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PRESENTATION + PAPER

Session: **Cotton – a Wider View (C3)**

Title: **A Technical & Financial Comparison of Machine and Hand Harvested Cottons in the Manufacture of Knitted Garments**

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A Technical & Financial Comparison of Machine and Hand Harvested Cottons in the Manufacture of Knitted Garments

Roger Gilmartin, Special Advisor, CCI

International *Cotton Conference*
Bremen, 17–18 March, 2021

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Introduction

- Cotton Council International (CCI), the export promotion arm of the National Cotton Council of America (NCC), is a non-profit trade association that promotes U.S. cotton fibre and manufactured cotton products around the globe with the COTTON USA Trademark.
- Every year we commission research projects to investigate aspects of US cotton that our customers have raised with us during our mill visits or during the various promotional events that we hold in our main markets.
- We always have these projects undertaken by reputable, independent, third party, textile industry consultants.

Introduction

- We often hear complaints from our customers about the high content of Neps that they find in their deliveries of US Upland cotton.
- Last year, one of the projects we commissioned was to look in more detail at the technical impact that Neps, both biological and mechanical, have in the manufacture of both carded and combed yarns and their transformation into dyed, knitted garments.

Mecha-nical neps

Seed coat neps

Introduction

- Previous independent research projects had demonstrated the technical and financial advantages of using US Upland cotton in the manufacture of high quality knitted garments.
- In last year's study we wanted to take that earlier work and go deeper into the impact that neps have on yarn and fabric quality and indirectly highlight the impact of neps created due to harvesting systems (machine versus manual picking) and ginning methods (Roller and saw ginning).
- The consultants compared cotton from four different origins in their study, **US, Sankar 6 from India, Brazil and West African PLEBE.**

Introduction

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Indian and West African cottons

West African, Brazilian and US cottons

Normally saw-ginned

Project conducted in India

Brazil and US cottons

Indian cottons

Less aggressively roller-ginned – fewer Neps than saw-ginned.

Introduction

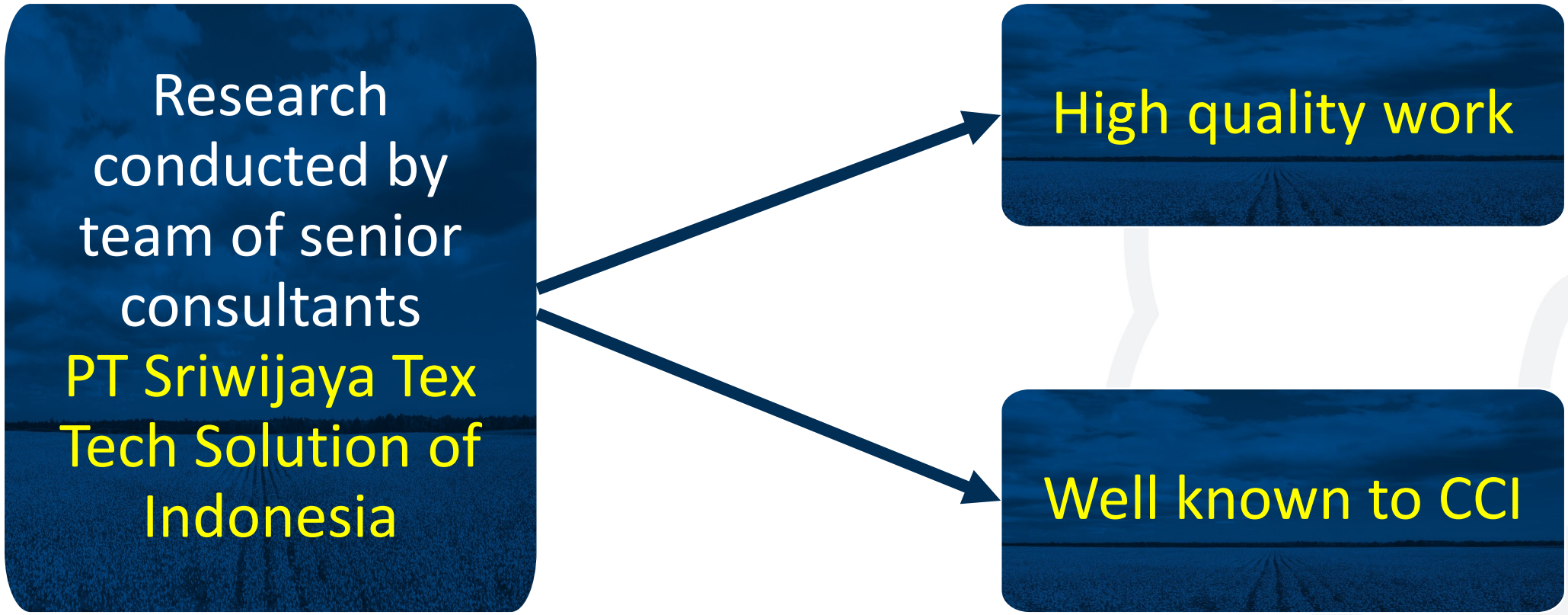
- Yarn manufacturing took place at a large, well-established mill producing high quality carded and combed, compact spun ring yarns.

