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Introduction

The Third Regional Meeting of the Latin American Association for Cotton Research and Development was held from August 19-23 at Campina Grande, Brazil. The meeting, which was co-sponsored by the International Cotton Advisory Committee, was organized by Dr. Raimundo Braga Sobrinho under the advice of Mr. Orozimbo Silveira Carvalho, Head of the National Cotton Research Center (CNPA, EMBRAPA), Ministry of Agriculture and Agrarian Reform, Campina Grande, Brazil. The meeting was also supported by Confederacao Nacional da Industria and the Federacao das Industrias do Estado da Paraiba. Representations of cotton producing countries of the region attended the meeting. The meeting followed up the decisions of previous two meetings held in 1986 and 1988 at Chaco (Argentina) and Lima (Peru) respectively. A complete report on the proceedings and recommendations of the meeting will be published in the next issue of *The ICAC Recorder.*

Dr. Lawrance Hunter, Division of Textile Technology, CSIR, P.O.Box 1124, Port Elizabeth 6000, South Africa, who is also the current Chairman of the

Working Group on High Volume Instrument Testing (HVI) of the International Textile Manufacturer's Federation (ITMF) was invited to present a paper at the Latin American Meeting on the Use and Misuse of HVI. Dr. Hunter's paper discusses the issues of standardization and accuracy of HVI measurements and identifies problem areas to be addressed in the future. In the paper he critically analyzes the correlation of fiber parameters measured by HVI and traditional tests. Dr. Hunter's paper has been reproduced in *The ICAC Recorder* for wider circulation.

This issue of the *Recorder* also reproduces an article published in the *Cotton Gin and Oil Mill Press* by Mr. Gino J. Mangialardi, Jr. on the impact of extensive lint cleaning on fiber quality. Higher lint cleaning through the use of more and more pre or post cleaners appears to be desirable for the growers or ginners, whoever sells lint, but undesirable for the spinner as it increases short fiber content. The paper justifies the use of a minimum number of cleaners. At the same time, the disadvantages of using an undesirably higher number of cleaners in the gin have also been discussed. The paper should be of interest to growers, ginners and spinners.

The Beltwide Cotton Conferences of the National Cotton Council of America will be held at Nashville, Tennessee, from 6-10th January 1992.

The 21st International Bremen Cotton Conference will be held from 12-14 March 1992 at Bremen, Germany. Immediately preceding the Conference the International Committee on Cotton Testing Methods of the ITMF will meet in Bremen on March 10-11, 1992.

HVI Technology: Its Use and Misuse

Dr. Lawrance Hunter, Division of Textile Technology, CSIR, P.O. Box 1124, Port Elizabeth 6000, South Africa

Introduction

The physical characteristics of cotton lint largely determine the most suitable processing route and conditions, processing behavior and efficiency and ultimately the yarn, fabric and end-use quality. These aspects are reflected in conversion and product costs and ultimately the textile "value" of the cotton. For example, the level and nature of trash in cotton affect processing mass loss (in terms of waste) and performance and yarn and fabric faults, cotton fiber length affects spinning efficiency and yarn and fabric quality, cotton fiber strength affects the fiber breakage patterns during processing and yarn and fabric strength, cotton fiber fineness affects neps, spinning efficiency (particularly in open-end spinning) and yarn quality, cotton maturity (particularly the presence of "dead fibers") affects neppiness and dyed fabric appearance, short fiber content affects fibrous waste (and fly), spinning performance and yarn and fabric quality, stickiness affects processing efficiency, and cotton color affects fabric color, bleaching and dyeing.

The above, together with the fact that the cotton lint characteristics can vary, often quite independently, from bale to bale, due to genetic and environmental factors as well as harvesting and ginning conditions, make it important, if not essential, that all the important cotton lint properties be known for every bale which a mill purchases and processes. How can a mill remain competitive in today's increasingly competitive and quality conscious environment, also taking into consideration the increasingly severe technical demands being placed on textile fibers by new and high speed machinery and technologies, if the mill does not have an accurate measure of the important textile related properties of the cotton which it is buying and processing and does not understand precisely how the properties of the lint interact with processing conditions to determine processing performance and cost and the quality of the cost of the yarn, fabric and end-product.

The latter necessitates quantitative relationships, generally empirically derived, between the cotton lint properties on the one hand and processing performance and yarn and fabric quality on the other hand (e.g. EFS of Cotton Inc. and other research work). Furthermore, how can cotton breeders, producers and ginners strive to provide mills with the most suitable and best quality cotton if the true textile quality of cotton is not quantified, by objective measurement, and reflected in the price paid for the cotton. For example, it is important that cotton be cleaned during ginning in such a way that the fiber is not excessively damaged (i.e. not over cleaned) which increases short fiber content.

From the above, the need to be able to accurately, practically and economically measure and quantify those properties of cotton lint of importance in determining its utilization, processing conditions, performance and cost and yarn and fabric quality and cost, is self evident. It is this need which the High Volume instrument (HVI) testing of cotton attempts to satisfy. Let it be stated right at the outset, however, that the HVI systems of today, though a major step in this direction, do not represent the final answer. Much research and development are still required, before cotton lint can be completely and accurately characterized. Nevertheless, there can be little doubt that HVI testing of cotton is the best system presently available and is superior to the traditional manual classing of cotton in terms of obtaining an acceptably accurate description of the textile quality and value of the cotton within practical, economical and time constraints. Dr. Preston E. Sasser (Cotton Inc.) has stated that the economics of cotton production and cotton textile manufacturing leaves no choice but to use the highest level of technology in measuring fiber quality for use in both marketing and spinning.

As an example, Table I illustrates the use of HVI data in predicting the variation in various important textile properties. Recent improvements in, and extension to, HVI testing could be expected to provide an even better prediction of these and other important textile properties.

Cotton Lint Properties of Textile Importance

From the research carried out on the role of lint characteristics in determining processing behavior, performance and waste, spinning end breaks, yarn quality, knitting and weaving efficiencies and fabric and end-product behavior and performance, it appears that, ideally, the values for the properties listed in Table 11 (some of which are related) need to be known to completely characterize cotton lint. Research worldwide is being aimed at developing systems which allow as many as possible of these properties to be measured accurately, economically and rapidly.

Growth in the Use of HVI

The worldwide growth in HVI is illustrated in Fig. 1, there being over 600 complete and partial systems in 47 countries compared to fewer than 30 systems at the start of the previous decade.

About half of the HVI systems installed worldwide are in the private sector (industry), the rest being in the official or public sector (e.g. Government, Cotton Boards, etc.), largely for the classing of cotton. Mills worldwide are using HVI to select and measure the quality of the cotton they buy, determine bale lay-downs (bale management), engineer predict/control the properties and quality of their products, particularly the yarn and fabric, and to minimize costs and optimize quality and processing performance. In this context, it is interesting to note that in 1990, some 4 million bales were processed in the US, using the HVI based EFS fiber management system. It is not far fetched to suggest that, one day in the not too distant future, cottons will be classed worldwide by HVI.

The growth of HVI classing in the US is illustrated in Fig. 2 the classing still incorporating subjective assessments of trash and grade since these cannot yet be satisfactorily measured by HVI. It is projected that almost the entire 1991 US Cotton Crop will be HVI classed, it having been estimated that some 250 million individual measurements would be required to HVI class the entire crop. It has repeatedly been shown that HVI classing was superior to the traditional, largely manual, system in terms of predicting processing performance and product quality.

