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ADVANCEMENTS IN USDA COTTON CLASSIFICATION

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Abstract

The mission of the USDA, AMS, Cotton Program is to support the orderly and efficient marketing of U.S. cotton, domestically and internationally, by providing unbiased classification, standardization, market news, and oversight of the research and promotion program. Therefore, the Cotton Program continuously strives to find innovative ways to improve its services to the cotton industry. Several advancements have recently been implemented or are currently under evaluation to further enhance many of the Program's operations and ultimately improve those services. Innovations recently implemented in Classing Operations, Quality Assurance, Standardization and Engineering, and Information Technology include new classification instrumentation, automation equipment, computer hardware and software upgrades, and extraneous matter guides. Other innovations will be implemented and/or evaluated in the coming year such as new lint removal systems, prototype fiber measurement equipment, and classification data dissemination enhancements. Additional efforts are also underway to accelerate collaborative studies to investigate methods for developing viable methods for measuring short fiber content and calculating an instrument leaf grade.

Classing Operations

Two recent advancements in the Cotton Program's classing operations were the acquisition of a new model of High Volume Instruments and the contracting for implementation of a new air-based lint removal system for use by the Quality Assurance (QA) Branch and evaluation for future use in classing laboratories.

Uster Technologies Model 1000 High Volume Instrument

One of the primary advancements in the area of classing operations is the evaluation and implementation of a new model of High Volume Instrument (HVI) into three classing offices nationwide and the QA Branch in Memphis. The Cotton Program obtained forty new model "1000" instruments manufactured by Uster Technologies. The new model's fiber measurement methodologies are very similar to the 250 existing Uster model 900-U instruments already in operation nationwide in the Cotton Program. However, the Uster-1000 instruments incorporate new advancements in system mechanics that simplify operation and maintenance while maintaining the same high level of data accuracy historically experienced from the 900-U. Further, the 1000-model utilizes a Windows-based operating system and new software features not offered from the 900-U. Preliminary results from the forty 1000-model instruments are very positive, showing increases in production capabilities, reduced maintenance requirements, and a solid data product that is very comparable to the 900-U.

High-Vacuum (HI-VAC) Lint Removal System

In early 2005, the Cotton Program will install its first HI-VAC loose cotton and lint removal system in the QA Branch in Memphis. This will mark the first time such a system has ever been installed in a classing laboratory operation. The lint removal system is similar to those used in manufacturing mills. The new removal system will replace the current underground conveyor system located in the QA Branch. If successful, similar HI-VAC systems will be implemented in all future classing offices and some existing facilities may be retrofitted to include the systems. These systems create a much more efficient means to remove loose cotton and lint from the workspace while drastically reducing the amount of maintenance and space currently necessary for the conveyor systems. In addition, the HI-VAC systems virtually eliminate any chance of fires starting in the classing offices' lint removal systems.

Quality Assurance Operations and Procedures

Two primary advancements occurring in QA Branch operations recently were the development and implementation of new automation equipment and a change in the operational methodology for processing checklot samples received from the twelve classing offices across the country each day.

Multi-tier Conveyor System

The Cotton Program installed a four-tier conveyor system in the QA classing laboratory in 2003. This system has been utilized and refined over the past two years and has proven to be extremely beneficial to the overall process flow in QA while significantly reducing labor. The conveyor system is designed to efficiently move all categories of trayed cotton samples throughout the QA operations simultaneously including checklots, futures, foreign growth, service test, study cotton, etc. Since all cotton samples submitted to QA must be processed on two different High Volume Instruments, the movement of these samples had always been performed manually by multiple production assistants. The movement of all of these different cotton samples has historically been the most labor-intensive facet of QA operations while introducing an additional element of potential human error in handling the samples. The Cotton Program's Engineering Staff worked with the QA Branch staff to design the four-tier conveyor system to incorporate all of the steps included in the QA classification process from the point of sample receipt into the office to the final end data product. The conveyor system originates in the receiving and conditioning room from the sample preparation stations and extends throughout the instrument-testing and manual classing laboratory operations. As a result of the implementation of the conveyor system, the amount of manual labor needed in the QA Branch operations has been reduced by approximately 50 percent while virtually eliminating error associated with additional handling of samples once they are prepared for testing.