Carding machine

Combing machine

- The processes from knitting to garment manufacturing were monitored at one of the yarn mill's customers producing high quality knitted garments.
- Both companies were considered leaders in their fields.

Methodology



Methodology

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Technical data in report personally collected by consultants who had **monitored and supervised** all stages of manufacturing process.

Consultant's report contained detailed technical results of the performance of four cottons compared at every process – **blowroom to garment manufacture**.

Technical results then **quantified financially** based on true costs of the partner mills where research conducted.

Yarn Manufacturing

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- The cottons compared in the study were those used in regular production by the spinning partner, to spin **carded and combed knitting yarns of count Ne 30/1,** with the exception of the Brazilian fibre that was purchased especially by the partner for the trial.

- As expected, the Neps per gram and the SFC were higher in the three saw-ginned cottons (US/Brazil/W Africa) than the hand-harvested, roller-ginned Indian Sankar 6.
- In the blow-room and carding, the testing results showed that with the appropriate machine settings, all the Neps in the saw-ginned cottons were easily removed.

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Description	IPI Value	Origin
Ne 30/1 CARDED yarn	143	US
	194	W Africa
	288	Brazil
	539	Sankar 6

Description	IPI Value	Origin
Ne 30/1 COMBED yarn	14	US
	21	W Africa
	16	Brazil
	19	Sankar 6

Waste lost in blow-room and carding	11.38%	US
	12.42%	W Africa
	15.48%	Brazil
	12.24%	Sankar 6

Consultants observed that Brazilian cotton contained a high volume of trash and bark

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	US	W Africa (PLEBE)	Brazil	Sankar 6 (Indian)
TRASH CONTENT	3.12%	2.82%	5.00%	3.38%
OVERALL CLEANING EFFICIENCY in the blow-room and carding ranged from **93.25% with US cotton** to a **low of 82.4% with Brazilian cotton.**				
NEP REMOVAL EFFICIENCY	85.98%	80.43%	77.63%	69.13%
SCN (Seed Coat Neps) REDUCTION in carding was also superior with all the saw-ginned fibres:				
	90.77%	75.41%	86.44%	64.42%

Yarn Manufacturing

	US	W Africa (PLEBE)	Brazil	Sankar 6 (Indian)
With the same machine settings in **COMBING**, there was a significant difference in the **NOIL PERCENTAGES** extracted from the four fibres:				
	13.90%	15.87%	**18.13%**	16.87%
SFCn REDUCTION achieved during combing	55.80%	54.40%	51.20%	47.90%

Even though the volume of mechanical Neps is higher in saw-ginned cottons, they are easily removed in carding and combing and result in higher yarn quality as the following yarn test results show.

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- **With the Ne 30/1 carded yarns, the IPI results achieved with US cotton were remarkable considering that in the blow-room the US fibre had the highest Nep Count/g (324.13) of the four cotton sources tested.**

Cotton Cops - Neps +140%/km	
US	626
W Africa PLEBE	713
Brazil	1141
Indian Sankar 6	1642

Total IPI Normal/km Results	
US	143
W Africa PLEBE	194
Brazil	288
Indian Sankar 6	539

- **The total IPI normal/km results for the four cottons confirmed the superiority of the US cotton.**
- **The US cops had a total IPI normal of 143 compared to the 539 for the hand-harvested, gentler ginned Sankar 6.**

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- **For many of the critical yarn quality parameters, the US yarn test results were below the 5% curve on the 2018 Uster statistics for Ne 30/1 carded yarns.**
- **The Sankar 6 30/1 carded yarns were the equivalent of only 63% on the Uster curves.**
- With the same count (Ne30/) combed yarns, for many of the tested parameters there was no significant difference in the results for the Indian, West African and Brazilian yarns.
- **The US combed yarn had the lowest Total IPI normal result of the other fibres:**