ITMF HVI Working Group

Recognizing the growing importance of HVI testing in its member countries, the International Textile Manufacturers Federation (ITMF), through its International Cotton Test Committee, established an HVI Working Group at its meeting in 1988. The Working Group has over 50 members from 22 countries, and has, as its main objectives (I) the standardization, on an international basis, of HVI calibration and testing procedures and methods; (II) improvement of inter-laboratory reproducibility and accuracy of test results; (III) the identification and selection of fiber parameters which should be HVI tested: (IV) the establishment of correlations between HVI and traditional laboratory instrument test results, and (V) the identification of problem areas. The Committee will meet again in Bremen early next year and it is envisaged that significant progress will be made towards achieving the above objectives at that meeting.

Specific Uses of HVI Data

HVI can contribute greatly towards reducing testing, raw material and production costs, while ensuring consistent running performance and product quality, finding successful application in areas listed in Table III (some of which are inter-related).

Micronaire

Micronaire is generally accurately HVI measured, correlating well with traditional tests. Discrepancies, at the extreme ends of the scale, can occur when micronaire is measured on an open and clean sample, such as that used in the FMT III/HVI, which now has been integrated into some HVI systems and provides a measure of cotton fineness and maturity in addition to micronaire.

Maturity

Progress has been made in the development of a rapid HVI compatible maturity test, viz by near infra-red (NIR) and double compression air-flow. Although neither is used routinely to any great extent with HVI, the double compression test (IC Shirley FMT III/HVI) has been integrated into certain HVI lines, testing time reportedly being approximately 30 seconds. This testing time was largely achieved by using rapid fiber preparation (Fiber-blender) and a variable sample mass. The question of the HVI measurement of fiber maturity distribution and "dead fibers" still remains to be solved and further work in this area is required. Round Trials involving FMT instruments have indicated that inter-laboratory variability tends to be high when testing relatively immature cottons.

Length and Length Distribution

Length and length uniformity, the latter as Uniformity Index (UI) or Uniformity Ratio (UR), have been measured virtually since the inception of HVI. Highly reproducible length values can be provided in the form of UHML or 2.5% Span Length, which generally agree closely, but are not equivalent. Calibration by means of the HVI calibration cottons result in UHML values which generally agree closely with 2,5% Span Length values, but it is important to once again emphasize that they are not equivalent and significant differences can occur. Associated with this and that of calibration cottons is the question as to which length uniformity, viz UI or UR should be used. The balance of evidence appears to favor the former as a better estimate of Short Fiber Content, (SFC) and it, together with the UHML are being used to provide an HVI estimate of SFC (confidence limits are not greater than those obtained using the array method) for saw-ginned Upland cotton. It is now necessary that the accuracy and usefulness of the HVI measures of SFC, which have been developed, are critically assessed. There is, however, still a need for a more accurate HVI measure of SFC.

Strength

It was the ability of HVI to provide strength values for each bale of cotton that largely led to the initial acceptance and speed of HVI testing, with the sub-committee of the Advisory Committee on Cotton Marketing (ACCM) in the US having recommended a schedule for price premiums and discounts based upon HVI strength, cotton with a strength below 24g/tex will collect a penalty and that above 25g/tex will collect a premium. The New York Cotton Exchange has a minimum HVI strength requirement of 22g/tex.

Of all the present HVI tests, strength probably correlates worst with the traditional tests. The HVI test differs fundamentally from Stelometer/Pressley tests, and they can not be regarded as equivalent. In the light of the differences between HVI and Stelometer/Pressley tests, (e.g. rate of extension, tapered vs. parallel beard, size of beard, tensioning and crimp removal, indirect estimation of sample mass, sample preparation), it is not surprising that, although HVI strength values are generally at a similar level as either the Pressley or Stelometer values (depending upon the particular calibration cottons and strength level used), the correlation is not always all that high and differences of up to 4g/tex can occur. A better micronaire based correction, or preferably a fineness/maturity based correction, for mass may give more accurate and reliable HVI strength results and which correlate better with Stelometer strength. Even then, however, HVI and Stelometer/Pressley strength should not be expected to be identical.

Uniform sample preparation (e.g. specimen brushing) and calibration, round trials, software calibration, and rigid controls of atmospheric conditions all contribute towards more reliable HVI strength results. Improvements in HVI strength testing appear desirable, some work being directed towards this and also towards rapid single fiber testing. Considerable work is presently in progress, particularly at the USDA, to improve the reproducibility and accuracy of HVI strength results and the more absolute calibration of the HVI strength testing units, and significant progress has been made.

Non-Lint Content

The optical scanning (video camera) method is used in the measurement of trash, providing a measure of the sample surface area (% area) covered by trash and the number (count) of trash particles. The two HVI systems measure trash in a similar way, although using different pixel spacing, sample observation size and particle clustering. HVI trashmeters are easy to calibrate, (although improvements have been suggested) and stable, but inter-laboratory reproducibility does not appear to be entirely acceptable, as yet. Recently the same window size, image area and reference tile have been adopted by the two manufacturers of HVI systems. This should improve agreement between the two systems, but there are other differences which still exist (e.g.. resolution, grey scale, spectral filter and thresholding).

Problem areas include an inability to measure dust and to distinguish between different types of trash, (e.g. leaf, grass and bark) and between difficult or easy to remove trash (i.e. cleanability), while seed coat fragments or light shaded bark particles may also not be counted. Furthermore reproducibility is sometimes erratic at high trash levels, calibration tiles can become smudged (affecting calibration) and results can be affected by cotton color. Work is in progress to develop more sophisticated image analysis systems to provide a measure of trash size and shape, and therefore trash type, and it appears that bark can be identified by this means. For the 1991 US cotton crop, not only will the HVI determined percentage of sample surface covered by trash be given, but also a trash determined by the classer.

Color

HVI measurement of color (measured at the same time and on the same sample as trash) provides accurate and repeatable measures of average reflectance (brightness or greyness) and yellowness. The two HVI systems are similar in the way they measure color, and their results agree well. It is important, however, that trash is not removed from the sample surface (color of trash may affect readings), that the sample completely covers the sample window and that there are no shadow casting folds in the sample being measured. Present limitations include the inability of the system to measure color uniformity, spottedness in particular. In the US HVI classing, each of the color grades are to be divided into four areas, and the exact co-ordinates of brightness (greyness) and yellowness also given.

Elongation

To date, the HVI measure of elongation, has proved to be unacceptably variable, showing the highest inter-laboratory variability, and poor correlation with Stelometer values. Nevertheless, a recent development, which involves the use of displacement transducers on all HVI systems, apparently allows elongation to be measured more accurately.

Stickiness

It appears that at present NIR has the most merit as a rapid method for measuring stickiness, (honeydew and plant sugars). Nevertheless, the isolated and localized (spotty) nature of honeydew stickiness (as opposed to plant sugars) could pose a problem, since an "average value" for sugar does not always adequately reflect processing stickiness.

Neps

Although neps are related to properties such as maturity, particularly the presence of "dead" fibers and seed-coat fragments, a separate test for neps is desirable. There is no HVI test for neps, the AFIS-N system of aero-mechanical separation and electro-optical measurement appearing to hold the most promise (possibly also for seed-coat fragments). Work is in progress to measure the neppy (flecked) appearance of dyed fibrous web.

Grade

An important aspect in the HVI classing of cotton which is presently receiving considerable attention is that of replacing the present Classer’s Grade by separate HVI measures of trash and color. It is anticipated that, in the US, the Classer’s Grade will be replaced by color and trash measurement with the 1993/94 crop.

Calibration

Two sets of calibration cottons (HVI and ICCS) are used for HVI, leading to potentially different levels of calibration and results, and it is essential that calibration levels always be specified.

