INTERNATIONAL COTTON ADVISORY COMMITTEE

Standing Committee **SC-M-455 Final**
Washington, DC **August 10, 2001**

MINUTES

455th Meeting of the Standing Committee
Tuesday, July 31, 2001
Commonwealth/Southampton Gin
Franklin, VA

PRESENT:

Mr. Alfonso Liévano, Colombia (in the Chair)
Mr. Aluisio de Lima-Campos, Brazil
Mr. Philippe Ondo Ondo, Cameroon
Mr. Abdoulaye Beri, Chad
Mr. Joe Lai, China (Taiwan)
Mr. John Morrisson, Côte d'Ivoire
Mr. Wael Shoaeb Samir, Egypt
Mr. Gaddam Dharmendra, India
Ms. Chigozie F. Obi-Nnadozie, Nigeria
Mr. Lucio C. Manghinang, Philippines
Mr. Teresa Orczykowska, Poland
Dr. B. N. Nengovhela, South Africa
Mr. Alfonso Pino, Spain
Mr. Alex Massinda, Tanzania
Ms. Mayanendja Nonon Saa, Togo
Mr. Cumhur Isbirakmaz, Turkey
Mr. Tatenda Makono, Zimbabwe
Mr. Robert Djimon Zantan, Benin
Mr. Timothy Pearson, Brazil
Mr. Len Alphin, Commonwealth Gin
Mr. Tom Alphin, Commonwealth Gin
Mr. Roy Roger, Commonwealth/Southampton Gin
Mr. Cris Stanley, Commonwealth/Southampton Gin
Mr. Roger B. Fermon, Continental Eagle Corporation
Mr. Auvie Kincer, Continental Eagle Corporation
Mr. Ibrahim Malloum, Cotontchad
Mr. Davis and Sons, Davis & Sons Inc.
Mr. Don Van Doorn, Lummus Corporation
Dr. Terry P. Townsend, Executive Director
Mr. Gerald Estur, Statistician
Mr. Carlos Valderrama, Economist
Mr. Alfonso Liévano Jr., ICAC Intern
Ms. Rosa M. Soper, Administrative Assistant

1. Adoption of the Agenda

The CHAIR called the meeting to order at 2:10 PM. He welcomed Messrs. Abdoulaye Beri of Chad, Joe Lai of China (Taiwan) and Gaddam Dharmendra of India, who were attending a Standing Committee meeting for the first time; and Mr. John Morrisson, newly appointed delegate of Côte d'Ivoire. He also welcomed Mr. Robert Djimon Zantan, an observer from the Embassy of Benin. The Chair welcomed members of the Expert Panel on Ginning Methods who were attending the meeting, including Mr. Donald Van Doorn of Lummus Corporation, Mr. Ibrahim Malloum of Cotontchad and Mr. Timothy Pearson from Brazil. He also welcomed Mr. Roger Fermon and Mr. Auvie Kincer of Continental Eagle who were attending the meeting, and he thanked Tom and Len Alphin of Commonwealth/Southampton Gin for their hospitality.

The CHAIR asked if there were comments on the agenda, and seeing none, found that the agenda was approved.

2. Report of the Expert Panel on Ginning Methods (Attachment II)

The executive director introduced Mr. Donald Van Doorn, Sr. Vice President and Chief Technology Officer, Lummus Corporation, to present the report of the Expert Panel on Ginning Methods. Mr. Van Doorn serves on the Panel. He extended an apology from the Panel Chair, Mr. Stanley Anthony, who had been unable to attend because of a prior commitment.

Mr. Van Doorn noted that in the short term existing quality standards determine best ginning practices to optimize monetary returns. However, current quality standards often do not mirror the needs of textile mills, and in the long term cotton classing standards should be modernized. He recommended that governments work to revise cotton standards to reflect spinning qualities valued by the textile industry.

He observed that gins are at the confluence of practically all segments of the cotton industry because the gin converts cotton into commercially saleable products, (lint and seed). Therefore, the efforts of seed breeders, farmers, suppliers of fertilizers, insecticides, herbicides, and harvest aids, harvesters, and ginners all come to fruition at the gin.

He noted that ginning technologies vary from simple to complex and that each may be best suited for its respective area. Fiber micronaire and strength are almost completely determined by variety, but staple length, uniformity, and short fiber content are determined by both variety and ginning practices. The ginner's objectives are to maximize profits from the sale of lint by producing the best combination of quality and quantity as determined by market prices.

Seed cotton storage is important to the preservation of lint quality and is often the direct responsibility of the ginner. Moisture must be kept below 12%. In humid areas, seed cotton should be monitored and ginned immediately if temperatures increase by 10° centigrade or exceed 49° centigrade.

The amount of equipment needed to clean and dry seed cotton prior to ginning will depend on humidity and the amount of foreign matter present. Hand-harvested seed cotton generally requires less cleaning than machine-picked seed cotton. Mr. Van Doorn described recommended machinery configurations in different situations. He demonstrated that additional cleaning can significantly improve color and trash content, but that neps, short fiber content, uniformity, length and turnout will likely deteriorate with additional cleaning. He noted that cleaning efficiency increases at higher temperatures with a decrease in fiber moisture, but that fiber spinning quality can also be reduced. Therefore, proper management of heat and moisture is important; temperatures should be kept below 93° centigrade and moisture should be maintained between 6% and 7% for best fiber quality preservation. He urged governments to take measures to ensure that training opportunities are available to managers and employees of gins to ensure that best practices are widely known. Safety and health conditions are governmental concerns and gins are focal points for the dissemination of safety and health information from field to bale shipment.

Mr. Van Doorn said that bale covering is important to prevent contamination, a major complaint of the textile industry. Cotton covers are optimal but often expensive. Consequently, combinations of woven polypropylene bonded to a light film, or solid polyethylene film are often used. Bale covers should fully cover all six sides of the bale, and sampling cuts should be patched. Bales to be stored outside should be covered with material impervious to ultraviolet rays.

The CHAIR thanked Mr. Van Doorn for his presentation and invited additional comments from members of the Expert Panel. Mr. Timothy Pearson said that he wished to elaborate on material contained in pages 12-14 of Attachment II. He agreed with Mr. Van Doorn that appropriate training is crucial to compliance with best ginning practices. Further, he felt that a key to maintaining lint quality during ginning is to reduce speeds below the rated capacity of the gin. He acknowledged that slower ginning speeds would result in reduced efficiency and higher costs, but felt that resulting improvements in quality justified slower speeds.

Mr. Van Doorn suggested that independent tests should be conducted on the impacts of slower ginning speeds on fiber quality and ginning costs.

Mr. Fermon reported that research conducted by gin manufacturers indicates that when gins are operated properly according to the specific characteristics of the seed cotton being processed, ginning speeds can be maintained at rated levels without sacrificing fiber quality. He noted that ginners with proper training are able to adjust machinery to achieve optimal results with seed cotton of varying characteristics.

Mr. Fermon noted that optimal results can only be achieved using equipment appropriate to each situation, and he urged governments to eliminate barriers to investment in modern ginning equipment, including barriers to machinery imports. He endorsed the recommendation made by Mr. Van Doorn that governments should work to establish universal cotton quality standards that reflect characteristics valued by spinning mills.

Mr. Van Doorn noted that reliable and fast methods of measuring fiber characters most valued by the textile industry have not yet been developed. However, slower methods of measuring fiber characteristics valued by mills, such as short fiber content, are available that could be employed at gins rather than at fiber testing centers. He added that it could be possible to halve the number of samples to be tested by testing every other bale and averaging the results over all bales in a module. He recommended that the feasibility of testing lint cotton samples at gins using the latest testing instruments should be explored.

Mr. Malloum said that it is not necessary to install sophisticated cleaning machinery in all situations, especially with hand-picked cotton in Africa. He noted that there have been substantial improvements in ginning methods, but that the quality requirements of spinners have changed and additional improvements in cotton quality are always needed. However, the cost of achieving quality improvements can sometimes exceed the benefits to textile mills, and changes need to be implemented prudently.

Mr. Pearson observed that gin manufacturers have constructed machines with narrower ribs in order to increase the number of saws in a gin without expanding width. He felt that this modification could be contributing to lower uniformity values. He recommended additional testing to determine if thicker ribs would lead to improved uniformity.

In response to a question regarding the relationship between picking methods, ginning and cotton quality, Mr. Fermon explained that hand-picked cotton generally contained less trash than spindle-picked cotton and required fewer cleaning operations at the start of the ginning practice. Consequently, hand-picked cotton is generally considered to be higher in quality.

Mr. Pearson noted that hand-picking does not always result in reduced trash levels, and that hand-picked cotton can have more problems with contamination. However, there was agreement with the observation of Mr. Malloum that hand-picked cotton is usually of superior quality.

The CHAIR thanked Mr. Van Doorn again for his presentation, and he thanked the members of the Expert Panel for joining the Standing Committee for this meeting.

3. World Cotton Situation (Attachment I)

The CHAIR introduced Mr. Gérald Estur, statistician of the Secretariat, to present the world cotton situation. Mr. Estur reported that International cotton prices as measured by the Cotlook A index, declined by 32% between December 2000 and July 2001, from 66 cents per pound to 45 cents per pound, and he noted that prices have been this low only twice over the last 25 years. The Cotlook A Index averaged 57 cents per pound in 2000/01. The 4-cent increase from the previous season reflects a decline in world ending stocks for the third consecutive season to a six-year low of 8.2 million tons. However, the burden of stocks continued to shift from China (Mainland), which remained a net exporter, to the rest of the world where stocks actually rose by some 100,000 tons.

World cotton production increased by some 300,000 tons to 19.2 million tons in 2000/01, despite prices being well below the long-term average. An unexpected 15% increase in China (Mainland)'s production, 600,000 tons, more than offset declines in India, Uzbekistan, and Francophone Africa. Production in the Southern Hemisphere increased by 170,000 tons, or 9%, to reach a record 2.1 million tons in 2000/01, accounting for 11% of the world production. The development of new areas for cotton in Brazil and Turkey contributed significantly to the rise in world production. Thanks to record yields in Turkey, Brazil and China (Mainland), the average world yield is estimated to have surpassed the 600-kilograms per-hectare mark in 2000/01 for the first time.

World consumption, which had increased by almost 1 million tons in 1999/00, declined by an estimated 100,000 tons to 19.7 million tons in 2000/01 because of slower economic performance in the United States and Japan. World cotton exports declined in 2000/01 by 400,000 tons, or 7%, to 5.7 million tons, 30% of world production.

World cotton area is estimated at 34.2 million hectares in 2001/02, up by 8%, or 2.5 million hectares. World cotton production is expected to increase by 6%, or 1.15 million tons in 2001/02, to 20.3 million tons, the highest since 1995/96. Major increases will take place in China (Mainland), India and the USA.

World cotton consumption is expected to increase by 1%, or 200,000 tons, to a record of 19.9 millions tons. The anticipated excess of supply over demand has placed strong downward pressure on prices since the end of last year.

The deterioration of the supply and demand situation in the USA, with stocks building up as production increases while consumption drops, puts an even stronger downward pressure on prices.

Mr. Estur concluded that low prices severely affect cotton producers and exporters worldwide.

The CHAIR thanked Mr. Estur for his presentation.

Mr. Van Doorn mentioned that the CBI (Caribbean Basin Initiative) is helping the U.S. textile industry to face competition from foreign countries on the domestic market.

Mr. Malloum pointed out that market fundamentals are distorted by subsidies to cotton production and exports in a number of countries.

The delegate of Brazil asked what was the effect of the strength of the dollar on the export sales from the USA.

Mr. Estur explained that all cotton traded on the international market is sold in U.S. dollars. The strong dollar is making cotton more expensive in the currencies of the importing countries. At the moment, U.S. cotton is very attractively priced against its competitors.

The CHAIR thanked Mr. Estur for his presentation and asked if there were questions.

Responding to a question from the delegate of BRAZIL, Mr. Estur confirmed that end-use consumption of cotton in the United States is growing while mill-use of cotton is decreasing.

Seeing no other questions, the CHAIR asked if there were reports on cotton news from member countries.