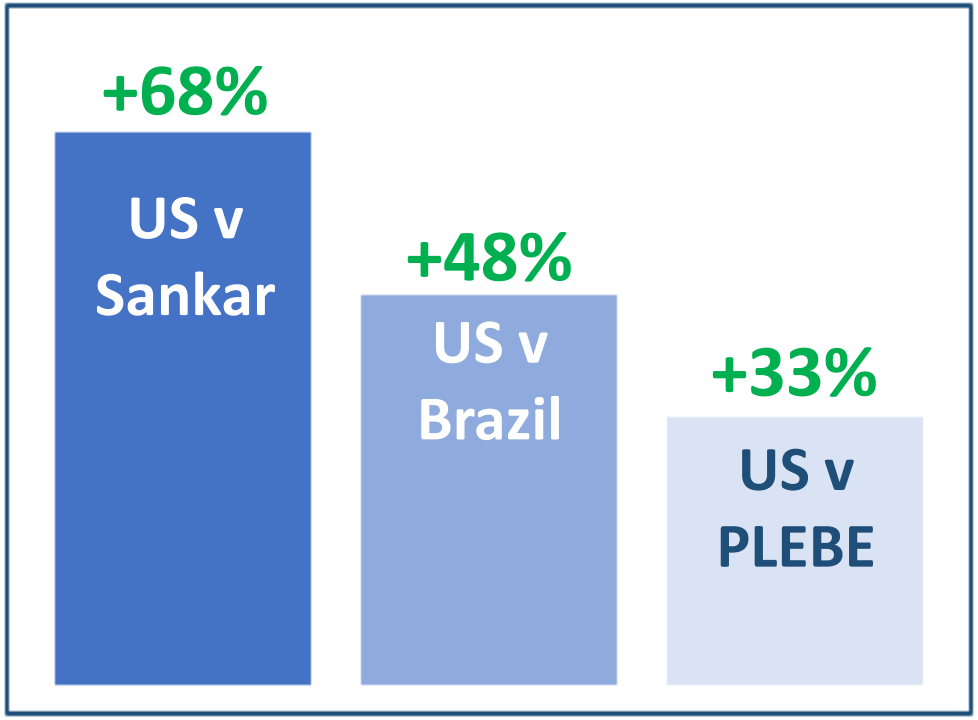
US	**14**
BRAZIL	**16**
SANKAR 6	**19**
PLEBE	**21**

- Once again, for many of the key parameters, the yarn test results for the **US combed cops** placed them **below the 5% curve** on the **Uster** statistics compared to **approximately 20%** for the other three cottons.

Yarn Manufacturing

- **In Winding, the clearer cuts per 100 kms in all categories were lower with the US cotton than any of the other fibres.**
- With the **Ne 30/1 combed yarns**, there was **very little difference** in the cuts per 100km results **between all four cottons**.
- **In the Classimat tests, on both the carded and combed yarns, the US yarns performed significantly better than the competitors, especially on the carded yarns (see picture).**
- In the ring-frames, the consultants monitored the performance of all four cottons in terms of end breaks per 1000 spindle hours and Pneumafil waste percentages.

Classimat Tests
Carded Yarn Results
US v. Competitors



Yarn Manufacturing

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	US	W Africa (PLEBE)	Brazil	Sankar 6 (Indian)
CARDED YARNS - end breaks per 1000 spindle hours	20.2	38.3	29.9	37.0
Pneumafil waste recorded	0.15%	0.30%	0.25%	0.30%
COMBED YARNS - end breaks per 1000 spindle hours	32.0	42.5	49.9	54.0
Pneumafil waste recorded	0.15%	0.35%	0.35%	0.40%