Standardized universal calibration procedures, cottons and levels and test procedures are essential for unambiguous, reproducible and accurate results. A modified software system, using the accumulation of calibration data, appears to provide more consistent and stable calibration levels for strength in particular. At the ITMF HVI Working Group meeting in Bremen in 1990, it was decided that a universal calibration level and set of parameters were highly desirable and it was recommended that only the USDA

HVI calibration cottons (plus the ICCS samples for micronaire) be used to calibrate HVI systems in the future. This would mean that the HVI strength values would approximate Pressley 1/8" gauge strength and that the HVI length values obtained would be those of Upper Half Mean Length and Uniformity Index. The USDA and machine manufacturers as well as researchers, particularly those of the USDA, were strongly requested, however, to develop more absolute calibration (and measurement) systems for HVI, particularly in respect of strength, it being reported by USDA representatives that improved calibration procedures were in fact being developed by the USDA. The time is perhaps opportune to develop calibration procedures which will eliminate the need for calibration cottons.

Round Trials and Reproducibility of Results

Two different round trials (check tests) involving HVI instruments, are being carried out regularly, via the USDA Check Tests (monthly) and the Bremen Round Trials (quarterly). More than 70 laboratories (about 30 of which are outside US) participate in the USDA Check Tests for HVI. The need for accurately controlled and universally standardized atmospheric conditions (particularly moisture content), test procedures, calibration procedures, calibration cottons and calibration levels (particularly in respect of strength) cannot be over emphasized if comparable and reproducible interlaboratory results are to be obtained. The "preparation" (openness, smoothness and roughness) of the cotton, as well as the ginning method (saw vs. roller ginning and the number and type of lint cleaners) and trash level can also affect the repeatability of HVI test results. Increasing the consistency of specimen preparation as well as the number of specimens tested can also greatly improve the repeatability of HVI test results. Increasing the consistency of specimen preparation as well as the number of specimens tested can also greatly improve the repeatability and accuracy of test results. The effect of the number of tests per bale on the precision of HVI strength results is illustrated in Fig. 3. The above, together with the participation in regular round trials, are critically important in improving inter-laboratory agreement and generally lead to acceptable interlaboratory reproducibility and agreement of HVI results, which also compare favorably with the results obtained on the traditional laboratory instruments (see Table IV).

The following table summarizes the average values obtained in recent years in the Bremen and USDA Round Trials (Check Tests) and provide an indication of the magnitude of inter-laboratory variability which can be expected in practice when testing is carried out under controlled conditions.

It is often assumed that an inter-laboratory variation (CV) of 5% or less is required for a test to be internationally acceptable. According to the above table, and the assumed criteria of a CV of 5% or less, all the HVI tests listed in Table IV qualify as having acceptable inter-laboratory variability, except for Elongation, with Color (+ b) and Strength marginal (i.e. æ5%).

According to International Inter-laboratory Round Trials/Check Tests, the tolerances shown in Table V would typically apply when a fairly uniform bale of cotton is HVI tested by different laboratories. It should be noted that the tolerances for the traditional laboratory instruments generally tend to be wider.

Atmospheric Conditions

It is widely recognized that the rigid control of atmospheric conditions, particularly relative humidity (specifically cotton moisture content), is critical for consistent and accurate HVI strength results. An increase of 1% in cotton moisture regain can increase strength by as much as 10%. It would be best to control relative humidity (RH) to narrow limits or else to monitor the moisture content of the test specimen (e.g. by NIR) and carry out a software correction. Conditioning time of at least 12 hours in an open state and open tray, appears desirable, although the fiber beard itself can respond within less than 30 seconds to changes in RH. What has emerged as particularly important is the short term (often over a span of a few minutes) cyclical fluctuation in the relative humidity of an air-conditioned testing room and which is generally not apparent from damped recording instruments and cannot be corrected for by means of calibration cottons. It is also important to consider the effect of moisture hysteresis, and it is preferable to always pre-dry the cotton sample before it is conditioned under standard atmospheric conditions.

Concluding Remarks

The cotton world has come a long way in the quest to objectively, completely and accurately characterize the textile quality and value of cotton by means of HVI, but further work needs to be done to further improve the reliability and accuracy of existing HVI tests and to extend HVI to cover other important lint characteristics. What is extremely important, however, is that all HVI laboratories use the same (universal) calibration cottons, procedures and levels, testing procedures, correct sampling procedures and sample preparation and conditioning. Equally important is that the atmospheric conditions (including short-term cyclical fluctuations), and particularly the moisture regain of the cotton at the instant of the strength test, be controlled to within very narrow tolerances (or else measured and corrected for). A challenge facing mills all over the world today is the effective utilization of present and future HVI data, since there can be little doubt that the correct use of HVI data provides a competitive edge.

Table I Variation Explained by HVI Data

Product	Yarn Strength	Yarn Evenness	Spinning & Weaving Efficiency	Fabric Strength	Yarn to Fabric Strength
Denim	85 to 96	60 to 80	75 to 95	76 to 89	69 to 78
Printcloth	80 to 91	60 to 80	80 to 95	69 to 84	70 to 79
Shirting	75 to 95	N/A	N/A	N/A	N/A
Knit	80 to 90	N/A	N/A	N/A	N/A

Smith, C.B., Proc. Beltwide Cotton Production Research Conf., 344 (1984)

Table II Cotton Lint Quality Characteristics Which Ideally Should Be Measured

VERY IMPORTANT

1. Length and length distribution, including length uniformity and short fiber content (ove rlong fibers and fiber fragments may also be problematic).
2. Strength
3. Non-lint content, subdivided as follows:
    (I) Trash; level, size and nature (considering cleanability and such aspects as seed-coat and mote fragments, etc).
    (II) Dust; level and size, (separating the components of micro and respirable dust.
    (III) Foreign matter and contaminants, e.g. plastics.
4. Micronaire (preferably fineness rather than micronaire).
5. Maturity and its distribution, including "dead" fiber.

IMPORTANT

6. Color (also its uniformity and bleachability)
7. Dyeability, (Dyeing behavior and dye defects, related to certain fiber dimensions and structure, and possibly UV reflectance).
8. Neps (size and distribution).
9. Elongation
10. Stickiness, (mainly, but not solely, due to honeydew).