The delegate of ZIMBABWE reported that the intended venue for the 60th Plenary Meeting had been damaged in a fire the previous week. However, he said that the government and the National Cotton Council of Zimbabwe are committed to hosting the meeting in Victoria Falls and that alternative arrangements are being made in consultation with the hotel owners. He said that the Government of Zimbabwe fully supports hosting the meeting, and he urged delegates to plan to attend.

4. Statement on Government Measures (Attachment III)

The CHAIR asked the executive director to introduce Attachment III. The executive director noted that a number of countries in the ICAC feel that government measures in some countries may lower world cotton prices and cause the burden of adjustment to lower cotton prices to fall heavily on producers in countries with limited government support, thus hindering economic development.

At the 454th Standing Committee Meeting, some delegates recommended that the Standing Committee develop a statement urging WTO negotiators to move forward with constructive proposals to reduce trade and production distorting policies, and that the statement be presented to the plenary meeting for discussion, adoption and communication to the broadest possible audience. The Private Sector Advisory Panel echoed these sentiments during a Round Table discussion with the Standing Committee in June in Washington.

The executive director suggested that the Standing Committee recommend that the Advisory Committee at its 60th Plenary Meeting in Victoria Falls should urge member countries of the ICAC to:

Adopt policies to reduce and eventually eliminate, to the extent possible, the negative effects on trade caused by direct government assistance to cotton production and trade implemented by some countries, and to

Encourage the WTO to urgently consider trade distortions on the world market caused by measures taken by some governments, and to

Advise their WTO negotiators to move forward with constructive proposals to reduce the trade and production distortions caused by policies implemented by some governments.

The CHAIR thanked the executive director for his recommendations and asked for comments.

The delegate of BRAZIL said that his government would like to strengthen the language calling for an end to measures that distort trade in cotton. He said that his government is not against subsidies that help farmers provided that the methods of support used by governments do not aggravate difficult world market conditions. He said that new programs being developed to support farmers with subsidies that would distort production and trade are a major concern. Therefore, he recommended that the following resolutions be forwarded to the Plenary Meeting for approval:

Adopt policies to reduce and eventually eliminate the negative effects on trade caused by direct government assistance to cotton production and trade implemented by major exporting countries, and to

Encourage the WTO to urgently consider trade distortions on the world market caused by measures taken by governments of exporting countries, and to

Advise their WTO negotiators to move forward with constructive proposals to reduce the trade and production distortions caused by policies implemented by the governments of countries that export cotton.

The delegate of SPAIN said that he preferred the original resolutions contained in Attachment III. However, if the Brazilian proposal is supported by other delegates, he suggested that the phrase "to the extent possible," be returned to the first resolution, and that the word "some" be used in reference to governments in all three proposals.

The executive director said that he had known in advance of the proposal by Brazil and had informed the delegate of the USA. The delegate of the USA was unable to attend the Standing Committee meeting, but he had sent a statement to be read:

"Regarding the resolutions in Attachment III, the USA does not support changing the language to include only exporting countries. There are many governmental policies that have negative effects on trade including, but not limited to, export controls, price controls, export restrictions and the various forms of import restrictions. Trade distorting measures are not exclusive to exporting countries. The proposed changes fundamentally alter—narrow—the scope of ICAC's government measures paper. A fundamental change to the core work of ICAC requires in-depth Standing Committee review and discussion. This has not happened."

The delegate of Nigeria said that it was inconsistent to call for an elimination of the negative effects of policies without also dealing with the programs and policies that cause the negative effects. She said that inclusion of the phrase "to the extent possible" would allow countries to continue to implement policies that distort world trade. The phrase "to the extent possible" waters down the resolution and so should not be included.

The delegate of SPAIN said that it is possible to modify policies to reduce their impacts on trade and production without eliminating the policies.

Mr. Malloum said that Chad would support the proposal by the delegate of Brazil.

The CHAIR noted that the Rules and Regulations require that the Committee operate by consensus. He observed that there was not a consensus to adopt either the set of resolutions contained in Attachment III or the proposals by the delegate of Brazil.

The delegate of EGYPT said that his government supports the elimination of subsidies that distort production and trade. He said that the ICAC should encourage WTO negotiators to tackle the issues of policies and programs that lead to distortions in world cotton production and trade.

The delegate of Nigeria said that her government supports the recommendation of the delegate of Brazil.

The CHAIR instructed the Secretariat to prepare a working paper for the plenary meeting that included both sets of resolutions so that the plenary meeting itself could determine which set should be adopted by the Committee.

5. Approval of Members of the Private Sector Advisory Panel (Attachment IV)

The CHAIR noted that members of the Private Sector Advisory Panel (PSAP) serve at their own expense and on their own time. He expressed his appreciation and the appreciation of governments for the contributions of the PSAP.

The executive director reported that Mr. Charles Wilson of Australia, Mr. Andrew Macdonald of Brazil, Mr. Heng Yi Tu of China (Taiwan), Mr. Amin Abaza of Egypt, Mr. John Accas of Greece, Mr. Suresh Kotak of India, Mr. Romano Bonadei of Italy, Mr. Alhaji Ibrahim Isa Funtua of Nigeria, Mr. Felix Stiegwardt of Paraguay, Mr. Isidor Gilan of the Philippines, Mr. Andreis Fourie of South Africa, Mr. Sebahattin Gazanfer of Turkey, Mr. Ray Butler of the UK, Dr. Phil Wakelyn of the USA and Mr. Sherzod Guazirov of Uzbekistan had been nominated by their governments to serve on the Panel from the start of the 60th Plenary Meeting to the 61st Plenary Meeting.

The nominees represent all three major segments of the world cotton industry, producers, shippers and spinners, and there are representatives from both developed and developing countries, as required by the Standing Committee. The executive director noted that the nominees are each prominent in their industries and that the ICAC is fortunate to attract the interest and services of people of their stature.

He noted that the PSAP would meet on Sunday evening, 16 September in Victoria Falls and that additional meetings could be held at the discretion of the PSAP between plenary meetings. It is possible that the PSAP will choose to meet adjacent to an international cotton gathering in 2002 such as the Bremen Cotton Conference in March or other similar event to which many PSAP members would likely be traveling in the normal course of business.

The CHAIR asked for comments and saw that there was unanimous agreement to approve the nominees to serve on the PSAP during 2001-02.

6. Other Matters

a. Quarterly Statement of Financial Position (Attachment V)

The executive director presented the Quarterly Statement of Financial Position for the fiscal year ending June 30, 2001. He noted that the annual audit of the Secretariat's finances would be completed in August and would be presented to the Subcommittee on Budget as soon as practicable. During 2000-01, Secretariat receipts totaled $1.384 million and disbursements totaled $1.146 million. As a consequence, fund balances rose by $238,000 during the year. The Secretariat received two years of back tax reimbursements totaling $223,000 from the U.S. State Department during the fiscal year, and these payments reduced expenditures under the category of "Other Benefits."

Assessment revenue was $13,000 more than budgeted. Nevertheless, there is a concern that three countries are at risk of having membership suspended for failure to pay assessments for two consecutive years. In addition, ten other members were one year in arrears on June 30. Arrears are a serious concern and the Secretariat is communicating actively with all countries to remain current in their support of the Committee.

When adjusted for disbursements under the business plan and the tax reimbursements received in 2000-01, total disbursements were $41,000 greater than the amount budgeted. Expenditures associated with severance payments to the previous statistician, relocation expenses paid to the new statistician and costs for advertising and interviewing statistician candidates totaled $30,000. Secretariat expenditures under travel and office expenses were less than budgeted, but expenditures under the training and printing categories were greater than budgeted.

Total revenue from business plan activities was $152,000. Of this, $30,000 was disbursed in 2000-01 for travel to national cotton industry meetings, purchase of equipment to implement the business plan and marketing activities to boost subscription sales. The remainder is being used to reduce assessments in the current fiscal year and for new activities under the Business Plan.

b. International Cotton Conference in Gdynia

The executive director reported that the Secretariat had been asked to announce that the 7th International Cotton Conference organized by the Gdynia Cotton Association would be held during September 6-7, 2001. The theme of the Conference is *Cotton: Friendly to Man and the Environment*. Major topics will include ecological and economic production and spinning processes, energy use in cotton production and processing, health aspects of the cotton industry, promotion of cotton and products as the material friendly to man and the environment. Additional information is available at <http://www.cotton.org.pl/>.

Seeing no other matters for discussion, the CHAIR again thanked Mr. Tom Alphin and the Commonwealth/Southampton Gin for their hospitality, and he thanked the members of the Expert Panel on Ginning for their report and their contributions to this meeting of the Standing Committee. He declared the meeting adjourned 4:30 PM.

INTERNATIONAL COTTON ADVISORY COMMITTEE

Standing Committee **Attachment II to SC-N-455**
Washington, DC **June 25, 2001**

Impact of Ginning on Fiber Quality: The Best Ginning Practices[1,2]

by

W. Stanley Anthony, Don Van Doorn, Earnest Edwards, Timothy J. Pearson, Ibrahim Malloum, Urania Kechagia, Iskender Ozdemir, and Doubt Nyoni[3]

INTRODUCTION

Cotton gins are responsible for converting a raw agricultural product, seedcotton, into marketable commodities such as bales of lint, cottonseed, "motes", compost, etc. Gins are a focal point of the cotton community and their location, resources, and contributions to the economy are critical to the cotton industry. Enormous differences exist across the worldwide spectrum of cotton production, harvesting and ginning. A summary of many of the factors is presented in Table 1 for most of the cotton producing countries. Harvest methods range from totally hand-harvested in some countries to totally machine-harvested in others. Cotton storage after harvesting ranges from small piles of cotton on the ground in some countries to mechanically made modules containing over 12 tons of cotton in others. Gin machinery sequences vary from little more than a gin stand as shown in Figure 1 to a complex arrangement of machines as shown in Figure 2. In a growing number of instances, gins are vertically integrated enterprises that include components that range from farm supplies to warehousing. Production of high quality cotton begins with the selection of varieties and continues through the use of good production practices that include harvesting and storage. Gins can only preserve fiber quality but they can dramatically improve market value. Just as yield and market qualities such as color, leaf, micronaire, length and strength are important characteristics of varieties, so are textile mill-related qualities such as neps (fiber entanglements), short fiber content (fibers shorter than 12.7 mm or 0.5 inch), and seedcoat fragments. Assessment of the true quality of cotton cannot be completed unless the textile mill processing techniques and end use are known. Full appreciation of the value of a particular cotton is not available with current classification and marketing systems anywhere in the world. Many classing and marketing systems worldwide actually encourage ginning practices that degrade quality factors important to textile mills.

Cotton possesses its highest fiber quality and best potential for spinning when the bolls are mature and freshly opened. Lint quality of the cotton in the bale depends on many factors including variety, weather conditions, cultural, harvesting and storage practices, moisture and trash content, and ginning processes. Genetics plays an important role in fiber quality, both in the initial quality of the fiber as well as how well the fiber withstands gin processes. For example, varieties with high numbers of trichomes (plant hairs) on the plant parts usually require additional cleaning equipment because it is more difficult to remove those trash particles. Harvesting practices from hand-picked to machine-stripped dramatically impact the amount of trash entangled with the cotton and thus the amount of cleaning machinery required at the gin. In order to take advantage of the best ginning practices, the characteristics of the varieties to be ginned must be understood. The ginner must know which fiber characteristics may or may not be impacted by gin processes.

Factors important to textile processing such as short fiber content, neps, and seedcoat fragments may differ by over 300% for varieties grown under nearly identical conditions. Standard marketing quality factors such as color, leaf, length, and micronaire do not exhibit such a large variance. Field weathering impacts most quality factors by weakening and discoloring the fiber. The color is substantially affected by weather and length of exposure to weather conditions after the bolls open. Abnormal color indicates a deterioration in quality. Continued exposure to weather and the action of microorganisms can cause white cotton to lose its brightness and become darker in color. The weakened fibers cannot withstand the standard lint-seed separation or lint cleaning processes without additional damage and fiber loss. In fact, varieties and excessive weathering have a far greater impact on fiber quality than do the most rigorous of gin processes.