Yarn Manufacturing

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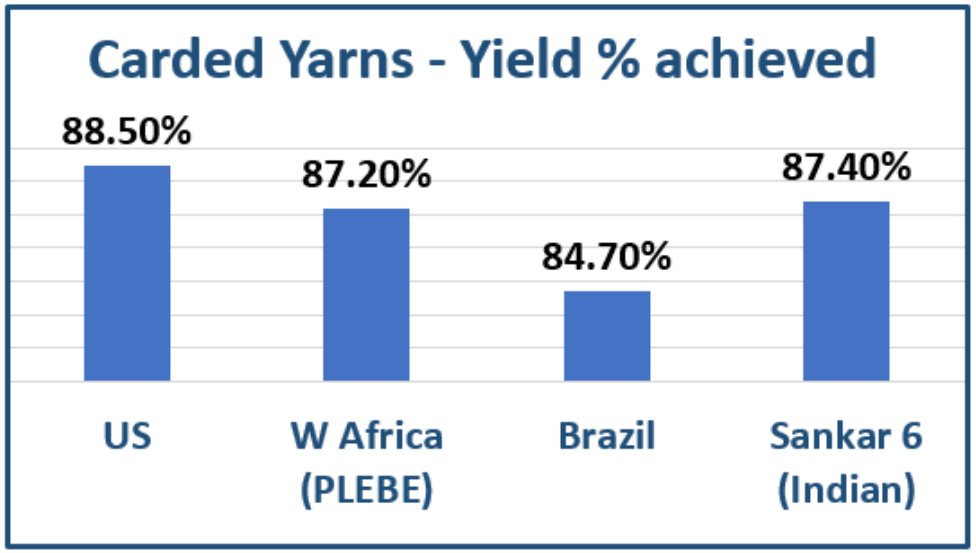
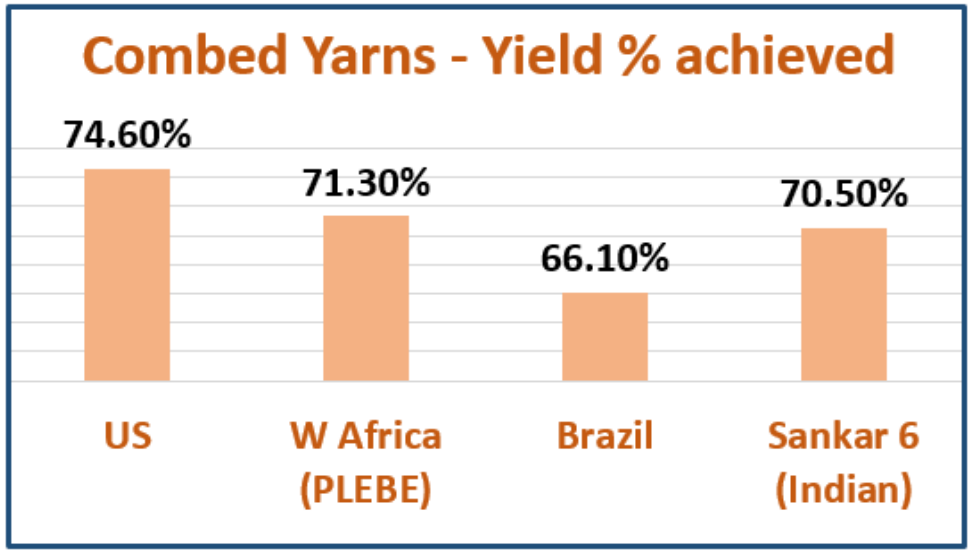
- Finally, the results of the **waste losses** recorded by the consultants for both yarn types, carded and combed **from bale to cop** were:





- **The report confirmed that in almost every aspect of yarn manufacturing, the machine harvested, saw-ginned cotton out-performed the hand harvested, roller ginned fibre.**

Knitting

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- The single jersey fabrics chosen for the project were knitted on a circular weft knitting machine with the following specifications:
  - Diameter 32 inches
  - Gauge 28
  - Total Needles 2808
  - Number of Feeders 102
- For the trials:
  - The Fabric Width was 30 inches
  - The Loop Length was 27.5 cm
  - The machine speed was 39 rpm.

Knitting

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- The consultants monitored the performance of the machine used for the knitting trials in terms of **machine stops per roll** of fabric produced, **translated into stops per 100 kgs of yarn knitted** for each of the four fibres.

Stops per 100 kgs during knitting	US	W Africa (PLEBE)	Brazil	Sankar 6 (Indian)
Ne 30's Carded yarn	4.5	9.4	19.3	10.8
Combed yarns	2.0	3.3	13.5	6.8

Knitting

- The consultants commented that **the majority of stops were caused** by **yarn breaking on the cones** or by “fluff” (**fibre loss**) **building up** in the slub catchers on the machines.
- They observed that the **fibre loss with the US cotton was significantly less** than the other three cottons although, with the exception of the Brazilian yarn, fibre loss in all the cottons during knitting was minimal, probably due to the yarns being **Compact** spun.
- They commented that the majority of the **Brazilian stops** were **caused by trash** still present in the yarns.
- The knitted, undyed fabric was inspected using the standard 4-point system based on frequency and size (diameter & length) of the defect.