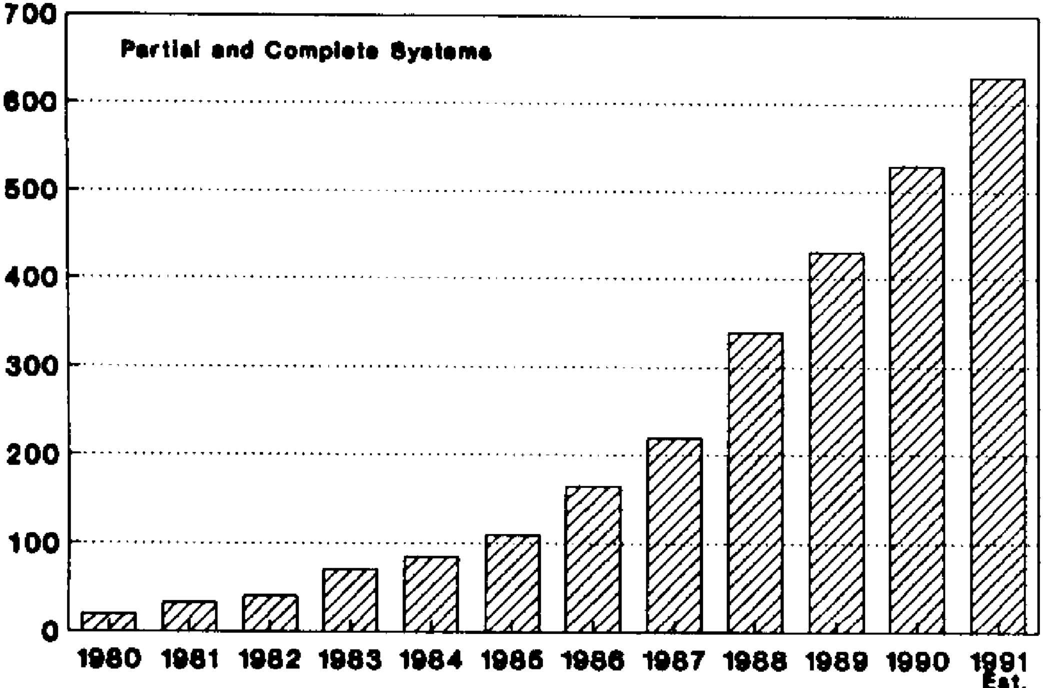
LESS IMPORTANT

11. Friction (probably largely related to surface wax)
12. Elasticity, Modulus and Work-to-Break (related to some of the above mentioned fiber properties).
13. Bulk or Crimp (related to convolutions and other properties)

*Moisture content can be measured (e.g. NIR) and corrected if necessary

FIGURE 1

HVI SYSTEMS WORLDWIDE



Source: Peyer/Motion Control and Zellweger-Uster/Spinlab

FIGURE 2

HVI CLASSING IN THE USA

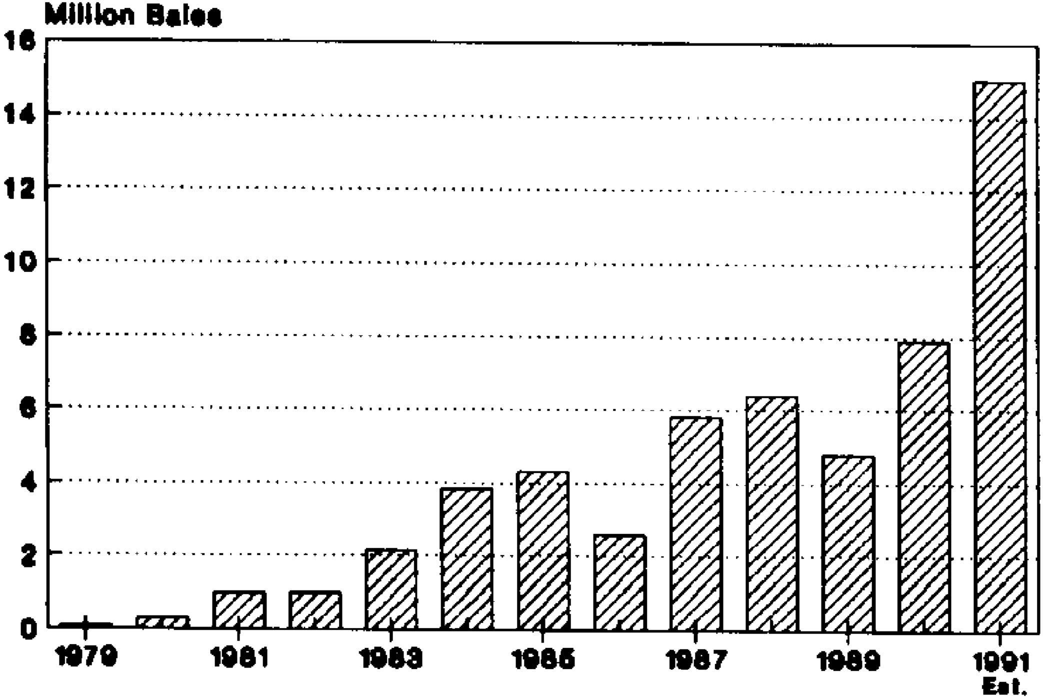


Table III Some Applications of HVI

(I) Classing and marketing, and the use of computer telecommunications in cotton classification and the dissemination of data (electronic data interchange).

(II) Optimum cotton selection for specific end-uses, processing conditions and planned bale lay-downs, (e.g. the EFS program).

(III) Pricing cotton, in terms of its true textile value and quality.

(IV) Cotton growing and breeding, and improved communication between breeders, growers, ginners and processors, although strength sensitivity may not be entirely acceptable for brooding.

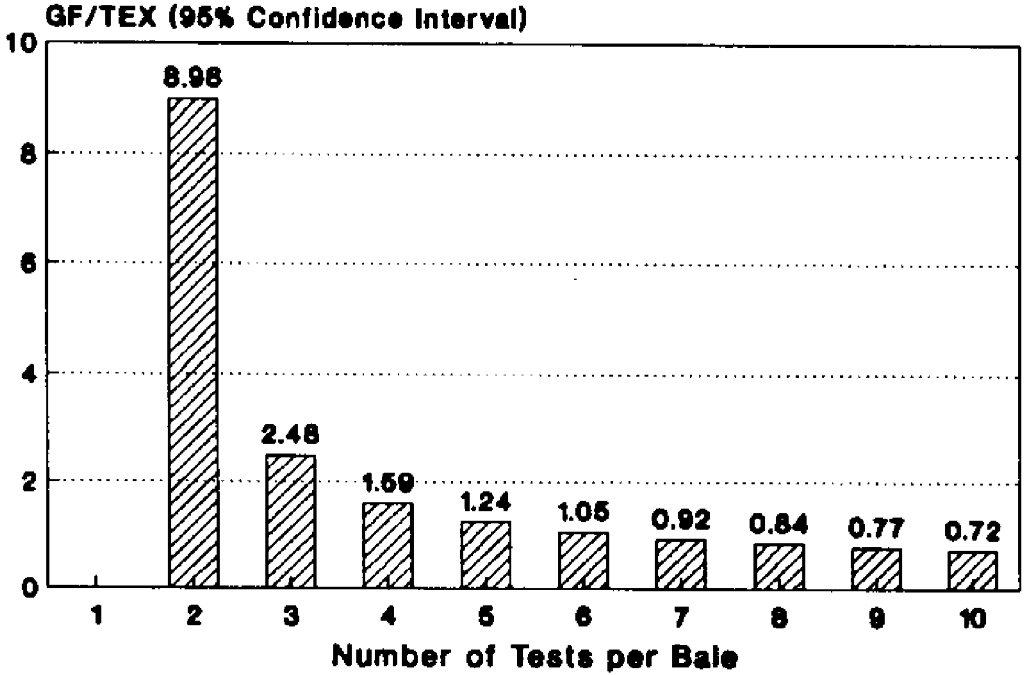
(V) Ginning trials, assessing cleaning efficiency and fiber damage, but better measures of SFC and neppiness are still required.

(VI) Accurate prediction of processing performance and product quality, using empirical mill specific regression equations.

(VII) Computer controlled and aided fiber processing and yarn manufacturing.