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1 Taken in part from the "Handbook for cotton ginners." Editors W.S. Anthony and W.D. Mayfield. U.S. Department of Agriculture, Agricultural Handbook 503, 377 pp. published in 1994.
2 For presentation at the 60th Plenary Meeting of the International Cotton Advisory Committee (ICAC), September 16-21, 2001, in Victoria Falls, Zimbabwe, and publication by the ICAC.
3 Members of Expert Panel on Cotton Ginning.

The quality aspects of cotton varieties, weathering, and the impact of gin machinery on fiber quality are available in numerous published references (Anthony 1982, 1990a, b, c, d, 1994a, b, 1996, 1999; Anthony and Calhoun 1997).

The principal function of the cotton gin is to separate lint from seed and produce the highest total monetary return for the resulting lint, seeds, etc., under the marketing conditions that prevail. These marketing quality standards most often reward cleaner cotton and a certain traditional appearance of the lint. The gin then must also be equipped to remove a large percentage of the foreign matter from the cotton that would significantly reduce the value of the ginned lint, especially if the cotton is machine harvested. A ginner must have two objectives: (1) to produce lint of satisfactory quality for the grower's classing and market system, and (2) to gin the cotton with minimum reduction in fiber spinning quality so that the cotton will meet the demands of its ultimate users, the spinner and the consumer. Thus, quality preservation during ginning requires the proper selection and operation of each machine that is included in a ginning system. The ginner must also consider the weight loss that occurs in the various cleaning machines. Often the weight loss to achieve higher grade results in a lower total monetary return.

The forward-looking ginner should also be concerned that the spinning quality of the lint produced is reduced as little as possible. This requires contact with the merchants, cotton buyers and textile mills, and knowledge of the latest technologies in raw cotton fiber testing that evaluate such qualities as short fiber content and neps. The ginner must also be knowledgeable of new gin technologies that impact fiber quality and value. A single "best ginning practice" does not exist for all cottons—each lot of cotton requires careful assessment of its needs and thus different ginning practices.

This document reviews the operating features of available gin machinery, presents their impact on fiber quality, and suggests the best ginning practices for each situation.

SEEDCOTTON STORAGE AND HANDLING

Adequate storage facilities for seedcotton on the farm or at the gin are essential so that the cotton may be harvested quickly before weathering reduces its quality. Seedcotton may be stored in piles on the ground, sheds, storage houses, trailers or modules so long as it is protected from weather damage and from excessive ground moisture. Cotton modules, predominantly used in the U.S., Australia and Brazil, are a freestanding stack of cotton produced by dumping harvested material into a form known as a module builder where it is compacted to a density of about 193 kg/m^3 (12 $lb/ft^{3)}$. When seedcotton is consolidated for storage, it should be in a covered storage area or covered with a high-quality tarpaulin.

Quality Changes During Storage

Moisture content, length of storage, amount of high-moisture foreign matter, variation in moisture content throughout the stored mass, initial temperature of the seedcotton, temperature of the seedcotton during storage, weather factors during storage (temperature, relative humidity, rainfall), and protection of the cotton from rain and wet ground all affect seed and fiber quality during seedcotton storage. Some color degradation (spotting) occurs in seedcotton stored at a moisture level above 11%. At high moisture levels, bacterial action causes temperature increases within 48 hours that result in discoloration. High moisture content causes yellowness to increase sharply at levels above 13-14%, especially when the storage period exceeds 45 days. For long storage periods, moisture should be below 12%.

Yellowing is accelerated at high temperatures. The rate of lint yellowing increases sharply at moistures above 13% and can increase even after the temperature of a module drops. Both temperature rise and maximum temperature are important--temperature rise of 8 °C (15 °F) or more, or temperatures above 49 °C (120 °F) indicate the need for immediate ginning to minimize quality degradation. Temperature rise is related to the heat generated by bacterial activity.

Seed Quality

When seedcotton is stored, the length of the storage period is important in preserving seed quality and should be based on the moisture content of the seedcotton. Seed quality factors such as germination, free fatty acid content and aflatoxin level can be degraded during storage. Seedcotton moisture content during storage is the most important variable affecting seed germination and oil quality. Seedcotton moisture should not exceed 10% for storage when the seed will be saved for planting. Oil quality can be preserved at 12% moisture content during storage.

Monitoring Temperatures During Storage

Temperatures should be checked daily at several locations in a stored mass for the first 5-7 days, typically about 1.5 meters (5 feet) apart. After that, the probing can be done every 3-4 days or as the temperature dictates. The temperature probe should reach at least 0.8 meters (2.5 feet) into the seedcotton. The temperature of cotton harvested at safe storage moisture will generally not increase more than 8 °C (15 °F) during the initial 5-7 days and will then level off and even cool down as storage continues. A rapid and continuing rise in temperature above 8 °C (15 °F) or more during the first few days generally signifies a moisture problem. If a temperature of 49 °C (120 °F) is reached, or if the temperature increases by more than 11 °C (20 °F), the cotton should be ginned immediately to avoid the possibility of major loss. Unless ginned immediately, high-moisture cotton may continue to increase in temperature, and thus damage, over a period of several weeks.

GIN MACHINERY

The minimum machinery required to process clean, hand-harvested cotton consists of a dryer and/or moisture restoration device followed by a feeder to uniformly meter seedcotton into a gin stand which may be a saw, roller, or some other type of fiber-seed separation device. The ginner must be able to adjust the moisture of the cotton up or down, individualize the locules of cotton, meter the locules uniformly into the gin stand to separate the fiber from the seed, and then package the fiber and seed for market. The simplified machine sequence in Figure 1 illustrates the minimum machinery necessary to produce marketable fiber. This simplified sequence, however, does not provide versatility to properly manage cotton that has excessive moisture or trash, or cotton that must meet specialized textile needs. Since saw-type lint cleaning is not included in Figure 1, the baled fiber will contain imperfections such as motes and trash, and will not have a smooth appearance. A more extensive machine sequence such as that shown in Figure 2 provides the flexibility to meet almost any situation for hand or machine picked cotton. The sequence of gin machinery to dry and clean spindle-harvested, upland cotton is as follows: dryer, cylinder cleaner, stick machine, dryer, cylinder cleaner, (optional cylinder cleaner), extractor-feeder and saw-type gin stand followed by two stages of saw-type lint cleaning (Figure 2). These gin machinery recommendations are applicable worldwide, although they are used in varying amounts depending upon the needs of the respective countries. Marketing system premiums and discounts as well as the cleaning efficiency and fiber damage resulting from various gin machines serve as a starting point in determining how much machinery to use. Variation from these recommendations is necessary for stripper-harvested cotton as well as other special conditions. For stripper cotton, at least one additional extractor is added to the sequence in Figure 2 prior to ginning. Moisture restoration equipment before and after fiber-seed separation should also be included--before to maintain fiber length, and after to reduce bale compression requirements.

Foreign-matter levels in seedcotton before gin processing usually range from 1% to 5% for hand harvested, from 5% to 10% for spindle-harvested, and from 10% to 30% for stripper-harvested cottons. The foreign matter level dictates the amount of cleaning needed. Obviously, any machinery that is not necessary for a particular lot of cotton should be bypassed. Dryers, seedcotton cleaners and extractors, and lint cleaners should be provided with bypasses to allow the cotton to skip these machines when extra-clean, dry cotton is brought to the gin.

The quality of ginned lint is directly related to the quality of the cotton before ginning. High grades will result from cotton that comes from clean fields harvested by hand or by machines in good condition and properly adjusted by trained and properly managed personnel. Lower grades will result from cotton that comes from grassy, weedy fields in which poor defoliation or harvesting practices are used.

When gin machinery is used in the recommended sequence, 75-85% of the foreign matter is usually removed from the cotton. Unfortunately, this machinery also removes small quantities of good quality cotton in the process of removing foreign matter, so the quantity of marketable cotton is reduced during cleaning. Cleaning cotton is therefore a compromise between foreign matter level, and fiber loss and damage. The trash removal efficiency and fiber damage are inversely related to the fiber moisture.

The market value per unit of cotton is improved during cleaning as foreign matter is removed and the fiber is combed and blended. Judicious use of the gin machinery combinations discussed here should yield good returns to the producer and provide cotton fiber of acceptable quality to spinning mills.

Feed Control

Cotton must be steadily and uniformly metered into the gin system. This is normally accomplished by a feed control, which may be manually or automatically controlled. The efficiency of the drying, cleaning and conveying systems increases as the uniformity of flow increases; this is especially true in large, high capacity gins.

Drying

Drying systems include reel-type, tower, tower hybrid, fountain, hi-slip, combination drier-cleaners, and belt-type systems. Drying systems can seriously overdry cotton and must be used properly to avoid reducing cotton quality. Drying at low temperatures is much less harmful than drying at high temperatures. Larger volumes of drying air allow drying at lower temperatures. The moisture content of seedcotton is very important in the ginning process. When seedcotton enters the gin plant with high moisture content, it should be exposed to as little machinery as possible (especially extractors) before entering the drying system. Seedcotton having too high a moisture content will not clean or gin properly and will not easily separate into single locks but will form wads that may choke and damage gin machinery or entirely stop the ginning process. Seedcotton with too much moisture will also form tight twists known as "fish hooks" that remain in the ginned lint and degrade appearance.

Both constituents of seedcotton--fiber and seed--are hygroscopic but at different levels. Dry cotton placed in damp air for long periods will gain moisture, and wet cotton placed in dry air will lose moisture. For every combination of ambient air temperature and relative humidity, there are corresponding equilibrium moisture contents for the seedcotton, fiber, and seed. For example, if seedcotton is placed in air of 50-percent relative humidity and 21 °C (70 °F), the fibers will tend to reach a moisture content (wet basis) of approximately 6%; the seed will tend to reach a moisture content of about 9%; and the composite mass will approach a moisture content of 8%. The equilibrium moisture content at a given relative humidity is also a function of the temperature and barometric pressure.

The effects of atmospheric conditions, particularly relative humidity, must be considered when harvesting seedcotton. The effect of relative humidity on cotton moisture is relatively simple, useful, and easily understood for ambient conditions. Cotton can be dried at gins by using either ambient or heated air. When ambient air is used, the relative humidity must be equal to that necessary to achieve the desired equilibrium moisture content of the cotton fiber. Most of the drying in cotton gins is done with heated air. As the air and seedcotton move through a dryer, the air temperature will drop because (1) heat is lost, (2) heat is used to increase the temperature of the cotton, and (3) moisture is vaporized from the cotton, which causes by far the greatest temperature drop. In addition, transport of cotton between machines with moist or dry ambient air will change the moisture content of the fiber significantly.

Drying cotton at high temperatures may damage the cotton fiber. Cotton should be dried at the lowest temperature that will produce satisfactory market grades and allow satisfactory gin operation. Cotton will scorch at 232 °C (450 °F), ignite at 460 °C (500 °F), and flash at 316 °C (600 °F). In no case should the temperature in any portion of the drying system exceed 177 °C (350 °F) because irreversible damage may occur. Temperatures over 93 °C (200 °F) damage dry fiber and should not be used if at all possible. There is an optimum fiber moisture content for each process in the gin. The effort required to control moisture will pay dividends in gin operating efficiency and market value of the baled cotton.

Cotton with too low a moisture content may stick to metal surfaces as a result of static electricity generated on the fibers and cause machinery to choke and stop. Fiber dried to very low moisture content becomes brittle and will be damaged by the mechanical process required for cleaning and ginning. Dry cotton requires more force and power to compress than does moist cotton. When pressing and baling such low-moisture cotton, it is often difficult to achieve the desired bale weight and density without adding moisture.

When two stages of seedcotton cleaning are employed, a second drying system should be used when high moisture cotton is processed. This second drying system can have less drying capacity than the first drying system, as the major moisture removal should be done in the first system. The primary function of the second drying system is to extend the drying time and to keep the seedcotton and the machinery hot and prevent condensation of moisture.

Almost all of the moisture removed during the short drying time in commercial gin dryers comes from the fibers rather than from the seed and trash. The seed constitute 55-60% of the weight of spindle-harvested seedcotton. The moisture content of the seed is considerably less important from a ginning standpoint than the moisture content of the fibers, unless the seeds are so wet that they are soft or mushy. For satisfactory ginning, seed moisture content should not exceed 12%.