Knitting

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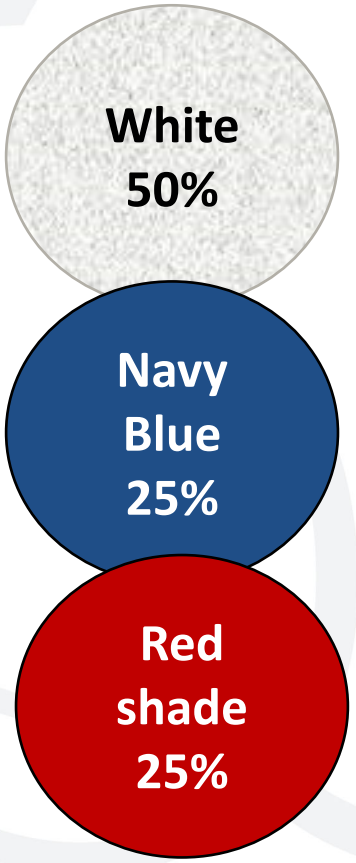
Greige Inspection Results	US	W Africa (PLEBE)	Brazil	Sankar 6 (Indian)
CARDED YARNS - points per 100 square yards fabric knitted	2.4	4.6	4.5	4.9
Translated into points per 100 kg of yarn knitted	16.9	31.2	32.6	31.9
COMBED YARNS - points per 100 square yards fabric knitted	1.3	1.7	5.2	2.6
Translated into points per 100 kg of yarn knitted	9.7	11.7	36.6	18.2

Dyeing & Finishing

- The consultants **dyed 50% of the fabric knitted into** a **White** colour, **25%** into **Navy Blue** and the remaining **25%** into a **Red** shade.
- The partner mill had installed Then Air Flow technology machines from Fongs.
- The fabrics were stentered, using the partner's standard settings for the fabric, on a Brückner machine.
- The dyed fabrics in all colours were examined using the partner's 4-point inspection system.
- The fabrics were also tested for Shrinkage, Spirality, Colour Fastness and the Delta-Values for each dye recipe.



Dyeing & Finishing

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- The Partner's 4-Point system graded any fabric with a points value of greater than 28 points per 100 square yards inspected as a REJECT.
- None of the fabric processed from any of the four fibre sources failed the inspection process in any colour. The results were:

30's Carded Red Fabric Results – Points per 100 sq yds							
US	1.92	Sankar 6	4.7	Brazil	5.3	PLEBE	16.65
30's Carded Navy Blue Fabric Results – Points per 100 sq yds							
US	0	Sankar 6	12.9	Brazil	5.8	PLEBE	11.3

- Both the consultants and the Partner's inspection teams commented on the low presence of Neps and "white spots" in the finished fabrics.

Dyeing & Finishing

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The consultants took 25 square centimetre samples from each fabric and physically counted the Neps and the White Spots in each sample. The results were:

	US	W Africa (PLEBE)	Brazil	Sankar 6 (Indian)
WHITE Samples	3 Neps/0 Spots	6 Neps/0 Spots	4 Neps/0 Spots	5 Neps/0 Spots
RED Samples	3 Neps/0 Spots	24 Neps/0 Spots	5 Neps/0 Spots	20 Neps/1 Spot
NAVY BLUE Samples*	2 Neps/1 Spot	4 Neps/2 Spots	5 Neps/1 Spot	10 Neps/2 Spots

** Technically the most difficult of the three colours to dye and finish*

- **AS IN YARN MANUFACTURING, THE D&F RESULTS SHOWED THAT IN TERMS OF BOTH FABRIC QUALITY AND THE IMPACT OF NEPS, THE FABRICS KNITTED WITH MACHINE PICKED, SAW-GINNED COTTONS, OUTPERFORMED THE HAND-HARVESTED, ROLLER-GINNED INDIAN FIBRE.**

Dyeing & Finishing

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- ✓ All four fibres met the Partner's 5% Spirality and Shrinkage standards.
- ✓✓✓ The US cotton produced the best results in both these tests.
- ✓ The "Whiteness Index" results for all four fibres were good.
- There was no significant difference in the testing results for Colour Fastness and the Delta-E values between any of the four fibres being tested.