Checklot Leaf Classification before HVI Testing

The Cotton Program's Checklot System randomly selects approximately 1% of all cotton samples classed each day in its twelve classing offices nationwide for immediate overnight shipment to the QA Branch in Memphis. These samples are retested in QA on two different High Volume Instruments and the results are averaged. These results are then evaluated and returned to the offices for immediate use in verifying accuracy and maintaining the proper classification level across the country. Historically, the checklot procedure in QA has consisted of instrument testing the samples before manually classifying them for leaf and determination of extraneous matter. This was due in large part to wanting to emulate the same operation as exists in the classing offices. However, prior to the 2004 classing season, Cotton Program staff studied the effects of reversing this process to manually classify the samples first before instrument testing. The primary theory behind the idea was to ensure the least amount of human intervention from the time the samples are placed in shipment sacks by manual classers in the classing offices until the time a supervisory classer in QA reviews the samples. Internal study and observation have shown that when instrument testing the samples first in QA before manual classing, there is an increased chance of the samples losing particles of leaf and/or extraneous matter, potentially making the samples more difficult to classify manually. In addition, when instrument testing takes place, a portion of the sample must be removed to load into the instrument for testing micronaire, length, strength, and length uniformity. Although these portions are small, there was concern in QA that if samples were retested, the amount of cotton removed could be significant enough to possibly skew the classer's judgment.

The new procedure for classing checklots consists of the samples being trayed as they are received from the classing offices and delivered via conveyor directly to the classing stations. Theoretically, the samples being introduced to the QA classers are the same sample last reviewed by the classers in the field. No further instrument testing has taken place so no lint has been removed since the day before when the samples were shipped. Each sample is reviewed by two supervisory QA classers independently and the respective grade is assigned. After the QA classers grade each sample, the data is entered into the computer and the sample is placed back in a tray to be sent to the HVI stations for instrument testing. Once each sample is instrument tested, the data is merged with the manual classification, and the record is ready for comparison to the original classification.

Standardization and Engineering

Three initiatives affecting the future potential of cotton classification fall into the category of standardization and engineering for evaluation. These are the evaluation of new fiber measurement equipment offered by Schaffner Technologies, the development of a new Extraneous Matter guide booklet, and collaborative efforts to study the potential for future measurement of short fiber and instrument leaf.

Evaluation of New Fiber Measurement Equipment

In a continuing effort to pursue advancements in color and trash measurements, the Cotton Program acquired two Isotester fiber measurement instruments from Schaffner Technologies, Inc. in 2003. This acquisition was based on the need to investigate different technologies in addition to the existing measurement components found on the

Uster 900-U HVI. The Isotesters utilize digital imagery through scanner-based technology to measure color, trash, and potentially extraneous matter such as bark and grass. The Cotton Program has studied the Isotesters extensively since 2003 and in 2004 began a collaborative effort with Cotton Incorporated that included evaluating a new, more automated version of the instrument and comparing those results to the two Isotesters and existing Uster 900-Us. Those studies are ongoing with hopes of uncovering potential improvements for measuring color, trash and extraneous matter in the future.

Extraneous Matter Guides

In cotton classification, only two determinations are still made by human classers – leaf and extraneous matter. The classers make leaf grade determinations based on the Universal Cotton Standards for Leaf, a set of physical standards designed to represent the low end of each leaf grade and the various levels between the various leaf grades. However, for extraneous matter such as bark, grass, seed coat fragments, preparation, spindle twists, oil, and others, there are no definitive physical standards available. Classers are trained to recognize these foreign substances during their certification process and refresher training sessions are conducted each year prior to the season. A clear-cut set of extraneous matter standards does not exist primarily due to the amount of different types and wide range of appearances that extraneous matter can have from one office to another.