Dryers should be adjusted to supply the gin stand with lint having a moisture content of 6-7% to preserve fiber quality. Cotton at this moisture level is more able to withstand the stresses of ginning without breaking. However, cotton at 5% moisture content will result in better cleaning and a smoother appearance, which is erroneously preferred by many classing and marketing systems.

Gin cleaners remove more trash at moisture levels below 6-7% but not without more fiber damage. Fiber moisture higher than 7% preserves fiber length but results in ginning problems and poor cleaning (Figure 3).

Also, overheating will cause increased fiber breakage from the mechanical action of cleaning in the gin and textile mill. Fiber length preservation can best be attained with fiber moisture from 6.5 to 8%; however, both cleaning efficiency and ginning rate are reduced at higher moistures. As a compromise, moisture contents of 6 to 7% are feasible. Ginning below 5% moisture can cause serious damage to the fibers, while ginning above 8% may produce rougher lint, decreased gin capacity, and less effective cleaning. For a given cotton, fiber lengths of 2.97, 2.95, 2.90, and 2.84 cm (1.17, 1.16, 1.14 and 1.12 inches) might result from processing at 9.4, 7.4, 4.9, and 3.7% fiber moisture, respectively (Anthony 1990d). For each 1% reduction in fiber moisture content below 5%, the number of short fibers is increased by almost 1%. The effects of ginning cotton below 5% moisture are decreased yarn strength and yarn appearance and increased short fibers in the card sliver.

When drying is increased to improve trash removal by lowering fiber moisture below 6%, most yarn qualities are reduced, although yarn appearance improves with drying up to a point because of increased foreign-matter removal. The effect of increased short-fiber content resulting from over drying outweighs the benefits of foreign-matter removal from the textile mill perspective but not from a market perspective. Many classing systems offer premiums for low trash and smooth appearance features but these incentives may also encourage over processing at the gin, which produces additional neps and short fibers.

SeedCotton Cleaning and Extracting

The term "seedcotton cleaning" is often used interchangeably by the ginning industry when referring to the process performed by either the total cleaning and extracting system of a gin or by specific types of machines within the system. The term "cleaning" when applied to individual machines usually refers to the use of various types of cylinder cleaners designed primarily for removal of dirt and small pieces of leaves, bracts, and other vegetative matter. "Extracting," on the other hand, refers strictly to those processes designed to remove large trash, such as burs and sticks, from the seedcotton. Bur machines, stick machines, extractor-feeders, and combination bur and stick machines are examples of extracting-type machinery.

The cleaning and extracting system serves a dual purpose. First, large trash components such as burs, limbs, and branches, must be extracted from the seedcotton before they are broken up and embedded in the cotton and so that the gin stand will operate at peak efficiency and without excessive downtime. Second, seedcotton cleaning is often necessary to obtain optimum grades and market values, especially when ginning high-trash-content cotton. Also, cleaners and extractors help open the seedcotton for more effective drying, which is usually done concurrently with cleaning. The amount of cleaning and extracting machinery required to satisfactorily clean cotton varies with the trash content of the seedcotton, which depends in large measure on the method of harvest.

The trash contents of seedcotton vary widely as a result of the different harvesting methods employed and the year-to-year variations in the weather during the growing cropping season. Gins process either hand-picked, machine-picked, or machine-stripped cotton and are usually equipped with only the amount and type of cleaning and extracting machinery required for the most severe conditions expected in their trade area. For less severe conditions, part of the system should be bypassed to prevent excessive weight losses and to minimize potential fiber damage. Seedcotton cleaning should be restricted to that which is necessary to ensure smooth, trouble-free ginning and that which is needed to obtain optimum bale values.

Cylinder Cleaners

Cylinder cleaners are used for removing small trash particles and for opening and preparing the seedcotton for the drying and extraction processes. The cylinder cleaner consists of a series of spiked cylinders, usually 4-7 in number that agitate and convey the seedcotton across cleaning surfaces containing small openings or slots. In the impact or revolving screen cleaner, cotton is conveyed between a series of parallel, revolving serrated disks. The impact cleaner also includes a reclaimer section. It is also used as a lint cleaner in roller gins.

Air line cleaners are usually mounted in a horizontal position in the unloading-system air line. These installations normally permit both the air and seedcotton to pass through the cleaner. In some designs an air line cleaner is combined with a separator in series to provide both cleaning and seedcotton/air separation. Air line cleaners have
gained wide acceptance in stripper-harvested areas as a means for removing soil particles from seedcotton and for opening partially closed bolls and wads of seedcotton for further cleaning.

Extractors

Stick machines utilize the sling-off action of high-speed toothed cylinders that hold the fiber while the seedcotton is beaten against grid bars to extract burs and sticks. Stick machines are usually preceded by one or two stages of drying and at least one stage of cleaning with a cleaner consisting of multiple spiked-tooth cylinders. The preceding cylinder cleaner will open cotton for more efficient cleaning by the stick machine and reduce seedcotton losses.

A Combination Bur and Stick Machine (CBS), which is used for stripper-harvested cotton, is a hybrid type of extractor that combines the best features of the bur machine and the stick machine. The upper section of a CBS machine resembles a bur machine in that it is equipped with an auger feed and trash extraction system and a large-diameter saw cylinder.

Gin stand feeders with extracting capabilities have been used since the early 1900's. Many modern extractor-feeders enhance fine trash removal by also employing cleaning cylinders similar to those found in an inclined cleaner. The primary function of an extractor-feeder is to feed seedcotton to the gin stand uniformly and at controllable rates, with extracting and cleaning as a secondary function. Uniform, controlled flow of cotton into the extractor-feeder increases its cleaning efficiency.

Cleaning and Extracting Efficiency

The efficiency of a cleaner or extractor depends on many factors, including machine design; cotton moisture level; processing rate; adjustments, speed, and condition of the machine; the amount and nature of trash in the cotton; distribution of cotton across the machine; and the cotton variety. The total trash removal efficiency of cylinder cleaners is generally low compared to extractors when measured by weight of trash, as the trash particles are small. However, usually they are not used alone but are used in combination with other machines. Cylinder cleaners perform a most useful function in opening the cotton and removing fine trash. Studies using both machine-picked and machine-stripped cottons have shown that the total trash removal efficiency of a six-cylinder inclined cleaner with grid rods generally ranges from 10-40% as measured by weight. Cylinder cleaners known as "hot air" machines also separate conveying and drying air from the seedcotton and require a vacuum dropper to return the cotton to atmospheric pressure. In this case, air is discharged with the trash.

The cleaning efficiencies of stick machines vary widely, depending on the condition of the seedcotton and on machine design variables. For machine-stripped cotton, a modern commercial stick machine can be expected to remove about 65% of the burs, 50% of the sticks, and 10-35% of the fine trash. The total cleaning efficiency for stripped cotton is normally in the 60-65% range for the latest models. The total cleaning efficiency can range from about 20% for cleanly picked seedcotton to as high as 50% for picked cotton containing significant amounts of burs and sticks.

Extractor-feeders are efficient cleaners. Seedcotton is usually well dispersed when it enters an extractor-feeder, and the feed rate through this machine is often lower than the feed rate of other seedcotton cleaning machinery. Studies wherein all seedcotton cleaners prior to the extractor-feeder were bypassed have indicated that the extractor-feeder removes 70% of the hulls, 15% of the motes, and 40% of the remaining trash components and has an overall cleaning efficiency of about 40% for machine-picked cotton.

Cleaning efficiencies for sequences of four seedcotton machines consisting of a cylinder cleaner, a stick machine, a second cylinder cleaner, and an extractor-feeder range from 40-80%, depending on the factors previously discussed. The amount of each type of trash in cotton also varies substantially. Hand- or spindle-harvested cotton normally contains less than 10% foreign material. Each type of seedcotton cleaner is designed to remove different types of trash, and any calculation of machine efficiency is predicated on the type of trash involved.

Gin Stands

The fiber-seed attachment force differs for varieties, field deterioration, moisture content, and other factors; but is typically about 55% of the breaking force (Anthony and Griffin, 2001) suggesting that the fibers could be removed from the seed without breakage. The gin stand, whether saw or roller, removes (pulls) the fiber from the seed and is the heart of the ginning system. The capacity of the system and the quality and potential spinning performance of the lint depend on the operating condition and adjustment of the gin stand. Gin stands must be properly adjusted, kept in good condition, and operated at or below design capacity. If gin stands are overloaded, the quality of the cotton may be reduced. Short fiber content increases as the ginning rate increases above the manufacturer's recommendation. Short fiber also increases as saw speed increases. Increased ginning rate also increases yarn imperfections. Seed damage can also result from increasing the ginning rate, especially when the seeds are dry. High ginning rate and low seed moisture cause seed damage ranging from 2-8% in gin stands. Thus, it is paramount to maintain the gin stand in good mechanical condition, to gin at recommended moisture levels, and to not exceed the capacity of the gin stand or other components of the system.

Roller-type gins provided the first mechanically aided means of separating lint from seed. Types of roller gins include Churka, reciprocating knife, and the most modern rotary-knife roller gin. The ginning rate of the rotary-knife gin is about 20% of the saw-ginning rate per unit of length. Seedcotton conditioning equipment in roller gins is the same type used in saw gins. Lint cleaning in current reciprocating knife roller gins is typically done with cylinder and impact cleaners similar to those used for seedcotton as well as air-jet cleaners.

Lint Cleaning

Lint cleaners remove leaf particles, motes, grass, and bark that remain in cotton after seedcotton cleaning, extracting, and ginning. Most gins that process machine-harvested cotton have one or more stages of lint cleaning. The lint cleaners now being marketed for saw-ginned cotton are of two general types; flow-through air type and controlled-batt saw type.

<u>Flow-Through Air Lint Cleaner</u>

The flow-through air lint cleaner, commercially known as the Air Jet/Super Jet®, Centrifugal Cleaner®, or Super Mote Lint Cleaner®, has no saws, brushes, or moving parts. It is usually installed immediately behind the saw or roller gin stand. Air and cotton moving through the duct change direction abruptly as they pass across a narrow trash-ejection slot. Foreign matter that is heavier than the cotton fibers and not too tightly held by fibers is ejected through the slot by inertial force.

Flow-through air lint cleaners are less effective in improving the grade of cotton than saw lint cleaners because these air lint cleaners do not comb the fibers. However, air lint cleaners do remove less weight from the bale. Fiber length, fiber strength, and neps are unaffected by the air lint cleaner. This type of cleaner is commonly used in both saw and roller gins.

<u>Controlled-Batt Saw Lint Cleaner</u>

Lint from the gin stand or another lint cleaner is formed into a batt on a condenser screen drum. The batt is then fed through one or more sets of compression rollers, passed between a very closely fitted feed roller and feed plate or bar, and fed onto a saw cylinder. In addition to removing trash, lint cleaners comb and blend the cotton to produce a smooth appearance. They also degrade some desirable mill qualities, especially at low moistures.

Lint fed to the cleaning machinery at high rates will result in decreased cleaning efficiency and perhaps lower bale values. For efficient cleaning and minimum damage, feed rates should average about 750 kg/hr/m (500 lb/hr/ft) of saw-cylinder length. Lint cleaners can process 1119 to 1492 kg/hr/m (750 to 1000 lb/hr/ft) of saw with no noticeable operational problems; this rate corresponds to about 1591 kg (3500 lb/hr) for a 1.7m (66-inch) wide lint cleaner (40.6 cm or 16-inch saw cylinder) and about 7500 kg/hr/m (7500 lb/hr) for a 2.4 m (96-inch) wide cleaner. The higher feed rates may cause additional fiber damage and lint loss. These feed rates are also directly related to the saw diameter and saw speed. Increased saw speeds also increase fiber damage and fiber loss. Larger diameter saws such as the 61cm (24-inch) ones have higher feed rates than 30.5 or 40.6 cm (12- or 16-inch) diameter saws.

The number of grid bars in a modern lint cleaner may vary from four to eight depending on the model used. Clearance gauges are used to set the grid bars with respect to the saw cylinder. Cotton ginning plants utilize grid-bar air wash to improve lint cleaner efficiency, pick up and remove waste, and reduce air pollution within the gin plant. Air movement across the grid bar area should average at least 33 m^3/min/m *(*350 ft^3/min/ft) of grid-bar length.