Garment Manufacturing

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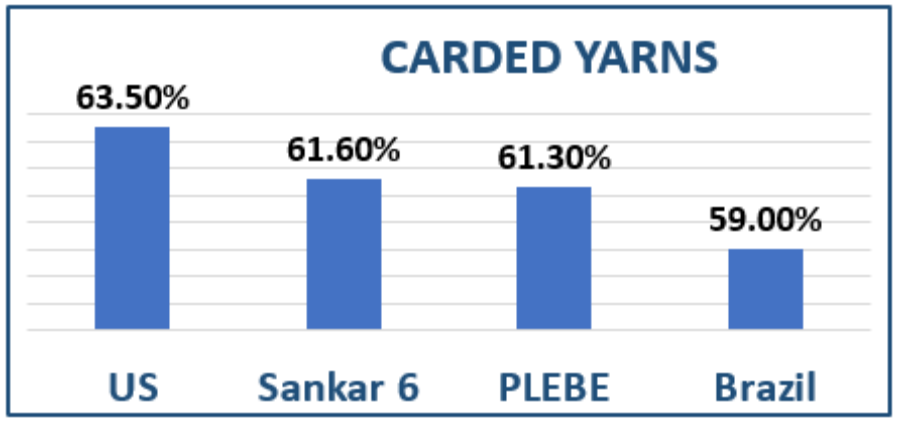
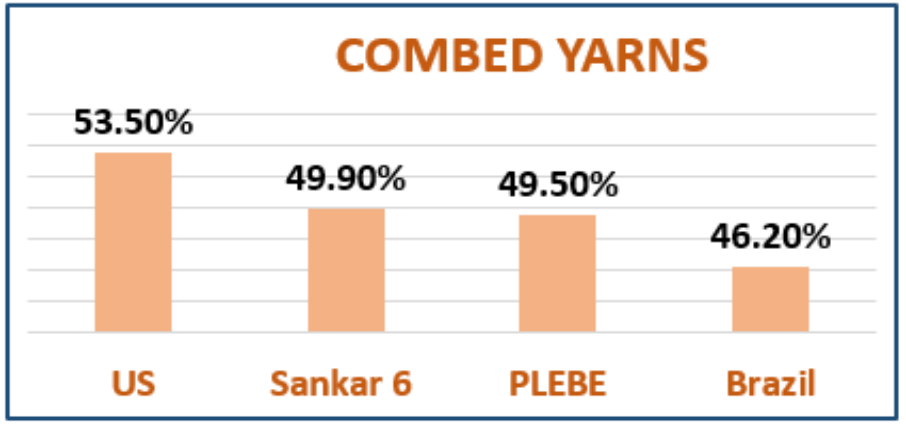
- The consultants manufactured T-shirts produced with the carded and combed yarns spun from each fibre source in White, Navy Blue and Red.
- For the partner mill, an important measure of performance is **“Yarn to Garment Realization” percentage.**
- This is calculated by monitoring and measuring fibre loss from bale to garment.

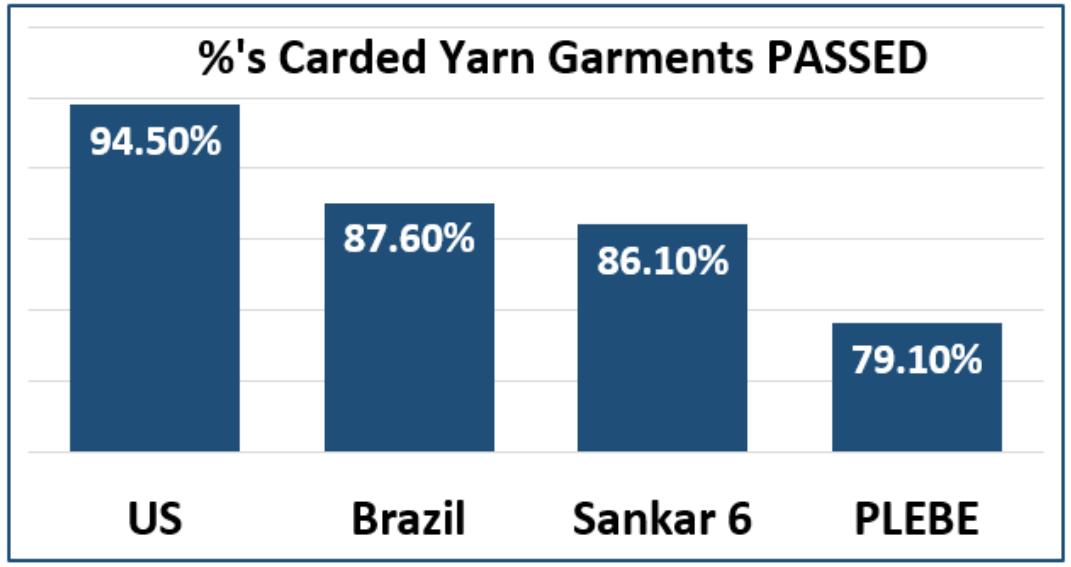
“Yarn to Garment Realization” Percentage