FIGURE 3

PRECISION OF HVI STRENGTH AVERAGE



Source: P.E. Sasser, Western Cotton Production Conf., Aug 90

Table IV Average Interlaboratory Variation

(Bremen and USDA Round Trials)

Properties		Average CV's (%)		Average CV's (1990 and 1991) (%)	
		Bremen	USDA	Bremen	USDA
Micronaire	LAB	3.0	3.4	2.8	3.3
	HVI	2.5	2.2	2.2	2.1
Strength	LAB	5.3	6.4	5.5	6.4
	HVI	4.8	4.9	5.6	4.7
Elongation	LAB	9.8	13.1	11.7	11.9
	HVI	13.6	19.5	11.7	18.8
Length[1]	LAB	2.3	3.1	2.4	3.0
	HVI	2.2	5.1	1.7	1.4
Uniformity Ratio	LAB	3.9	4.1		
	HVI	3.6	3.5	4.1	3.7
Uniformity index	LAB				
	HVI	2.5	1.2	2.2	1.1
Color (Rd)	HVI	1.5	1.7	1.3	1.9
Color (+ b)	HVI	4.5	4.8	3.5	5.5
Percentage Maturity	LAB	7.3		9.2	
Maturity Ratio	LAB	8.0		9.7	
Fineness	LAB	8.0		9.4	

[1] 2.5% Span Length or Upper Half Mean Length

Table V Example of Typical Interlaboratory HVI Tolerances

(Based upon international round trials/check tests)

Property	Average	97% Tolerances	95% Tolerances
Length	28mm	±0.5mm	±1mm
Uniformity Index	80%	±1.5%	±3%
Uniformity Ratio	47%	±1.9%	±3.7%
Micronaire	4	±0.1	±0.2
Strength	25gf/tex	±1.3	±2.5 gf/tex
Color (Rd)	75	±1.2	±2.4
Color (+b)	11	±0.5	±1

Effects of Extensive Lint Cleaning on Fiber Quality[1]

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Abstract

Saw-cylinder lint cleaners are used at gins to blend the fibers, extract foreign-matter, and improve the classer's grade designation of the cotton. However, lint cleaners create neps, shorten fiber length, and cause some problems at the mill. This paper reports on the usefulness of cotton when it has been gin processed with up to seven stages of saw-type lint cleaners. In particular the effects of extensive lint cleaning on the fiber's short fiber content, nep count, and foreign-matter level; amount of lint waste materials extracted; and the market value of the bale were determined.

[1]Published in the *Cotton Gin and Oil Mill Press,* July 13,1991, Vol, 92, No. 14, pp 10-13.

Introduction

Lint cleaners are designed specifically for removing leaf particles, motes, grass, and bark that remain in cotton after seed-cotton cleaning and extracting. They were developed and improved in conjunction with the transition from manual to mechanized harvesting of cotton. Virtually all gins in the United States have lint-cleaning facilities, and over four-fifths of the gins have two or more stages of lint cleaning (14). Although flow-through, air-type lint cleaners are used in gins, the controlled-batt saw cleaner is the most common in the ginning industry today.

Lint cleaners are referred to as unit or bulk (battery), depending on whether they process lint from one or from more than one gin stand. The unit cleaner is located behind a gin stand and receives lint only from that stand. A bulk cleaner receives lint from two or more gin stands. Two or more lint cleaners, either unit or bulk, placed in series so that the same lint passes through each of them results in what is variously called tandem or multiple lint cleaning. In many high-capacity gin plants, the bulk cleaners are installed back-to-back with a common lint flue. In that way the lint from all the gin stands is divided ("split stream") and each saw receives only one-half of the cotton. The number of stages of saw cleaning refers to the number of saws over which the fibers pass (9).

The amount of material removed by lint cleaning depends on harvesting practices and grades of cotton being ginned. With multiple stages of saw lint cleaners, the first cleaner removes the most weight.

Typical quantities of waste removed by one, two, and three stages of lint cleaning has ranged from 22, 30, and 36 pounds for spindle-picked cotton, to 31, 41, and 45 pounds for machine-stripped cotton (3, 8, 10).

Perhaps the best index to cotton quality is the performance of the fibers during spinning at the mill. Increasing the number of saw lint cleaners at the gin decreases the manufacturing waste during spinning, but often has the adverse effect of increasing neps in the card web and lowering the yarn strength and appearance. A decline in appearance is greater for the finer carded yarns. From a spinning standpoint, the use of more than two saw lint cleaners in series has been discouraged (6, 8).

Lint cleaning generally improves the grade classification of the lint. As the number of lint cleaners increases, grade tends to increase. However, each succeeding cleaner gives less grade improvement than the preceding one. In addition, lint cleaners blend Light-Spotted cottons so that some of these pass into the White grades and decrease the number of bales which are reduced in grade because of the grass and bark content. But when grades are improved, bale weights are reduced and staple length may decrease; and these opposing factors affect bale value. In some cases the offsetting losses cause the bale value to be reduced by lint cleaning. When price spreads between grades are small, the grower has obtained maximum bale value most often by using one saw lint cleaner on early-season clean cottons and two stages of lint cleaning on late-season, more trashy, or Light-Spotted cottons (3, 7, 10).

Using performance characteristics data on individual machines with simulation models, researchers are predicting cotton quality and monetary returns as cotton is processed through the seed cotton and lint cleaning processes at gins. The models track the cotton moisture content, quality, and turnout as it passes through the cleaning machines; and predict a grade and monetary database (2, 4).

The main objective of the experiments reported here was to determine the degree that three to seven stages of saw-cylinder lint cleaning affect the amount of foreign matter in cotton, the fiber quality, and bale value in comparison with conventional two-stage lint cleaning. A second objective was to determine at what point extreme amounts of saw-type lint cleaning cause an unacceptable amount of fiber damage. Decreasing the foreign-matter content in cotton to very low levels would also reduce its dust content; this could help to reduce the card room dust levels at some spinning mills (5). However, the effects of the multiple lint cleaning on fiber length parameters and nepping potential were of special importance.

Methodology

Seed cotton used in the experiments was grown over a two-year period by the Delta Branch, Mississippi Agricultural and Forestry Experiment Station, Stoneville, Miss., and local growers. Harvesting and Ginning was performed in September and October.

Twenty-four bales of spindle-harvested cotton were processed each of the two years in three replications. Each replication involved a different variety of hairy-leaf cotton. The cotton varieties for the first year were Delta Branch Experiment Station (DES) 56, Stoneville (STV) 825, and Deltapine (DPL) 26; and varieties for the second year were DES 56, STV 825, and STV 506. In each replication, from a unit of eight bales of alike cotton (one variety), one bale received each of eight lint cleaner treatments.

The ginnings were conducted in the commercial-size ginning plant at the U.S. Cotton Ginning Laboratory. The ginning sequence consisted of tower dryer, 6-cylinder cleaner, stick and green-leaf machine, tower dryer, 6-cylinder cleaner, extractor feeder, a 94-saw gin stand, and seven stages of Model "66" saw-cylinder lint cleaning. Special duct and flue arrangements allowed varying the number of lint cleaners from zero to seven. Four manufacturers' lint cleaner models/types were represented among the seven cleaner sequence. The lint cleaners used in the experiments were operated according to the manufacturer's recommendations for commercial cotton-ginning plants.

The lint cleaner treatments tested were: (1) No lint cleaning (2) one saw-cylinder lint cleaner, (3) two lint cleaners, (4) three lint cleaners, (5) four lint cleaners, (6) five lint cleaners, (7) six lint cleaners, and (8) seven stages of saw-cylinder lint cleaning. About fifteen-hundred pounds of seed cotton were used in each test lot. Tower drier temperatures were set to attempt to maintain a 6 to 7 percent fiber moisture content range at ginning and the ginning rate was set at about 4 bales per hour.

For each lint-cleaner combination, samples were obtained for initial seed-cotton moisture and foreign-matter content, lint moisture level during ginning and lint cleaning, lint foreign-matter content, classer's grade and staple length, and fiber testing. The packaged bales and waste were weighed and analyzed. The weights of the packaged bales and collected waste were adjusted to 516 pounds of lint per bale before lint cleaning.

