any other fiber.

Chinese Consumer Survey

Below are highlights from the most recent results:

- Apparel Shopping: Chinese consumers say they buy most of their clothing from e-commerce platforms (26%), followed by chain stores (22%), department stores 15%), small independent shops (12%), and hyper- markets (9%).
- Clothing Purchase Factors: Over three-fourths of Chinese shoppers say fit (86%), style (81%), fiber content (79%), finishing (79%), price (78%), color (77%), and durability (76%) are the most important factors when considering what clothing to purchase.
- Clothing Ideas: Chinese consumers are most likely to get their clothing ideas from friends and people they see regularly (54%), followed by what they already own and like (53%), family members (40%), in-store displays (39%), brand and retailer Websites (34%), and social media sites (32%).

Brand Tracker

In the first half of 2021, 3.8K U.S. respondents were interviewed regarding their awareness and attitudes toward cotton and competitive fibers. The information provides insight into changing emotions toward fibers and shows that promotions are meeting objectives by maintaining cotton's significant lead in fiber awareness and emotional connection. The most recent results available from the first quarter indicate consumers' emotional connection to the fiber remains exceptionally strong with more than 85% saying cotton is a fiber they like or love. Key brand metrics show cotton continues to lead competitive fibers in awareness (81% unaided, 95% aided) and a significantly larger share of respondents, compared to competitive fibers, consider cotton to be comfortable (83%) and a fiber they like to wear (81%).

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 the first half of 2021.

Trade

February 4, 2021	Van Murphy Elected as Cotton Incorporated Chairman
February 16, 2021	CLO Virtual Fashion Hosts First-Ever Global Virtual User Summit
February 22, 2021	Doubling down on Trust: How Brands Can Help Manage Risk through a Recession
May 19, 2021	Denim Jeans Market 2025 Emerging Trends | Challenges, Application Scope, Size, Status

Consumer

January 21, 2021	9 style and beauty brands that will give you free gift cards, products, and coupons for recycling items
April 12, 2021	Comfort and Confidence Take Many Forms & Cotton Is the Common Thread in New Campaign
April 22, 2021	Consider This Your Download on Upcycled Clothing
May 29, 2021	Cotton Incorporated talks sustainability goals

Print Coverage

The following is a list of some of Cotton Incorporated's print coverage in the first two quarters of 2021.

Florence Morning News	Mention of Cotton Incorporated

Television and Radio Coverage

The following is a partial list of Cotton Incorporated's television and radio coverage in the first two quarters of 2020.

Station	Market	Topic
88.9 Noticias	Mexico	Mention of Cotton Incorporated
Southeast AgNet Radio Network	Florida, Georgia, Alabama	Mention of Cotton Incorporated
Dakota Radio Group News	South Dakota	Mention of Blue Jeans Go Green™ program

Internet Coverage

The following is a partial list of the online mentions of Cotton Incorporated, or its initiatives or programs, in the first two quarters of 2021.

Cotton Farming	Mention of Cotton Incorporated
Hudson Valley Post	Mention of Blue Jeans Go Green™ program
Nonwovens Industry	Mention of Cotton Incorporated
Cotton Grower	Mention of Cotton Incorporated
Textile World	Mention of Cotton Incorporated
Bustle	Mention of Blue Jeans Go Green™ program
Real Simple	Mention of Blue Jeans Go Green™ program
Fashion Mannuscript	Mention of Cotton Incorporated
The Independent	Mention of Blue Jeans Go Green™ program
Parade Magazine	Mention of Blue Jeans Go Green™ program
Hunting Life	Mention of Cotton Incorporated
Staten Island Parent	Mention of Blue Jeans Go Green™ program