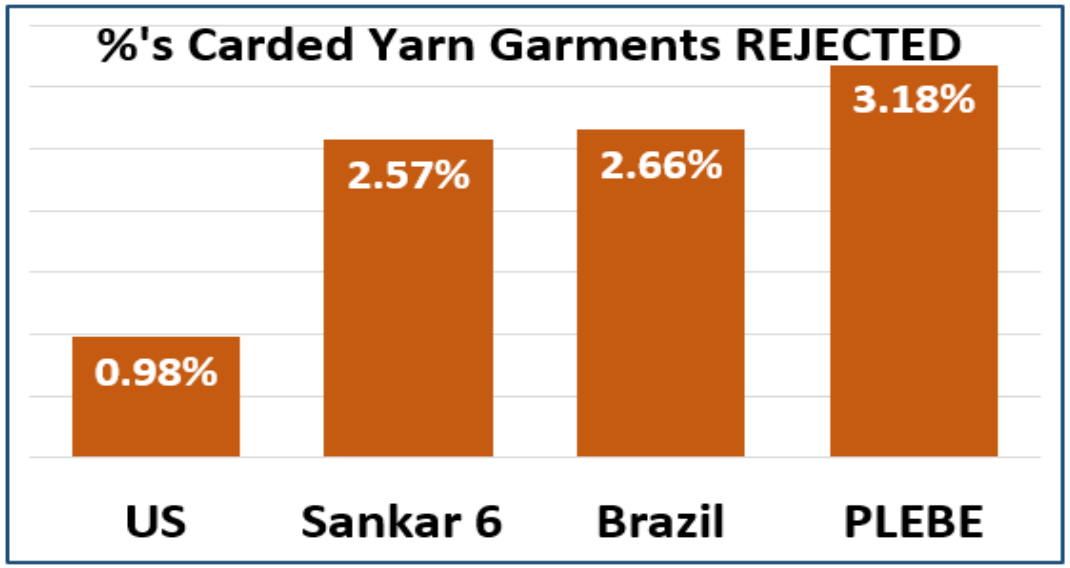




Garment Manufacturing

- The consultants commented that poor Brazilian results with both carded and combed yarns was due mainly to the fibre losses during yarn manufacturing and knitting.
- After their completion, all the garments produced during the trial were inspected to the partner's normal quality standards. The partner had **three grades of inspection, Pass, B Grade and Rejection.**