The U.S. Agricultural Marketing Service classed the samples at Greenwood, Miss. and made fiber tests at Clemson, S.C. Fiber tests included micronaire readings, length measurements determined by the Digital Fibrograph and the Suter-Webb fiber array methods, and nep counts. Lint foreign-matter content was determined by the Shirley Analyzer [2] nonlint tests, ASTM Standard Method D 2812 (1). Samples for the nep count

[2] Mention of a trade name, proprietary product or specific equipment does not constitute a guarantee or warranty by the U.S. Department of Agriculture and does not imply approval of a product to the exclusion of others that may be suitable.

analyses were tested with the USDA AMS standard method which measures the number of neps in 100 square inches of web (12). Bale value was calculated from the cotton's grade and staple length, bale net weight, and price per pound. The price per pound was based on both the 1989 U.S. Department of Agriculture Commodity Credit Corporation's (CCC) loan rate for warehouse-stored cotton at selected points, and the average spot market prices during August 1989-June 1990 at the seven locations designated as spot markets. The average price used for Strict Low Middling grade and a staple length of 34 thirty-seconds of an inch was 50.75 cents per pound for the CCC loan rate and 68.89 cents per pound for the spot market base (13).

The study was analyzed as a randomized complete block experiment, blocked on year and variety. Comparisons among the eight lint cleaner treatment means were made at the 5-percent significance level using Waller-Duncan's procedure (11).

Results and Discussion

Control Obtained

The actual ginning rate in the experiment averaged 3.7 bales per hour. This corresponded to about 0.8 bale per hour per foot of lint cleaner saw-cylinder length. Seed cotton was dried and cleaned at the rate of 3.7 bales per hour for all test treatments. Moisture content of seed cotton at the wagon averaged 1 1.4 percent for the 2-year study. After passing through the driers, the level had been reduced to 9.2 percent at the feeder apron.

Foreign-matter content of the seed cotton averaged 6.2 percent at the wagon for the study. Corresponding foreign-matter content at the feeder apron was 2.6 percent. Lint samples taken after ginning but before lint cleaning showed that the average lint moisture content for the 0-7 cleaner treatments ranged from 5.3 to 5.8 percent.

Lint Cleaning Efficiency

The foreign-matter content of the ginned lint, based on total waste as determined by the Shirley Analyzer method, averaged 7.7 percent before lint cleaning (Table I). Foreign-matter content of the baled lint decreased from 3.9 to 2.3 percent as the amount of lint cleaning increased from one to seven stages.

Accumulated lint cleaner efficiency, determined from the lint foreign-matter contents (total waste), increased from 52 to 72 percent as the amount of lint cleaning increased, showing that the greatest degree of cleaning was obtained in the first stage. Cleaning efficiency is defined as the ratio of foreign-matter removed from cotton to the foreign-matter content of cotton as it entered the lint cleaner or combination of lint cleaners, expressed as a percentage.

The total Shirley Analyzer waste is equal to the sum of the visible and invisible wastes (1). Visible waste is foreign matter deposited in the waste boxes of the machine during the test. Invisible waste is weight loss from the sample due to dust, moisture, loose fibers, etc. carried away by the air stream during the test.

The ratio of the amount of visible to total waste in the cotton decreased as the amount of lint cleaning increased. Before lint cleaning about 70 percent of the foreign-matter in the samples was visible waste, and after seven stages of lint cleaning 77 percent of the foreign-matter remaining in the samples was invisible waste. When accumulated lint cleaner efficiency was determined from the visible waste data, the efficiency averaged about 19 percent higher than that obtained using the total waste procedure.

Cotton Classification

Manual classification of samples showed that the color grade designations for the bales were mainly Low Middling with some light spots before lint cleaning (Table 2). One lint cleaner raised the color factor to Strict Low Middling. Further lint cleaning increased the color factor to about Middling with almost no light spots noted.

Leaf grade designations ranged from Good Ordinary to Low Middling before lint cleaning. There was an improvement in the leaf factor as the amount of lint cleaning increased. Leaf factor designations averaged Strict Low Middling after one, two, and three lint cleaners; and averaged Middling in grade after four, five, six, and seven lint cleaning stages.

The classer's composite grade designations ranged from Below Grade to Low Middling White and Low Middling Light Spotted before lint cleaning for the test bales. The Below Grade cotton was reduced from Low Middling Light Spotted grade by the classer because of excessive grass or bark content. Composite grades increased to about Low Middling Plus after one lint cleaner, and to about Strict Low Middling Plus after two lint cleaners. The average composite grade designation of the bales did not improve further when the amount of cleaning was increased from two to seven stages. Although all of the bales were normal in preparation, the classer noted that samples from bales ginned with more than three lint cleaners contained a considerable number of neps. The grade trends supported the lint foreign-matter content results.

Staple length of the bales was about 36 thirty-seconds of an inch before lint cleaning and decreased an average 3 thirty-seconds with lint cleaning (Table 3). The mean staple length of the cotton for the study was 34.4 thirty seconds of an inch after two stages of lint cleaning and 32.8 thirty-seconds of an inch after seven stages of lint cleaners.

Bale Turnout and Values

Lint turnout decreased as the amount of cleaning increased; the decrease was consistent for each lint cleaner stage added (Table 3). Lint turnout at the press, based on initial seed-cotton weight, averaged 35.4 percent before lint cleaning and decreased to 31.4 percent when seven lint cleaners were used. The net bale weights decreased from 516 pounds before lint cleaning to 480 and 459 pounds as a result of using two and seven stages of lint cleaning, respectively.

At 1989 CCC loan prices, two stages of saw-cylinder lint cleaning increased the average bale value about $54 when compared to cotton that did not receive lint cleaning; one lint cleaner increased the value $49 (Table 3). When increasing the amount of lint cleaning from two to four and from two to seven stages, bale values decreased about $11 and $19, respectively, from the two lint cleaner values. The bale-value losses were attributed to the lint cleaners extracting fibers from the bale while not improving its market grade. However, the data showed that even the six and seven lint cleaner treatments produced higher bale values than would have been obtained with no lint cleaning. Similar results were obtained when using the 1989-90 spot market prices. However, the spot market values averaged $88/bale higher than the CCC loan values.

Fiber Tests

Micronaire. Micronaire tests on samples taken from ginned lint showed the readings ranging from 4.6 to 4.8 among the zero to seven lint cleaner treatments (Table 4). There did not appear to be a constant change in these readings with changes in the level of lint cleaning.

Fiber Length Distribution. Both the Digital Fibrograph and Suter-Webb array methods showed that there was a significant decrease in the fiber length with an increase in the amount of saw-type lint cleaning (Tables 4 and 5). The 2.5-percent span length decreased from 1.122 to 1.086 inches when the number of lint cleaners was increased from none to seven stages. Corresponding uniformity ratios of length were 46.3 and 44.1 percent. The decrease in uniformity ratio was significant when more than one lint cleaner was used.

Upper quartile and mean length of the fibers decreased with lint cleaning; mean length decreased significantly when more than two lint cleaners were used. The seven stages of saw-cylinder lint cleaning reduced the average mean length of the fibers from 1.03 inches before lint cleaning to 0.97 inch after cleaning. Coefficient of variation in length for the study increased from 30.8 to 33.2 percent with the lint cleaning. Increasing the amount of lint cleaning from zero to seven stages reduced the percentage of fibers longer than one inch from 62 to 54 percent, increased those ½ to 1 inch from 30 to 36 percent, and increased the percentage of fibers shorter than one-half inch from 8.4 to 11.0 percent. The decrease in percentage of long fibers for two lint cleaners was significant.