Lint cleaning generally improves the grade classification (color, leaf, and smoothness) of the lint. However, the extent of grade improvement decreases with each succeeding cleaning. In addition, lint cleaners blend Light-Spotted cottons so that some of these pass into the White grades (Mangialardi 1990, 1993, 1996). Lint cleaners can also decrease the number of bales that are reduced in grade because of grass and bark content. But they also reduce bale weights and may decrease staple length, thus affecting bale value. In some cases the net effect of multiple stages of lint cleaning is a loss in bale sales value as well as an increase in neps and short fiber content which decreases its spinning value (Mangialardi and Anthony, 1998).

<u>Lint Cleaning for Roller Ginned Cotton</u>
Cylinder cleaners, textile-type beaters, impact cleaners and airjet cleaners may be used to remove motes, broken seed, fiber entanglements, and small trash not removed in seedcotton cleaning. There is no standard machinery sequence for lint cleaning roller-ginned cotton. Lint cleaning in U.S. plants is mostly performed by an inclined cleaner, impact cleaner and one airjet cleaner in series. The controlled-batt saw cleaner is not used in roller gins because it changes the characteristic appearance of roller ginned cotton.

Moisture Restoration

Adding moisture before fiber/seed separation and lint cleaning will help maintain fiber length and reduce the number of fibers that break in the gin stand and lint cleaners. For example, if moisture is restored to the seedcotton to raise the fiber moisture from 4% up to 6%, staple length will be increased by 0.08mm (1/32 inch) and short fiber content will be decreased by 2%. Adding moisture to lint that has already been ginned, however, will not increase fiber length. Other benefits resulting from moisture restoration include reducing the static electricity level of the cotton, reducing the volume of the cotton required to achieve a given bale size and reducing the force required to press the bale. The resilient force exerted on the restraining bale ties is also lower for the higher moisture cotton.

Many approaches have been used to restore moisture in cotton fiber. Moisture restoration may occur at several locations such as module feeder, feed control, dryers, above extractor feeders, moving-bed conditioners, press battery condensers, grids and other apparatus in the lint slide. There is a practical physical limit to the quantity of moisture that may be added to seedcotton. Wetting of the cotton by condensation within machinery and pipes must be prevented, or choking will result. If liquid water is present on the seedcotton mass, gin stand operation will become irregular and may cease altogether. Cotton with fiber moisture of 9% or more may be rough in appearance and will not smooth out properly when processed through the lint cleaners. Thus, the recommended fiber moisture level of 6-7% is based on production aspects as well as quality aspects. Lint moisture in the bale must be uniform and not exceed 9% to avoid fiber discoloration and weight loss during storage.

One approach is to use humid air to moisten cotton. The air must be heated to carry sufficient moisture to the cotton fiber. Air can carry 10 times as much water vapor at 54 °C (130 °F) (0.1118 lb/lb) as it can at 16 °C (60 °F) (0.01108 lb/lb). The air is first heated to high temperatures where it is exposed to atomized water droplets, which evaporate into the air. The evaporation process lowers the air temperature and increases the “dew point” temperature of the air. The dew point temperature of the air must be well above the temperature of the cotton. This humid air is then blown through the cotton, which lowers the air temperature below its dew point causing fine water droplets to form on the cotton fibers throughout the cotton batt. The amount of moisture restoration with this system is limited, especially at higher ginning rates. The cotton fibers lose some of their resilience, thus reducing compressive forces required in baling.

Another approach is to atomize water and spray it directly on the cotton. Sometimes a wetting agent is added to the water to hasten its distribution through the cotton. Most gins that use this system spray water on the cotton at the lint slide. Care must be exercised to avoid wet spots in the bale, which promote bacterial and fungal growth and cause degradation of the fiber; thus, this method is not recommended.

Packaging Lint Cotton

Bale packaging is the final step in processing cotton at the gin. The packaging system consists of a battery condenser, lint slide, lint feeder, tramper, bale press, bale covering, and bale tying systems. The basic tramping and pressing system may be supplemented with systems for bale conveying, weighing, and wrapping. The bale press consists of a frame, one or more hydraulic rams, and a hydraulic power system. Tying subsystems may be entirely manual, semi-automated, or fully automated. Restraining ties are usually steel wire or flat, steel straps but may also be plastic straps. Six to 10 ties are typically spaced along the bale but a spirally wrapped continuous tie is sometimes used. The stress on the ties after the bale is released from the press is a function of the uniformity of the lint distribution, bale weight, bale dimensions, density to which the bale was pressed, moisture content, tie length and other factors. Bale tie strength must be matched carefully to the bale press system to prevent tie breakage and subsequent contamination and handling difficulties. In the U.S., ties for gin universal density bales (227.3 kg or 500 pounds confined in a 53.3 cm wide x 137.2 cm long x 76.2 cm thick (21inch x 54 inch x 30 inch) package must have minimum breaking strengths at the joint of 9.3 kN to 17.8 kN (2100 to 4000 pounds), depending on the type tie.

Bales should be fully covered (including openings caused by sampling), and all bale covering material should be clean, in sound condition, and of sufficient strength to adequately protect the cotton. Bales are covered in natural fibers such as cotton (preferably), burlap, and jute, and synthetics such as polypropylene and polyethylene. The material must not have salt or other corrosive material added and must not contain sisal or other hard fiber or any other material that will contaminate or adversely affect cotton. For outside storage, bale coverings must include ultraviolet inhibitors commensurate with the anticipated storage period.

EFFECT OF GIN MACHINERY ON COTTON QUALITY

Cotton quality is affected by every production step including variety selection, cultural practices, defoliation, harvesting, storing, and ginning. Certain quality characteristics are highly influenced by genetics, while others are determined mainly by environmental conditions, cultural practices, or by harvesting and ginning practices. Problems during any step of production or processing can cause irreversible damage to fiber quality and reduce profits for the producer as well as the segments of the textile industry including spinning, weaving, dyeing, and finishing. After varietal and cultural practices are complete, fiber quality is highest the day the mature cotton boll opens. Weathering, mechanical harvesting, handling, ginning, and manufacturing can diminish the natural quality.

There are many measures of the overall spinning quality of cotton fiber. The most important include strength, fiber length, short fiber content, length uniformity, maturity, fineness, trash content, color, seedcoat fragment and nep content, and stickiness. The market generally recognizes these factors even though not all are measured on each bale, especially when the bale is first appraised for sale.

The ginning process can significantly affect fiber length, uniformity, and the content of seedcoat fragments, trash, short fibers, and neps. The two ginning practices that have the most impact on quality are (1) the regulation of fiber moisture during ginning and cleaning, and (2) the degree of gin cleaning used. Figure 3 illustrates the impact of moisture on fiber quality generally, and Figure 4 illustrates the impact of cleaning on fiber quality. The extractor-feeder/gin stand shown in Figure 4 represents the absolute minimum machinery required to produce marketable fiber. The addition of seedcotton cleaning (SCC) machinery impacts some fiber quality parameters and saw-type lint cleaners impact nearly all fiber quality parameters. Large and small trash particles are removed by gin machinery. In fact, particles commonly known as “pepper trash” that are typically about 500 microns are dramatically reduced by all gin processes except gin stands. Saw-type lint cleaners are especially efficient at removing small trash particles.

Choosing the degree of gin cleaning is a compromise between fiber trash content and fiber quality. Lint cleaners are much more effective in reducing the lint trash content than are seedcotton cleaners, but lint cleaners can also decrease fiber quality and reduce bale weight (turnout) by discarding some good fiber with the waste. Cleaning does little to change the true color of the fiber, but combing the fibers and removing trash and dust changes the perceived color. Lint cleaning can sometimes blend fiber so that fewer bales are classified as spotted or light spotted. Ginning does not affect fineness and maturity. Each mechanical or pneumatic device used during cleaning and ginning increases the nep content, but lint cleaners have the most pronounced influence. The number of seedcoat fragments in ginned lint is affected by the seed condition and ginning action. Yarn strength, yarn appearance, and spinning-end breakage are three important spinning quality elements. All are affected by length uniformity and, therefore, by the proportion of short or broken fibers. These three elements are usually best preserved when cotton is ginned with minimum drying and cleaning machinery.

Seedcotton cylinder cleaners decrease the lint trash content, but they slightly decrease the yarn strength. The yarn appearance is improved by cylinder cleaners, but using more than 14 cylinders in a gin can cause quality problems.

Air-type lint cleaners remove motes (aborted ovules), green leaf, large foreign matter, seedcoat fragments and seed, and have a cleaning efficiency of about 10% by weight. Saw-type lint cleaners remove motes, small and large foreign matter, dust, seedcoat fragments and seed, and improve the perceived color. They have a cleaning efficiency of about 50% by weight. Saw-type lint cleaners also draft, comb and blend the fibers; they also increase short fiber content and neps, and decrease length as they improve market color, grade and appearance.

COTTON CLASSIFICATION

Cotton classification worldwide is manual or a combination of manual and instrument commonly referred to as the high volume instrument (HVI) classification system. International Cotton Standards are prepared and maintained by the U.S. Department of Agriculture. These standards are reviewed, modified if necessary, and approved every three years by a group of foreign signatories (merchants and textile mill representatives that purchase or use U.S. cotton) and the U.S. Cotton Advisory Committee. They are then used as worldwide references for manual classification as well as for reference samples for the HVI system.

Manual Classification - Upland Cotton

There are 25 color grades, 15 physical samples and 10 descriptive. Color grades fall into five color groups as follows: White, Light Spotted, Spotted, Tinged, and Yellow Stained. The range of each color grade for which there is a physical standard is represented by six samples placed adjacent to each other in a standards box. For practical considerations, the color and leaf grade standards are contained in the same box. For instance, the standards box containing the Strict Low Middling color grade also contains the size and amount of leaf that would be described as leaf grade 4. Each descriptive standard provides a description for cotton that lies above, below, or between certain physical standards.

The color is affected to a great extent by weather and length of exposure to weather conditions after the bolls open. It may also be affected by varietal characteristics and by harvesting and ginning practices. When upland cotton opens normally, it has a bright, white color. Abnormal color indicates a deterioration in quality. Continued exposure to weather and the action of microorganisms can cause the white cotton to lose its brightness and become darker in color. When plant growth is stopped prematurely by frost, drought, or other weather conditions, the cotton may have a yellow color that varies in intensity. Cotton may also become discolored or spotted by insects or fungi.

Leaf grade describes the amount of leaf content in the cotton. There are seven leaf grades, and all are represented by physical standards. In the spinning industry, leaf material is viewed as waste and adds an additional cost and fiber quality degradation factor associated with its removal. Leaf content is affected by cotton variety as well as the different types of harvesting methods and harvesting conditions. The amount of leaf material remaining in the lint after ginning depends on the amount present in the seedcotton before ginning and on the type and the amount of cleaning and drying equipment used during ginning. Even with the most careful harvesting and ginning methods, a small amount of leaf will remain in the cotton lint. Generally, there is less leaf material in ginned cotton now than in past years, primarily because of improvements in harvesting and ginning methods.

Preparation is a measure of the degree of "roughness" or "smoothness" of the ginned lint cotton. As a general rule, smooth cotton has less spinning waste and produces a more uniform yarn than rough cotton. However as mentioned previously, the desired smooth appearance may also encourage over processing at the gin.

Extraneous matter in a cotton sample is any substance that is not cotton fiber or leaf material and that is not included in the official prepared cotton standards. Examples of extraneous matter are bark, grass, spindle twists, dust, and oil.

High Volume Instrument (HVI) Determinations - Upland Cotton

Traditional classing systems employ human classers to assess the color, leaf and length of cotton and instruments assess the micronaire. Use of the HVI classification system is mandatory in the U.S. for cotton to be eligible for the Commodity Credit Corporation loan program. The HVI system is supplemented by humans especially in assessing leaf and discount factors such as bark, grass and preparation.

Fiber length is measured by passing a small tuft of parallel fibers through a sensing point of the HVI system. It may also be determined manually. Fiber length is a varietal characteristic that is influenced strongly by environmental conditions; it may be reduced by processing equipment, especially at low moistures. Length uniformity, which is typically 80 to 82 for upland cotton, is the ratio of the average or mean length of the fibers to their upper half mean length and is expressed as a percentage. If all fibers in a sample were the same length, the length-uniformity index would be 100.