There have been inquiries over the years from the cotton industry, both domestic and international, regarding the formulation of extraneous matter standards. Cotton Program classing offices have also requested better definitions or guides to use in order to effectively determine the presence of extraneous matter. A recent official request from industry occurred in 2002 during the Universal Cotton Standards Triennial Conference when a proposal came forward to "better define" and "explore the possibility of creating standards" for extraneous matter. An additional formal inquiry was raised the following year during the annual Standards Matching Meeting to create guides or standards to use. Since 2003, extraneous matter has continued to be a focal point with the cotton industry due to increased use of high-speed mill equipment and the necessity for fiber to be contaminant-free when spinning yarn.

As a result of these requests and the pursuit of improving the accuracy and consistency of extraneous matter determinations, the Standardization and Engineering Branch of the Cotton Program developed a visual guide booklet consisting of high quality digital images of bark and grass samples to provide classers with a tool to use when classing samples. Bark and grass were chosen initially since they represent the two most prominent forms of extraneous matter found in samples and were the most feasible to capture visually for image guides. Images were taken across the entire leaf range and prototype booklets complete with written definitions for bark and grass were completed for evaluation in 2004. These booklets are being evaluated by several classers in four different classing offices and the concept will be discussed during the 2005 Universal Cotton Standards Conference in Memphis.

Collaborative Studies for Future Fiber Measurements

Short Fiber Measurement

The Cotton Program has expanded it efforts to find a viable, production-oriented, measurement for short fiber by entering into collaborative studies and research with national and international organizations. One of these collaborations involves evaluating and comparing various short fiber measurement methods and the mill utility of those measurements. Part of this study was to select a set of bales that have varying short fiber characteristics to evaluate the response when tested on different types of fiber length measurement instruments in different locations. Participating collaborators include ARS-Cotton Quality Research Station in Clemson, SC; ARS-Southern Regional Research Center in New Orleans, LA; International Textile Center in Lubbock, TX; Cirad in Montpelier, France; Gdynia Cotton Association in Gdynia, Poland; and Lintronics in Arad, Israel. Several different types of instrumentation have been used to test samples and others will be utilized in the future as this collaborative study continues.

Instrument Leaf Grade

The Cotton Program has been investigating possible avenues for pursuing an instrument leaf grade to eventually replace the current manual method of determining leaf. Currently, the leaf grade and the determination of extraneous matter are the only two remaining facets of cotton classification performed manually by visual inspection. Investigations are underway to determine if the instrument measurements of Percent Area and Particle Count can be combined to formulate a conversion look-up table similar to that used for official color. With color, the measurements of Rd and +b are matched using the Nickerson-Hunter color chart and the intersection of the two

determines the converted color grade. The current instrument leaf studies use the same premise in an effort to surmise if a viable leaf grade correlation to percent area and count exists as well.

Information Technology Upgrades

The Information Technology (IT) arena is most likely the area of Cotton Program operations experiencing the most advancement over the past couple of years. Several key enhancements were realized and others are currently underway including both hardware and software applications.

Internet

One of the most significant advancement occurred with the full implementation of Internet availability for cotton classification data. Although implemented in 2003, the Cotton Program's Internet service really came into its own in 2004 as the number of Internet customers rose significantly to include over 60% of its total customer base. Dedicated lines to each regional classing office were upgraded prior to the 2004 season to enable faster retrieval for the National Database, faster access for Internet customers, and the ability for Farm Services Administration (FSA) to access classing data as needed.