The Moultrie Observer	Mention of Cotton Incorporated
American Cattlemen	Mention of Cotton Incorporated
Textile Excellence	Mention of Cotton Incorporated
High Plains Journal	Mention of Cotton Incorporated
Oklahoma Farm Report	Mention of Cotton Incorporated
Katie Couric Media	Mention of Blue Jeans Go Green™ program
Arkansas Democrat Gazette	Mention of Cotton Incorporated
Benzinga	Mention of Cotton Incorporated
Stock & Land	Mention of Cotton Incorporated
Reader's Digest	Mention of Blue Jeans Go Green™ program
Salon	Mention of Cotton Incorporated
Just-Style	Mention of Blue Jeans Go Green™ program
Fast Company	Mention of Blue Jeans Go Green™ program
The Progressive Farmer	Mention of Cotton Incorporated
The SPIN OFF	Mention of Cotton Incorporated
The Times and Democrat	Mention of Cotton Incorporated
Vail Daily	Mention of Blue Jeans Go Green™ program

CORPORATE ADMINISTRATION/FINANCE

The Corporate Administration Division includes Board of Director Services, Human Resources, Corporate Office and Facility Services, and Legal Departments.

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

The Board held an Executive Committee Meeting March 1-3, via WebEx Conference, in conjunction with the Cotton Board's meeting. The Cotton Incorporated 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, via WebEx Conference, April 1. Topics of discussion included 2021 budget execution, 2021 meeting schedule options, the Cotton Board's Program Recommendations for 2022, medium-term funding, longer-term funding, personnel, and key programmatic directions.

In addition, the Cotton Incorporated Board of Directors held a Directors Meeting June 14-17, via WebEx Conference, in conjunction with Cotton Board Members. The key objectives of the meeting were for management, staff, and Board Officers to:

- Provide Updates on 2021 Program Activities
- Present 2022 Budget Framework for Discussion and Board Recommendation
- Present 2020 Audit Report
- Present of 2020 Actual-to-Budget Report
- Provide a Response to the Cotton Board's Program Recommendations

COTTON INCORPORATED
BUDGET DATA THROUGH JUNE 30, 2021

Program Area Expenditures	Budget	Actual
Agricultural Research	$ 14,901,000	$ 2,360,939
Research & Development		
➢ Fiber Competition	$ 4,308,000	$ 1,843,898
➢ Product Development & Implementation	$ 9,289,000	$ 3,762,948
	$ 13,597,000	$ 5,606,836
Global Supply Chain Marketing	$ 15,711,000	$ 6,189,223
Consumer Marketing	$ 30,718,000	$ 11,734,736
Corporate Administration	$ 5,433,000	$ 2,459,435
TOTAL:	$ 80,360,000	$ 28,351,179

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; testing the cottonseed nutrient profile to determine natural variation in germplasm and evaluating this germplasm for adding value and reducing input potential; and developing new products and utilizing 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 – This activity aims 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 – This activity aims 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 (AER) – 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 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.

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

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 Development Laboratory (PDL): This laboratory houses knitting and Computer Aided Design and Manufacturing equipment for producing fabric samples.

Research and Technical Center: Cotton Incorporated's research center is located in Cary, NC. For the activities covered in the Research and Development Committee, annual funding for operating the research center is allocated to include expenses for machinery, chemicals, contract labor, and materials.

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.

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.

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.

Digital Supply Chain initiative – Refers to an initiative in the GSCM division in an effort to enhance the division's marketing capability by incorporating the latest and most widely used 3D textile design tools.

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, Corporate Communications, Brand Partnerships, and Corporate Strategy & Insights

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.

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%.

Corporate Social Responsibility (CSR) – CSR is a business model that helps a company be socially accountable to itself, its stakeholders, and the public.

Key Performance Indicators (KPI) - KPI are metrics used by decision makers to track and evaluate the effectiveness of a campaign against established business goals and objectives.

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.

Video View Rate (VVR) - A ratio showing the number of paid views of a video ad to the number of impressions. View rate is similar to click-through rate (CTR), but instead of measuring clicks, it counts people who viewed your video ad after seeing it on YouTube or the Display Network.

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.

Gross Rating Point (GRP) – GRP is a term used in advertising to measure the size of an audience reached by a specific media vehicle or schedule. It is the product of the percentage of the target audience reached by an advertisement, times the frequency they see it in a given campaign. For example, a TV advertisement that is aired 5 times reaching 50% of the target audience would have 250 (GRP = 5 x 50% --) i.e., GRPs = frequency x % reach. To determine a total GRP, individual ratings for each media vehicle are added together.

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.

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.