Fiber strength is determined by the HVI system on the same tuft of fiber used for the length measurement. Results are reported in grams per tex. A tex is equal to the weight in grams of 1,000 m of fiber. The strength reported is the force in grams required to break a one-tex bundle of fibers.

Micronaire refers to an airflow measurement that indicates fiber fineness and maturity. Micronaire is determined by passing air compressed to a standard pressure and temperature through a cotton specimen of standard weight and standard volume. The volume of airflow through the specimen is expressed as the micronaire, which may be referred to as the mike reading or simply mike. Some fibers are extremely fine simply because they are immature. These fibers cause dyeing irregularities, increase manufacturing waste during picking and carding, and lower product appearance. A micronaire reading below the optimum range may indicate immaturity; one above the optimum range may indicate that the fiber is too coarse for manufacturing many high-quality products.

Fiber fineness is a varietal characteristic that is estimated by micronaire, which is also affected by growing conditions in the latter stages of fiber development. Favorable growing conditions result in fully mature fibers and higher micronaire readings. Unfavorable conditions, such as lack of moisture, early freeze, or any other conditions that interrupt plant processes, will result in immature fibers and lower mike readings.

Presently, the USDA classification system includes a determination of color by HVI. The HVI color determinations are in terms of grayness (measured in Rd) and yellowness (measured in +b). Grayness (or percent reflectance) indicates the lightness or darkness of the sample. Cotton Rd values are usually within the 48 to 82 range. Yellowness indicates the amount of yellow coloration in the sample and is usually within the 5 to 17 range. Normally, opened cotton will have an Rd of 70 or higher and a +b of 9.0 or lower. The various combinations of grayness and yellowness can be converted into color values based on the Rd and +b values using a "colorimeter" chart.

The trash content measured by the HVI system is determined by scanning the sample surface and recording the particles present. Results are reported as the percentage of the sample surface covered by nonlint particles. The maximum is less than 5.0%.

American Pima grade standards are also represented in physical form. There are six American Pima grades, numbered 1 through 6. American Pima and upland grade standards differ widely. The leaf content of American Pima standards is unique to this cotton and does not match that of upland standards. The preparation is very different from the preparation for upland standards, since American Pima cotton is normally ginned on roller gins and is more stringy and lumpy. Upland cotton is usually cleaned with saw-type lint cleaners that produce a smooth, blended, combed sample. Roller ginned cotton is usually cleaned with air or cylinder-type cleaners and is rough in appearance.

Balancing Fiber Quality and Cleaning

The typical impact of gin machinery on various quality parameters is illustrated in Figure 4 for reflectance, yellowness, leaf grade, HVI trash, uniformity, HVI length, short fiber content, neps, seedcoat fragment weight, number of seedcoat fragments, trash and dust.

Whether it is done in a gin or in a textile mill, cleaning generally lowers most of the important fiber quality characteristics other than the color, foreign matter and appearance, and reduces the amount of usable fiber (Columbus, Bel and Robert, 1990). Ginners must compromise between trash removal and fiber damage when choosing their cleaning machinery. For machine-picked cotton, ginners should use 12-14 cylinders of seedcotton cleaning along with a stick machine and one or two lint cleaners, depending on seedcotton trash content and color potential. For stripped cotton, a second extractor and an air line cleaner or cleaning separator should be included; a second saw lint cleaner may be required. To deliver the absolute highest quality products for spinning performance, growers and ginners must take care during production, harvesting, ginning, and textile manufacturing to avoid practices that may diminish fiber quality.

TEXTILE NEEDS

For most end uses the textile mills want a fiber that runs efficiently on their textile machines and that produces a competitive quality end product at a competitive cost. In processing and in determining the end use of cotton, the following properties are critical (not in order of importance): Fiber length, fiber strength, micronaire, foreign matter, short fiber content, maturity, stickiness, fiber cohesion, and contaminants. Textile mills continually modernize so that they can produce world-class quality yarns and fabrics at the highest possible efficiency and lowest cost. Modernizing equipment, however, is not the whole answer; the raw material (ginned lint) also plays a major role in accomplishing this objective. The yarn making system used determines which fiber properties are important. Generally, fibers are desirable if they are strong, fine, mature, long, uniform, and relatively free from neps, small trash, seedcoat fragments, and dust. Cotton breeders should be encouraged to spend more effort on improving the strength, uniformity and fineness/maturity of most upland varieties. The use of proper harvesting and ginning techniques can preserve the properties of the lint and remove the objectionable nonlint material to produce yarns of world-class quality.

BEST GINNING PRACTICES

In view of the information presented herein, it is apparent that the best ginning practices are those that meet the needs of the textile customer consistent with acceptable farmer income; however, they are constrained by the initial quality of the seedcotton and market prices. Gin machinery sequences range from simply a dryer and/or moisture restoration device, a feed control, gin stand and bale press to a complex arrangement of numerous seedcotton cleaning and lint cleaning machines. Unfortunately, gins may have multiple customers each with competing interests at farm, market and mill levels. The secret to successful ginning is meeting the most important interests and achieving an acceptable compromise on the others. The short-term interests of the farmers are usually to achieve the most money for their cotton. If the potential market prices and initial qualities of the cotton are known before ginning, then farmer income can be optimized. Although it is difficult for ginners to make those machinery decisions, new computerized gin process control technology developed by the U.S. Department of Agriculture to monitor and control cotton quality at the gin can automatically make and execute the optimum decisions. The computer-based system assesses the color, leaf, moisture and other parameters of the cotton continuously and online before, during and after processing, and combines that information with the performance characteristics of each gin machine as well as the market value of various grades of cotton (Anthony, 1990b). The optimum processing procedures are then determined and executed. Gins equipped with computerized process control typically produce cotton with more favorable mill qualities in addition to more profits for the farmer. Without that new technology, ginners must be aware of the impact of gin machinery on the marketing and quality factors. For example, drying cotton generally improves its processing and helps reduce foreign matter but it may cause fiber damage. However, cotton must never be exposed to temperatures above 177 °C (350 °F) because the fiber is irreparably damaged. Drying at temperatures above 121 °C (250 °F) should be minimized, and those less than 49 °C (200 °F) are preferred. Fiber moisture should be maintained between 6 and 7% to preserve fiber length and should never be below 5% or above 9%. Sometimes, however, cotton arrives at the gin at moisture below 5% and moisture should be restored before fiber-seed separation. Since cleaning efficiency and fiber damage are inversely related to moisture, then drying is a compromise. Typically a fiber moisture of 6% is a suitable compromise.

Likewise, gin machines remove foreign matter but they also impact various fiber quality characteristics. They are necessary, however, to remove the fiber from the seed as well as to remove foreign matter to meet market requirements. The best ginning practice is simply to use the minimum machinery for a particular cotton to achieve the optimum market grade. Seedcotton rarely requires more than two cylinder cleaners and two stick machines, and lint cotton rarely requires more than two saw-type lint cleaners.

From a textile customer prospective, best ginning practices become more complicated. The typical market factors such as color and leaf may not be as important as fiber-damage related factors such as neps, short fiber content and seedcoat fragments. However, these factors are not in the current market system. Micronaire is not affected by gin machines; however, it is an estimate of fiber fineness, which is important to textile customers. Neps are increased by any manipulation of cotton fibers whether mechanical or pneumatic, thus reduced gin processing also reduces neps. Short fiber content is increased by the gin stand as well as by saw-type lint cleaners with the degree of increase strongly affected by low moisture content. Thus from both a farmer and textile mill perspective, cotton must be ginned with the minimal drying and cleaning to achieve acceptable market grades. Simplified machine sequences like Figure 1 or complex sequences like Figure 2 may be required to meet industry needs worldwide.

Selection of cotton varieties that have more desirable genetic features such as low neps, low short fiber content and minimal plant hairs (trichomes), coupled with good management practices that reduce fiber damage and foreign matter contamination in the field and during harvesting and storage are more important than ginning practices in determining fiber quality. Gins can only preserve fiber quality, but they can dramatically enhance market value.

Recommended Best Ginning Practices

1) Determine the needs of customers including marketing firms, textile mills, and cotton farmers.
2) Install gin machinery that meets the needs of the customers.
3) Include necessary pollution abatement equipment inside and outside the gin.
4) Ensure that farmers are aware of the best variety selection, production, harvesting and storage practices so that high quality cotton with minimal foreign matter and damage can be delivered to the gin. If this is done, minimal drying and cleaning will be required, and thus less fiber damage, higher quality fiber, and greater gin turnout will result.
5) Monitor farmer activities and provide guidance if necessary.
6) Develop and implement a comprehensive gin maintenance program that is continually documented and communicated. The maintenance program must include off-season repair, in-season preventive maintenance, and problem repair and documentation. Prime time should be programmed (typically one hour per 12-hour shift) for routine maintenance to include cleanup of facilities and machines. Use maintenance checklist for routine maintenance. Formal reviews should be conducted annually.
7) Develop contamination prevention program to ensure contaminant free bales.
8) Develop specific job description for each employee, and make sure that it is available in the appropriate language.
9) Train gin personnel in basic mechanics and how to use hand and power tools properly. Provide additional training annually.
10) Train personnel in basic gin machinery operations and minor repairs such as how to replace belts, install bearings, etc. Provide refresher training annually.
11) Train management and gin personnel in the capabilities, functions and safe use of each gin machine and associated equipment as well as the entire ginning system.
12) Train senior gin personnel in visual fiber quality assessment and the causatives of changes in fiber appearance.
13) Train operator and management personnel in safety. Hold weekly safety meetings. Post conspicuous safety warning signs. Empower employees to help monitor and enforce the safety program.
14) Ensure that all machinery is in good working order.
15) Ensure that all gin machines operate at the correct speeds, settings and capacities.
16) Ensure that each gin machine is matched to the process rate of the gin stand(s).
17) Develop a functional cotton flow plan from seedcotton storage on the gin yard, to the gin, and to the bale storage area. Also plan for handling the bales, cottonseed and trash.

18) Develop association with companies and personnel for technical assistance.
19) Group cotton with similar drying and cleaning requirements and process sequentially.
20) Manage moisture before and after the gin stand. Should have capability of measuring moisture accurately before and after moisture conditioning, and adding or removing moisture prior to the gin stand.
21) Gin at 6 to 7% fiber moisture at the gin stand.
22) Ensure that proper seed roll density is maintained in the saw gin stand.
23) Maintain uniform flow of cotton through all machines.
24) Ensure that the cotton is uniformly distributed across the width of the machinery, including the battery condenser and thus the bale.
25) Ensure that air velocities (meters per minute (feet per minute)) are correct: 1678 to 1830 (5,500 to 6,000) for vertical telescope pipes; 1068 to 1525 (3,500 to 5,000) air to convey seedcotton; 1220 to 1525 (4,000 to 5,000) for hulls and trash; 1220 to 1525 (4,000 to 5,000) for cottonseed in small pipes; 610 to 762 (2,000 to 2,500) for seedcotton in dryers; and 458 to 610 (1,500 to 2,000) for lint. About 0.57 m^3 (20 ft^3) of air is required to convey 0.45 kg (1 pound) of material. Drying systems may use over 1.1 m^3 (40 ft^3) per 0.45 kg (pound) of seedcotton and the increased volume of air allows lower temperatures for drying.
26) Use minimum temperatures during drying. Avoid temperatures above 121 °C (250°F) and never use temperatures above 177 °C (350°F). Extremely high moisture cotton may require gins to exceed these recommended temperatures.
27) Whenever possible, utilize new, proven technology that is supported by independent, unbiased, and published scientific reports.
28) Use feedback from farmer, marketing, textile and other customers to refine and improve gin operations.

SUMMARY

Genetics plays an important role in fiber quality, both in the initial quality of the fiber as well as how well the fiber withstands gin processes. Cotton possesses its highest fiber quality and best potential for spinning when the bolls are mature and freshly opened. The quality of baled cotton depends on many factors including variety, weather conditions, degree of weathering, cultural, harvesting and storage practices, moisture and trash content, and ginning processes. Cotton gins are responsible for converting seedcotton into bulk cottonseed and bales of lint. Gins can only preserve fiber quality but they can dramatically improve market value. Just as yield and market qualities such as color, leaf, micronaire, length and strength are important characteristics of varieties, so are textile mill-related qualities such as neps, short fiber content, and seedcoat fragments. Varieties and excessive weathering have a far greater impact on fiber quality than do the most rigorous of gin processes.