Nep Count. The neps per 100 square inches of web (USDA-AMS method) averaged 13.7 before lint cleaning, 21.8 after two lint cleaners, 44.9 after four cleaners, and 63.8 after the seven stages of lint cleaning (Table 4). The number of neps counted after two lint cleaners was significantly higher than that for no lint cleaner, and the further increases after the third, fourth, sixth, and seventh lint cleaners were each significant.

Lint Cleaner Waste. Waste material extracted per bale increased consistently from 29 to 58 pounds as the number of lint cleaning stages increased from one to seven (Table 6). These data are based on 480 pounds of lint packaged with the two lint cleaner sequence.

The percentage of foreign-matter in the waste was less for the cotton that had received the higher degree of lint cleaning. This was significant and confirmed that the lint cleaners remove a greater percentage of lint from the cleaner cottons. The lint cleaner waste contained about 28 percent fibers when only one lint cleaner was used compared to 52 percent fibers for the seven lint cleaner sequence.

Upper quartile length of fibers in the waste materials averaged 1.18 inches compared to 1.24 inches for ginned lint (Table 7). Mean length of fibers in the waste averaged 0.93 inch and the mean coefficient of variation in length was 35 percent. About 48 percent of these fibers were longer than one inch, 39 percent were one-half to one inch long, and 13 percent were shorter than one-half inch. Generally, no significant differences were measured among the seven lint cleaner stages for fiber lengths in the waste materials.

Summary and Conclusions

The main objective of this investigation was to determine the degree that three to seven stages of saw-cylinder lint cleaning affect the amount of foreign-matter in cotton, the fiber's quality, and bale value in comparison with conventional two-stage lint cleaning. The effects of extensive lint cleaning on fiber length parameters and nepping potential were of special importance.

Three hairy-leaf cotton varieties were ginned each of two years in the study with none, one, two, three, four, five, six, and seven stages of saw-cylinder lint cleaning. Cottons ginned in the experiments were tested for foreign-matter content, classer's grade and staple length, nep count, short fiber content, lint-cleaner waste composition, and market value.

The average net bale weight for the study decreased from 480 to 459 pounds as the amount of lint cleaning increased from two to seven stages. Fibers in the lint cleaner waste averaged 1.18 inches in upper quartile length, and 48 percent were longer than one inch.

Foreign-matter content of the ginned lint averaged 3.3, 2.9, and 2.3 percent for the two, four, and seven lint cleaner setups. Two lint cleaners produced an average composite grade of Strict Low Middling Plus, but further lint cleaning did not improve the composite grade.

Staple length was reduced three thirty-seconds of an inch by the seven stages of cleaning. Mean length of the fibers was reduced from 1.03 to 0.97 inch and the percentage of fibers shorter than one-half inch increased from 8.4 to 11.0 percent when the amount of lint cleaning was increased from none to seven stages.

Neppiness in the cotton increased consistently with each stage of lint cleaning. The neps per 100 square inches of web averaged 22 after two lint cleaners and 64 after the seven stages of cleaning. Neps were also noted by the classer in samples ginned with more than three lint cleaners.

Two stages of saw-cylinder lint cleaning produced the highest market value for the bale. There was a consistent decrease in the bale value with each added lint cleaner.

At 1989-90 spot market prices the total decrease averaged $22 per bale when seven lint cleaners were used.

Thus, the experiments showed that the extensive lint cleaning did not destroy the quality and market value of the cotton. However, the use of more than two or three saw-type lint cleaners to reduce foreign-matter contents would also reduce the market value of the bale to the grower, and cause some quality decrements which would be reflected in poor manufacturing performances at the textile mill.

Table 1 Foreign-matter Content In Ginned Lint Samples and Lint-cleaner Efficiency for Extensive Lint Cleaning Experiments[1]

Number of lint cleaners	Foreign matter content, %	Unit cleaner efficiency by position, %	Ratio of visible to total waste, %	Cumulative cleaning efficiency %	
				Visible waste basis	Total waste basis
0	7.7a		70a		
1	3.9b	51.5a	47b	66.9a	51.5a
2	3.3c	13.9b	38c	78.2b	57.2ab
3	3.0cd	10.7bc	35cd	81.4bc	60.4bc
4	2.9de	1.6c	31de	84.8cd	66.1 cd
5	2.7de	6.4bc	28ef	87.4de	68.2d
6	2.5ef	7.0bc	26ef	89.3e	69.9d
7	2.3f	7.4bc	23f	90.9e	71.9d

Table 2 Cotton Classer's Grade Designation Data for Extensive Lint Cleaning Experiments[1]

Number of lint cleaners	Color grade		Leaf grade		Composite grade	
	Index	Designation	Index	Designation	Index	Designation
0	84a	LM	77a	SGO	71a	GO
1	96b	SLM	92b	SLM	92b	LM+
2	98c	M	96c	SLM	96bc	SLM+
3	99c	M	97cd	SLM	97c	SLM+
4	99c	M	98cde	M	96bc	SLM+
5	98bc	M	100d	M	97c	SLM+
6	99c	M	100de	M	97c	SLM+
7	99c	M	101e	M	98c	SLM+

Table 3 Cotton Classer's Staple Length and Bale Turnout and Value Data for Extensive Lint Cleaning Experiments[1]

Number of lint cleaners	Staple length, 1/32 in.	Bale turnout		Bale value, dol[2]	
		Bale net weight, lb	Lint turnout, %	CCC loan	Spot market
0	35.6a	516a	35.4a	194.76d	300.20d
1	35.2a	487b	33.6b	243.66abc	332.18ab
2	34.4b	480c	33.5b	248.86a	335.11a
3	33.8c	478c	32.8bc	247.83ab	334.00ab
4	33.2de	474d	32.4bcd	238.27abc	323.96abc
5	33.4cd	4689	32.3bcd	236.29abc	320.43abc
6	33.1de	464f	32.0cd	234.59bc	318.43bc
7	32.8e	459g	31.4d	230.34c	313.31cd

[2]Bale values are based on 1989 CCC loan prices and average spot market prices from August 1989 to June 1990.

Table 4 Micronaire, Digital Fibrograph, and Nep Count Data for Ginned Lint Samples Tested in Extensive Lint Cleaning Experiments[1]

Number of lint cleaners	Micronaire reading	Digital Fibrograph		Neps per I 00 sq. in. of web, no.
		2.5% span length, in.	Uniformity ratio of length, %	
0	4.8a	1.122a	46.3a	13.7a
1	4.7ab	1.099ab	45.8a	18.3ab
2	4.6b	1.087b	44.9b	21.8b
3	4.6b	1.094ab	44.6bc	31.2c
4	4.6b	1.082b	44.0c	44.gd
5	4.6b	1.077b	44.2bc	49.2d
6	4.7ab	1.086b	44.1c	55.0e
7	4.7ab	1.086b	44.1c	63.8f

Table 5 Suter-webb Fiber Length Distribution In Ginned Lint Samples for Extensive Lint Cleaning Experiments[1]

Number of lint cleaners	Upper quartile length, in.	Mean length in.	Coefficient of variation in length, %	Fibers longerthan 1 in., %	Fibers 1/2 to 1 inch long., %	Fibers shorter than inch, %
0	1.27a	1.03a	30.8a	62.1a	29.7a	8.4a
1	1.24abc	1.01abc	30.8a	59.6a	31.7ab	8.8a
2	1.26ab	1.01abc	31.8ab	59.6a	30.8a	9.5abc
3	1.22c	0.97d	33.2b	54.2b	34.8bc	11.0c
4	1.23bc	0.98cd	32.8ab	54.2b	35.7c	10.1abc
5	1.24abc	0.99bcd	32.7ab	54.7b	35.1 bc	10.1abc
6	1.22c	0.97d	33.0b	53.7b	36.2c	10.1abc
7	1.23bc	0.97d	33.2b	53.7b	35.5bc	10.8bc