New Data Format

Beginning June 1, 2005, the Cotton Program's data records disseminated to customers will have a new format. The current format contains 73 characters including blank spaces, obsolete fields, and one unnecessary physical decimal. The new format will consist of 69 character, no blank spaces, no physical decimals, and updated fields to include implied decimal places for Rd color and Length Uniformity as well as a field for corrected records. This new format was proposed in early 2004 for implementation in June 2004 but at the request of the cotton industry, the Cotton Program elected to postpone the activation of the new format until June 1, 2005 in order to give data users an opportunity to prepare computer programs to handle the new format. The additional decimal places for Rd and Length Uniformity will take advantage of additional precision already provided by the HVI. Focus on Length Uniformity Index has increased recently with the continued move to high efficiency mill operations and the apparent correlation between uniformity index and short fiber content. This correlation and the attention given to Length Uniformity index globally is reason enough for the additional decimal place in the new data format to prove beneficial to the users of classification data.

Classification Database

Beginning in 2003, the Cotton Program's IT Staff took on the challenge of completely redesigning its three primary information databases. Starting with the Classification Database, the IT Staff reviewed hundreds of programs and developed new and improved fields, reports, and utilization capabilities previously unavailable such as programs to capture and store various types of experimental for conducting studies to potentially improve classification procedures. The new database design also offers more ability to utilize HVI precision previously available but not attainable with the old format, specifically for Rd Color and Length Uniformity Index.

Quality Assurance Database

The Classification Database was immediately followed by a complete upgrade of the Quality Assurance Database. This was very significant in that it created new and innovative ways to utilize QA checklot data, the basis for assuring accuracy and consistency in classification operations nationwide. The QA Database upgrade created a new ratings program for instrument operators, supervisors, technicians, and others based almost exclusively on the accuracy of the data product from the HVI. The previous database did not have the capability of directly correlating actual instrument measurement performance back to individual employees for use in making management decisions. Instrument performance data was matched to the specific HVI only. Employee ratings were based primarily on subjective observations and not the objective data product being generated. Since some of the measurements given by the HVI are operator-influenced, it became essential for the database upgrades to incorporate accountability into the ratings program. The new QA Database in conjunction with the Classification Database accomplished that accountability and provided potential improvements in the ratings arena for the future. In addition to creating a much improved ratings system, the QA Database offers a wide variety of data evaluation tools for managers to track their respective offices' performance. These QA reports can generate valuable data by a host of criteria including overall Program, region, office, shift, HVI number, operator, classer, supervisor, etc. These reports serve as valuable management tools in ensuring the most accurate data possible is being provided to customers. The new QA Database also offers new operational features to QA managers not previously available. These assist in tracking subtle trends related to Futures classification, checklots, and other types of operations reserved for the Quality Assurance Branch specifically.

National Database

After completing the QA Database upgrade, the IT Staff moved immediately into redesigning the National Database, the primary means that customers retrieve their classing data. Once again, the IT staff reviewed hundreds of programs and determined necessary improvements to antiquated database features. The National Database will incorporate all data format changes previously discussed for the Classification Database and Quality Assurance Database. There are two additional new features affiliated with the National Database as part of the upgrade. One is the ability for users to search up to four crop years in addition to the current year when the user selects the "old crop" search option. Previously, only the current and immediate past crop could be searched. Second, the National Database has an option for the user to specify whether to receive a "Not Found" message in the data file if the requested bale is not found for some reason. This will prevent the customer from having to potentially deal with large numbers of records shown as "NF" if they feel this record is not beneficial.

Conclusions

Cotton classification is becoming more global with the expanding export markets for U.S. cotton and several countries now developing classification systems very similar to the USDA system. The Cotton Program has historically taken an active role in continuous work improvement to find ways to enhance its services while maintaining a cost-effective fee structure for its customers. Recent advancements in classing operations, quality assurance procedures, standardization and engineering, and information technology are just a few ways in which the Cotton Program strives for continuous improvement. Efforts will continue in the future to build upon these advancements and keep the USDA cotton classification system as the benchmark in the global cotton industry.