A ginner must have two objectives: (1) to produce lint of satisfactory quality for the grower's classing and market system, and (2) to gin the cotton with minimum reduction in fiber spinning quality so that the cotton will meet the demands of its ultimate users, the spinner and the consumer. A single "best ginning practice" does not exist for all cottons--each lot of cotton requires careful assessment of its needs, and thus different ginning practices. Moisture content, length of storage, amount of high-moisture foreign matter, variation in moisture content throughout the stored mass, initial temperature of the seedcotton, temperature of the seedcotton during storage, weather factors during storage (temperature, relative humidity, rainfall), and protection of the cotton from rain and wet ground all affect seed and fiber quality during seedcotton storage. For long storage periods, moistures should be below 12%. The temperature of cotton harvested at safe storage moisture will generally not increase more than 8 °C (15 °F) during the initial 5-7 days and will then level off and even cool down as storage continues. Foreign-matter levels in seedcotton before gin processing usually range from 1% to 5% for hand harvested, from 5% to 10% spindle-harvested, and from 10% to 30% for stripper-harvested cottons. A simple gin machine sequence such as a dryer, extractor-feeder and gin stand is required for clean cotton; however, a more extensive machine sequence is required for trashy cotton. The extensive sequence of gin machinery to dry and clean trashy cotton includes a dryer, cylinder cleaner, stick machine, dryer, cylinder cleaner, extractor-feeder and saw-type gin stand followed by two stages of saw-type lint cleaning. For stripper-harvested cotton, an additional extractor is required. The quality of ginned lint is directly related to the quality of the cotton before ginning. High grades will result from cotton that comes from clean fields harvested by hand or by machines in good condition and properly adjusted by trained and properly managed personnel. Lower grades will result from cotton that comes from grassy, weedy fields in which poor defoliation or harvesting practices are used.

When gin machinery is used in the recommended sequence, 75-85% of the foreign matter is usually removed from cotton. Drying cotton at high temperatures may damage the cotton fiber. Cotton should be dried at the lowest temperature that will produce satisfactory market grades and allow satisfactory gin operation. In no case should the temperature in any portion of the drying system exceed 177 °C (350 °F) because irreversible damage may occur. Temperatures over 93 °C (200 °F) damage dry fiber and should not be used if at all possible. Adding moisture before fiber/seed separation and lint cleaning will help maintain fiber length and reduce the number of fibers that break in the gin stand and lint cleaners. The ginning process can significantly affect fiber length, uniformity, and the content of seedcoat fragments, trash, short fibers, and neps. Choosing the degree of gin cleaning is a compromise between fiber trash content and fiber quality. Lint cleaners are much more effective in reducing the lint trash content than are seedcotton cleaners, but lint cleaners can also decrease fiber quality and reduce bale weight (turnout) by discarding some good fiber with the waste. The best ginning practice is simply to use the minimum machinery for a particular cotton to achieve the optimum market grade.

Ginners must determine the needs of their customers and select the drying and cleaning processes that meets their needs. They must ensure that farmers are aware of the impact of varieties and cultural practices on the quality of the seedcotton brought to the gin, and thus, the amount of gin processing equipment required. Gin procedures must be well planned to ensure timely and efficient processing. Operator and management personnel must be well trained and skilled in all aspects of gin operations. Gin machinery must be operated at the proper speeds and capacities, and must be well maintained. Moisture must be managed from harvesting through packaging. Cotton must not be harvested or stored at seedcotton moisture levels above 12% wet basis. Cotton should not be exposed to temperatures above 121 °C (250° F) and must not be exposed to temperatures above 177 ° C (350 °F) unless it is wet. Fiber moisture at the gin stand should be 6 to 7%, and the fiber should be packaged at less than 8% moisture. Bales should be packaged at the proper density and protected by high quality bale ties and bale coverings. Good gin operations use only the amount of drying, moisture restoration, and cleaning required to meet customer demands. New, proven technology must be used to process cotton as well as to monitor and control fiber quality.

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Disclaimer

Table 1. Summary of gin-related factors for major cotton producing countries. Note that P=primary method and S=secondary method.

Factor	Argentina	Australia	Brazil	China (Mainland)	India	Pakistan	Paraguay	Syria	Tajikistan	Turkmenistan	Turkey	United States	Uzbekistan	Other
Staple length, cm														
Extra-long (>3.18)		S		S					S	S	S	S	S	
Long-staple (>2.62 - <3.18)	P	P	P	P	P	P	P	P	P	P	P	P	P	
Short staple (<2.62)					S	S						S		
Harvesting														
Manual	P		S	P	P	P	P	P	P	P	P		S	
Spindle	S	P	P	S					S	S	S	P	P	
Strip		S										S		
Storage														
Module		P	P									P		
Trailer	S		S	S								S		
House	P		S	S	S	S	P	P			P			
Ground				P	P	P			P	P			P	
Gin Plant														
Cotton entry														
Module Feeder		P	P									P		
Suction pipe	P		S	P	P	P	P	P	P	P	P	S	P	
Conveyor									P	S	S		S	
Hand Fed					P	P								
Feed control														
None			S	P	P	P					P			
Automatic	P	P	P	S			P	P	P	P	S	P	P	
Dryer														
One stage	P		P	P			P	P	P	P	P		P	
Two stages	S	P										P		

Table 1. Summary of gin-related factors for major cotton producing countries. Note that P=primary method and S=secondary method.

Factor	Argentina	Australia	Brazil	China (Mainland)	India	Pakistan	Paraguay	Syria	Tajikistan	Turkmenistan	Turkey	United States	Uzbekistan	Other
Cylinder cleaner														
One				P			P	P			P			
Two			P	S					P	P	S	P	S	
Three	P	P	S	S					S	S			P	
Four														
Extractors														
One	P	P	P	P					P	P	P	P	P	
Two												S		
Three														
Conveyor distributor														
No				S	S	S					P			
Yes	P	P	P	P	P	P	P	P	P	P	S	P	P	
Manual	P	S	P	S		P	P	P	P	P			P	
Automatic	S	P	S	P								P	S	
Extractor feeder														
Extractor				P							S	P		
Cylinder									P	P			P	
Cyln + extr	P	P	P	S								S		
Gin stand														
Saw	P	P	P	P	P	P	P	P	P	P	S	P	P	
Roller		S		S	S	S			S	S	P	S	S	
Churka					S	S								
Other														

Table 1. Summary of gin-related factors for major cotton producing countries. Note that P=primary method and S=secondary method.

Factor	Argentina	Australia	Brazil	China (Mainland)	India	Pakistan	Paraguay	Syria	Tajikistan	Turkmenistan	Turkey	United States	Uzbekistan	Other
Lint cleaner														
Cylinder											P	S		
Air	S	S	P				S	S				S		
One Saw	P		S	P			P	P	P	P	S	S	P	
Two Saw	S	P									P	P		
Three Saw														
Bale density, kg/m^3														
<320					P	P								
336-497	P	S	P	P			P		P	P	P	P	P	
>497		P	S					P			S			
Bale weight, kg														
136-159														
159-182														
182-205				P							P			
205-227	P				P	P				P		P	P	
227-250	S	P	P				P							
250-272														
Bale covering														
None												S		
Cotton				S					S	S			S	
Burlap-Jute	P	P		P	P	P	P	P	P	P	P	S	P	
Polyethylene		S										S		
Polypropylene												P		
Other														

Table 2. Summary of gin-related factors for major cotton producing countries. Note that P=primary method and S=secondary method.

Factor	South Africa	Zimbabwe	Malawi	Zambia	Tanzania	Uganda	Sudan	Egypt	Cameroun	Nigeria	Benin/ Togo	Chana	Ivory Coast	Mali/B /faso
Staple length, cm														
Extra-long >3.18							S	S						
Long-staple >2.62->3.18	P	P	P	P	P	P	P	P		P	P	P	P	P
Short staple (<2.62)		S	S	S					P	S		S	S	S
Harvesting														
Manual	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Spindle														
Strip														
Storage														
Module														
Trailer	S	S												
House	S	S				S		P	S		S			
Ground	P	P	P	P	P	P	P	S	P	P	P	P	P	P
Gin Plant														
Cotton entry														
Module feeder														
Suction pipe	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Conveyor														
Hand Fed														
Feed control														
None	S	S	S	S	S	S	P	P	S	S	S	S	S	S
Automatic	P	P	P	P	P	P	S	S	P	P	P	P	P	P
Dryer														
One stage	P	P							P			P	P	P
Two stages														

Table 2. Summary of gin-related factors for major cotton producing countries. Note that P=primary method and S=secondary method.

Factor	South Africa	Zimbabwe	Malawi	Zambia	Tanzania	Uganda	Sudan	Egypt	Cameroun	Nigeria	Benin/ Togo	Ghana	Ivory Coast	Mali/B/ faso
Cylinder cleaner														
One	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Two														
Three														
Four														
Extractors														
One														
Two														
Three														
Conveyor distributor														
No					S	S	P	S						
Yes	P	P	P	P	P	P	S	P	P	P	P	P	P	P
Manual	P	P		P	P	P	P	P	P	P	P	P	P	P
Automatic	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Extractor feeder														
Extractor	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Cylinder														
Cyln + extr														
Gin stand														
Saw	P	P	P	P	S	S	S		P	P	P	P	P	P
Roller		S			P	P	P	P						
Churka														
Other														

Table 2. Summary of gin-related factors for major cotton producing countries. Note that P=primary method and S=secondary method.

Factor	South Africa	Zimbabwe	Malawi	Zambia	Tanzania	Uganda	Sudan	Egypt	Cameroun	Nigeria	Benin/ Togo	Ghana	Ivory Coast	Malli/ B/faso
Lint cleaner														
Cylinder	P	P	P	P	P	P			P	P	P	P	P	P
Air														
One Saw	P	P		P					P	P	P	P	P	P
Two Saw														
Three Saw														
Bale density, kg/m^3														
<320														
336-497	P	P	P	P	P	P	P	P	P	P	P	P	P	P
>497												S		
Bale weight, kg														
136-159														
159-182							S	P						
182-205							P	S						
205-227	P	P	P	P	P	P			P	P	P	P	P	P
227-250														
250-273														
Bale covering														
None														
Cotton														
Burlap/Jute	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Polyethylene														
Polypropylene														
Other														

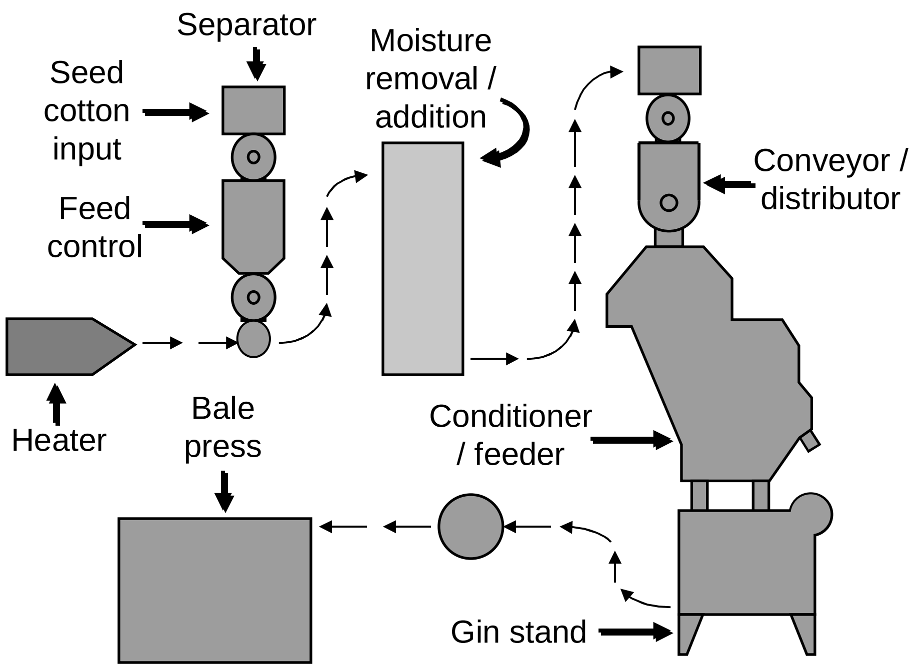

Figure 1. Machine sequence used to process clean, hand-picked cotton.