Table 6 Weight of Waste Material Extracted Per Bale and Its Foreign-matter Content for Extensive Lint Cleaning Experiments[1]

Number of lint cleaners	Lint cleaner waste, lb/bale	Foreign matter content of waste, %
1	29a	72.0a
2	36b	66.1b
3	38b	63.8bc
4	43c	61.gc
5	48d	57.5d
6	53e	53.5e
7	58f	47.5f

Table 7 Suter-webb Fiber Length Distribution in Lint-cleaner Waste Material Extracted in Extensive Lint Cleaning Experiments [1]

Number of lint cleaners	Upper quartile length, in.	Mean length, in.	Coefficient of variation in length, %	Fibers longer than 1 inch, %	Fibers 1/2 to 1 inch long, %	Fibers shorter than inch, %
1	1.14a	.92ab	35.5a	47.4a	38.5ab	14.1a
2	1.17a	.96a	34.3a	52.2a	35.2b	12.5a
3	1.19a	.95ab	33.3a	50.8a	38.2ab	11.0a
4	1.20a	.94ab	34.7a	49.4a	38.2ab	12.3a
5	1.19a	.92ab	36.7a	46.1 a	39.9ab	14.0a
6	1.18a	.92ab	36.2a	45.7a	40.4a	13.8a
7	1.17a	.91b	36.5a	45.7a	39.5ab	14.7a

[1] Each figure is the average of three cotton tested each of two years. Data in the col - umns followed by different letters are significantly different at the 5% level of probabili ty.

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Biotechnology: News and Views

Insect Immune System

A compound has been identified at the University Of Nebraska, USA which can block the insect immune system. According to Dr. David Stanley Samuelson, Head of the insect Biochemistry/Physiology Laboratory of the University, his work, if successful, could eliminate the use of pesticides in agriculture. He claims that even the most harmless natural bacteria can theoretically become a deadly killer of insects. The substance he discovered, blocks the production of certain hormones called "EIcosanoids" which are responsible for the activation of the insect's immune system. Ultimately this severely compromises the insect's ability to fight off bacterial infection, as the most beneficial natural bacteria may be able to invade and kill the insect. The initial research work conducted so far shows that it may eventually lead to an engineered bacteria that has this blocking substance and kills the host insect. Commercialization of the product in a spray for agricultural crops may take years. (Source: *AgBiotechnology News,* May/June 1991.)

European Biotech Partnership Conference

The small biotech companies in Europe are organizing a 3 day conference from 16-18th October, 1991 at the Hague, Netherlands. The objective is to present their techniques and products to bigger companies. Thus the event is called the European Biotech Partnership Conference. It is sponsored by the Netherlands industrial and Agricultural Biotechnology Association and several other biotech associations in Europe. (Source: *AgBiotechnology News,* May/June, 1991.)

Biotech Business in China

Foreign companies and enterprises are now permitted to enter into joint ventures or work as wholly-owned enterprises in China, preferably in high technology such as biotechnology. At present no foreign company is involved in biotechnology of agriculture in China, although some companies are involved in pharmaceutical businesses.

The Chinese Government attaches high priority to the application of biotechnology in agriculture in the country. The State Science and Technology Committee every year publishes a report titled, "National Policy for

Biotechnology," which examines the current status of biotechnology in the country and recommends specific strategies for large-scale benefits. Although Chinese scientists have made ample strides in agricultural biotechnology, the government is very eager to commercialize the technology and reap benefits as early as possible. The priority areas identified are breeding for high yield, quality, resistance to insects pests and various types of stresses, rapid propagation of plants, growth regulators and some other fields related to animal, poultry and fish. (Source: Ag*Biotechnology News,* January/February 1991.)

Field Testing of Genetically Engineered Plants

Genetic engineering is one of the future hopes to increase productivity, evade pest attacks, protect the environment and decrease the cost of production. In cotton, genetically engineered material has reached the stage of extensive field testing. So far 24 companies and 12 research institutions in the USA have received permits from the Animal and Plant Health Inspection Service, United States Department of Agriculture, for field testing of their synthesized material. Since the commercial adoption of engineered plants has economic incentives, more and more private companies are becoming involved but not many in cotton. In cotton only three companies have received permits during 1991-92 to undertake field testing of herbicide-tolerant and Bt gene material. Calgene Inc. has permission to test cotton genotypes tolerant to the herbicide "bromoxynil" for the 3rd year. DuPont Company continues to evaluate the performance of "sulfonylurea" for the 3rd year. Monsanto Company is in the field again to finalize results on the Bt gene. The permits issued by the Animal and Plant Health Inspection Service of the USDA, which are valid for one year, are restricted to field testing and do not allow the marketing of the product.

USSR AgBiotech Institute

The USSR’s institute of Agricultural Biotechnology, Building No. 4, Pskovskaya 12, Moscow 127253, is looking for joint ventures in various fields of agriculture. The main areas of interest are bulk seed production of F1 generation through the use of male gametocides, plant growth regulators, virus-free seed in vegetables and cow insemination technology. (Source: *AgBiotechnology News,* November/December 1991.)

Use of Biotechnology in Commercial Cotton Hybrids

The development of commercial cotton hybrids, like many other self-pollinated crops, has a number of limitations. Genetic Male Sterility still has better prospects for commercial adoption than the Cytoplasmic Male Sterility system. However, one of the constraints of Genetic Male Sterility has been the identification of fertile plants at an early stage and their elimination before they share the inputs with sterile plants. With the development of herbicide-specific genotypes in cotton, through the use of biotechnology, it seems quite feasible that herbicides can target only the fertile plants, destroying them at an early stage, even before thinning, thus leaving the field with only sterile plants for pollination with identified male parent.

Secondly, in the case of identified combiners, only the seed developed on the female parent can be used as hybrid seed. The self-seed of the pollen parents has to be discarded, except for a small quantity required to continue the male parent. One approach could be to develop self-incompatible lines which could be maintained with pollination from their regular B lines. The self incompatible lines would behave as self-sterile but fertile for outcrossing. The reciprocal cross combination seed can be harvested from both the complementing parental lines(identified combiners). It is anticipated that biotechnologists somewhere in the world may already be working along these lines.

Review Article " Biotechnology of Cotton"

The third article in the series of ICAC review articles on "Biotechnology of Cotton," published by ICAC and CAB International is at final stage of publication. The publication will be mailed to the member governments at the end of this year.

AgBiotechnology Outlook: 1991-92

There are different views about the impact and prospects of genetically engineered plants and animals on the environment. Governments are framing regulations and a number of countries have set rules to test the synthesized material. *AgBiotechnology,* a bimonthly publication on agricultural research/business conducted a survey to see how people feel about the impact and future of biotechnology in agriculture and business. The survey covered new product projections, university AgBiotechnology activities, assessment of government regulations, pros and cons of AgBiotech patents, venture financing and the future of agricultural biotechnology. Sixteen private companies, 19 universities, 15 service organizations, 8 associations and 3 venture capitalists responded. Some of the universities and companies responding were from countries other than the USA. The results have been compiled in the form of a publication, *AgBiotechnology Outlook: 1991-92,* which is available from Freiberg Publishing Company, P.O.Box 7, Cedar Falls, IA 50613 USA.