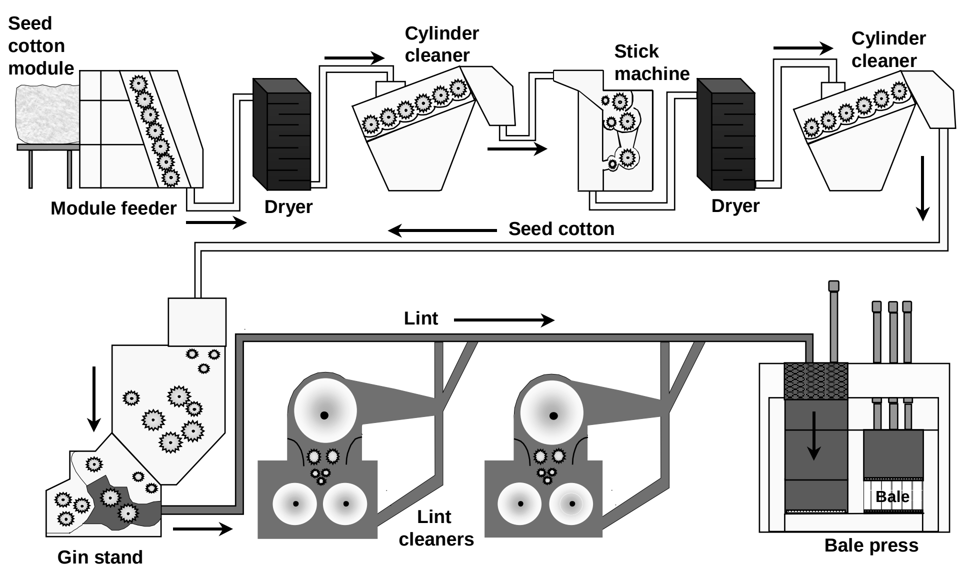

Figure 2. Representative cross-sections of typical types of gin machinery arrayed in a sequence used for spindle-picked cotton.

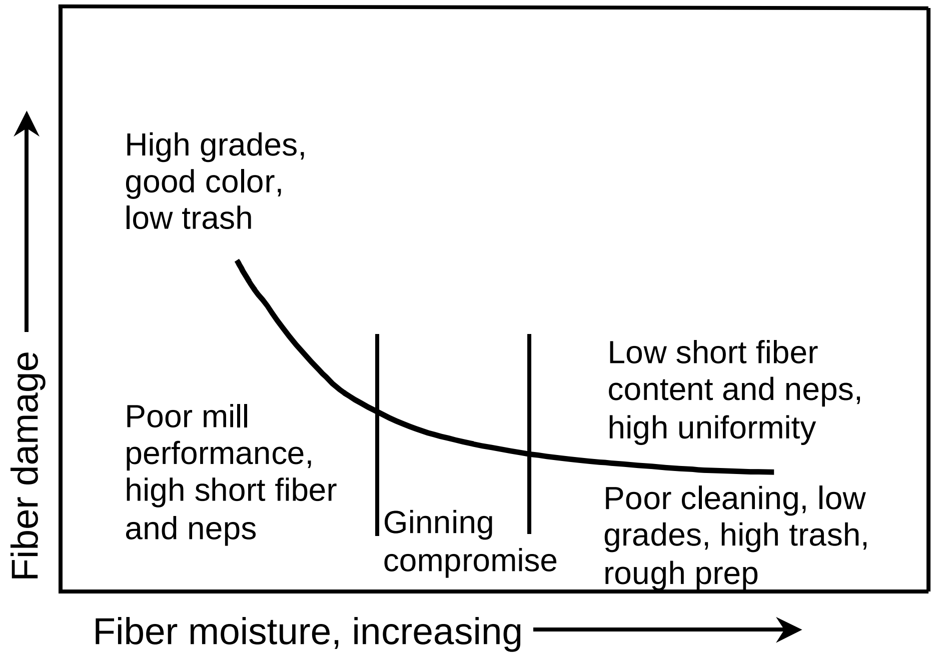

Figure 3. Moisture content during gin processing is a compromise between cleaning efficiency and fiber quality.

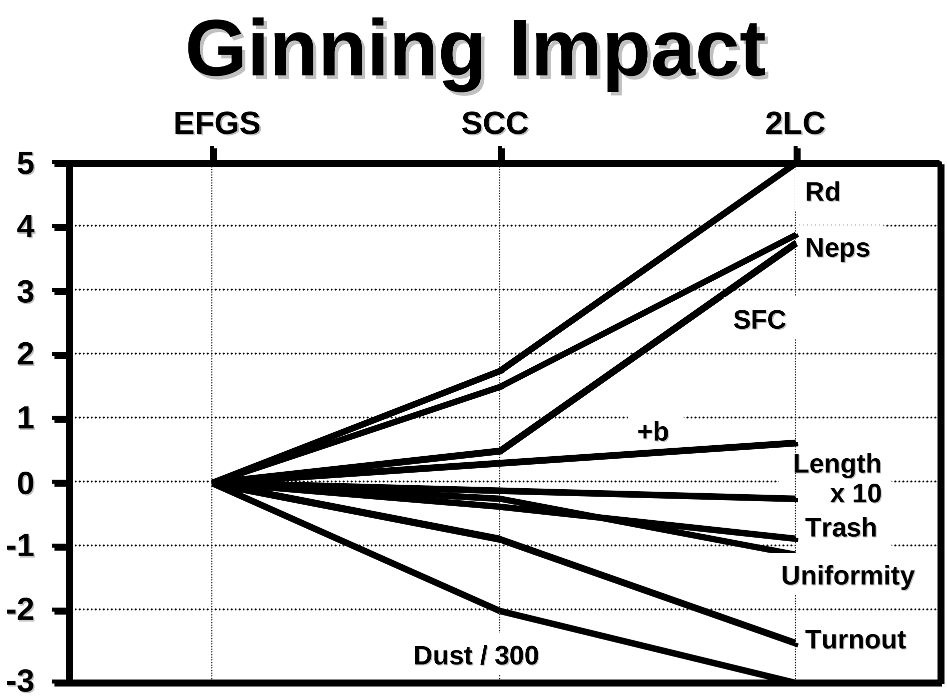

Figure 4. Typical response of fiber parameters to seedcotton cleaning and lint cleaning machinery at 5% lint moisture. Note that EFGS = extractor-feeder and saw-type gin stand and represents the absolute minimum amount of machinery required (similar to Figure 1); SCC=cylinder cleaner + stick machine + cylinder cleaner + EFGS; and 2LC=two saw-type lint cleaners + EFGS; Rd=HVI reflectance; neps=neps per 100 in^2 of web; SFC=short fiber content by weight (AFIS); +b=HVI yellowness; length x10=HVI length times 10; trash= HVI trash; uniformity =HVI fiber length uniformity (ratio of mean length to upper half mean length); turnout=ratio of lint to seedcotton; and AFIS dust/300=Advanced Fiber Information System dust particles smaller than 500 microns divided by 300 for graphing purposes.

Government Measures and the World Cotton Industry

The subject of government measures in cotton has been discussed in the ICAC since the creation of the Committee in 1939. Throughout the 1990s, the Committee drew attention to the impacts of government measures that distort production and trade in cotton. A number of countries in the ICAC have noted that trade barriers and subsidies in some countries contribute to price volatility and impact adversely the level of cotton production in other countries. Countries have noted that barriers to trade in cotton and cotton textiles hinder economic development, and a number of countries have expressed the view that subsidies lower world cotton prices and cause the burden of adjustment to lower cotton prices to fall heavily on producers in countries with limited government support.

In the early 1990s, the ICAC looked forward to the successful outcome of the Uruguay Round of GATT multilateral trade negotiations and encouraged member countries to actively support efforts to conclude the discussions on agriculture satisfactorily. In 1994, the ICAC noted that the Uruguay Round Agreement did not meet the expectations of all countries, particularly efficient exporting countries. Nevertheless, it was recognized that the World Trade Organization (WTO) is an effective forum to monitor the Agreement on Agriculture, and member countries were encouraged to observe commitments arising from the Round in order for agriculture to benefit fully from inclusion in the multilateral trading system.

In the late 1990s, after the creation of the WTO, many governments remained concerned that subsidies, particularly production and export subsidies, tariffs and trade barriers distort the world cotton economy. Numerous governments urged the elimination of these practices throughout the whole production, processing and marketing chain. However, governments have noted also that measures affecting the cotton industry often have social purposes or are implemented to encourage good environmental practices or to achieve other beneficial objectives. Therefore, the ICAC recognized that subsidies, tariffs and trade barriers are appropriately addressed in the WTO, and governments expressed the wish that multilateral negotiations in the WTO result in a substantial reduction in measures that distort production and trade. In the 59th Plenary Meeting in Cairns in 2000, the ICAC explicitly asked the WTO to urgently consider the distortions created by subsidies in the cotton market.

Reports by the Secretariat indicate that government measures have an impact on the structure of the world cotton economy. The most recent report by the Secretariat (Attachment IV to SCM 454) indicates that the level of direct assistance to production provided by governments amounted to $3.6 billion in 2000/01. According to the Secretariat, 55% of world cotton production is benefiting from direct income or price support programs in 2000/01, and cotton area in countries that provide direct subsidies to growers increased from 11 million hectares in 1998/99 to 11.7 million in 2000/01. In contrast, cotton area in countries that do not provide direct subsidies to growers declined from 22 million hectares in 1998/99 to 20 million in 2000/01.

At the 454th Standing Committee Meeting, some delegates recommended that the Standing Committee develop a statement condemning domestic policies that distort cotton prices and trade. It was further recommended that the statement should urge WTO negotiators to move forward with constructive proposals to reduce trade and production distorting policies, and that the statement be presented to the plenary meeting for discussion, adoption and communication to the broadest possible audience. The Private Sector Advisory Panel echoed these sentiments during a Round Table discussion with the Standing Committee in June in Washington. The PSAP noted that governments seek to achieve many valid objectives through the use of measures affecting agriculture and that it is not realistic to expect the immediate elimination of all forms of government measures. Therefore, the PSAP suggested that the ICAC focus its efforts on achieving a gradual but steady reduction in those government measures that directly subsidize increased cotton production.

Therefore, in order to improve the health of the world cotton economy by reducing distortions to world cotton production and trade caused by government measures, the Standing Committee recommends that the Advisory Committee at its 60th Plenary Meeting in Victoria Falls should urge member countries of the ICAC to:

Adopt policies to reduce and eventually eliminate, to the extent possible, the negative effects on trade caused by direct government assistance to cotton production and trade implemented by some countries, and to

Encourage the WTO to urgently consider trade distortions on the world market caused by measures taken by some governments, and to

Advise their WTO negotiators to move forward with constructive proposals to reduce the trade and production distortions caused by policies implemented by some governments.

The Secretariat is instructed to communicate this resolution to the broadest possible audience, including the press, member countries and multilateral organizations.

INTERNATIONAL COTTON ADVISORY COMMITTEE

Standing Committee
Washington, DC

Attachment IV to SC-N-455
July 26, 2001

Nominations for Members of the Private Sector Advisory Panel

The membership of the Private Sector Advisory Panel (PSAP) is reviewed by the Standing Committee prior to each plenary meeting to ensure the ongoing relevance and commitment of its members. The terms of service for members of the Third PSAP will extend from the 60th Plenary Meeting in Victoria Falls to the end of the 61st Plenary Meeting in Cairo.

There is no limit to the size of the Panel, except that there may be no more than one member from each country. The Panel must be representative of all three major segments of the world cotton industry, producers, shippers and spinners, and the Panel must include members from both developing and developed countries. The Secretariat has received notification of the following nominations for the Third PSAP.

Private Sector Advisory Panel 2001-2002

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