Garment Manufacturing

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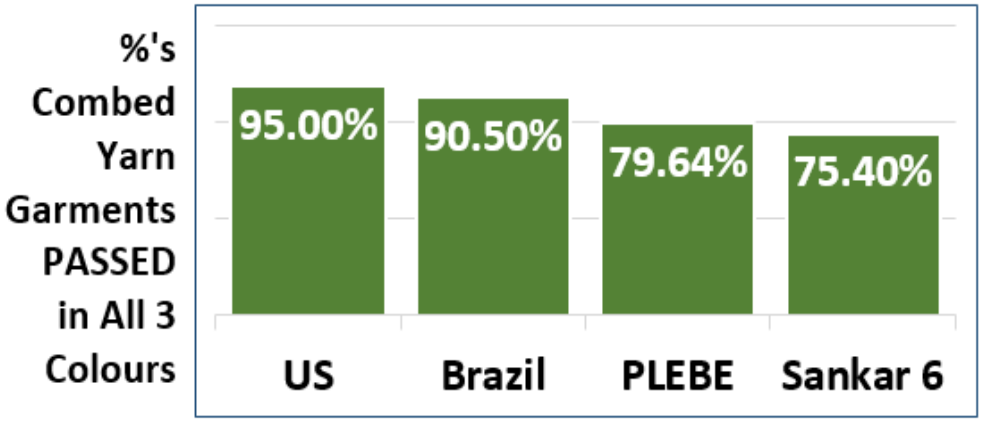
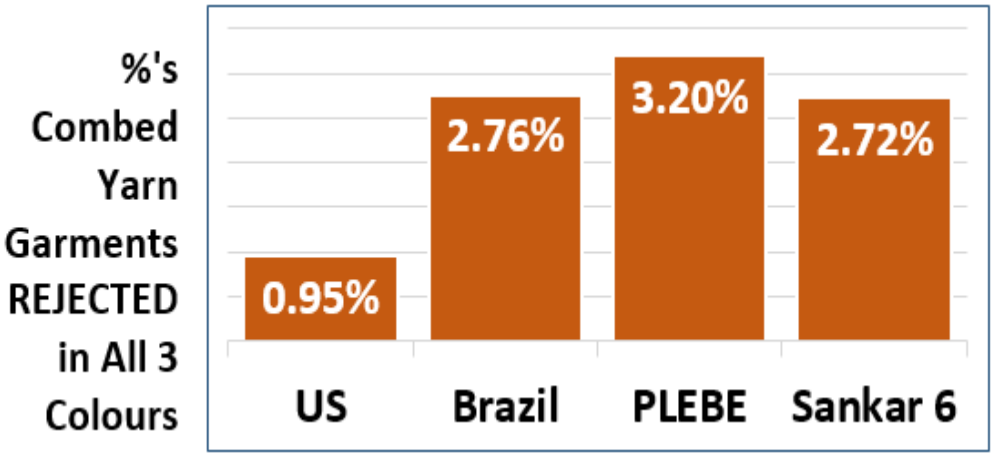
- For **Combed** yarns, **the percentage of garments** that achieved a **Pass** level in **all 3 colours** were:





- **The consultants commented that the hand-harvested cottons, PLEBE and Sankar 6, contained very high levels of contamination in both carded and combed garments.**
- The **second** most frequent **cause of a B grade** rating was **thick and thin** yarns.
- **No garments in any of the four cottons were rejected or graded B for NEPS.**

Financial Comparison

- For the four cottons compared in this study, the yarn manufacturing partner paid the following prices per pound in US dollars.
- Using the cost data of the two project partners, the consultants calculated the **profit per garment** generated by each of the four compared cottons.

Financial Comparison

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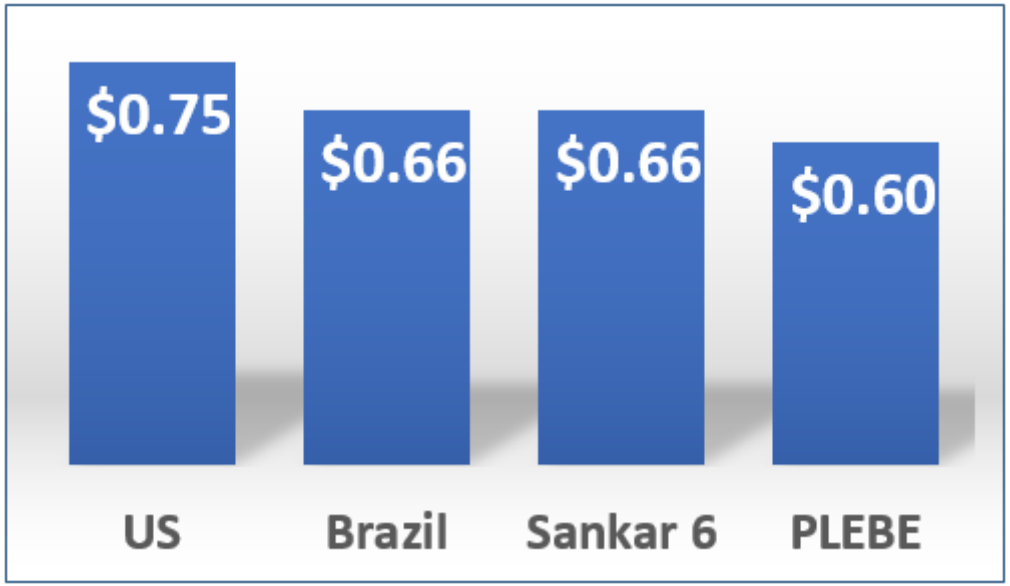
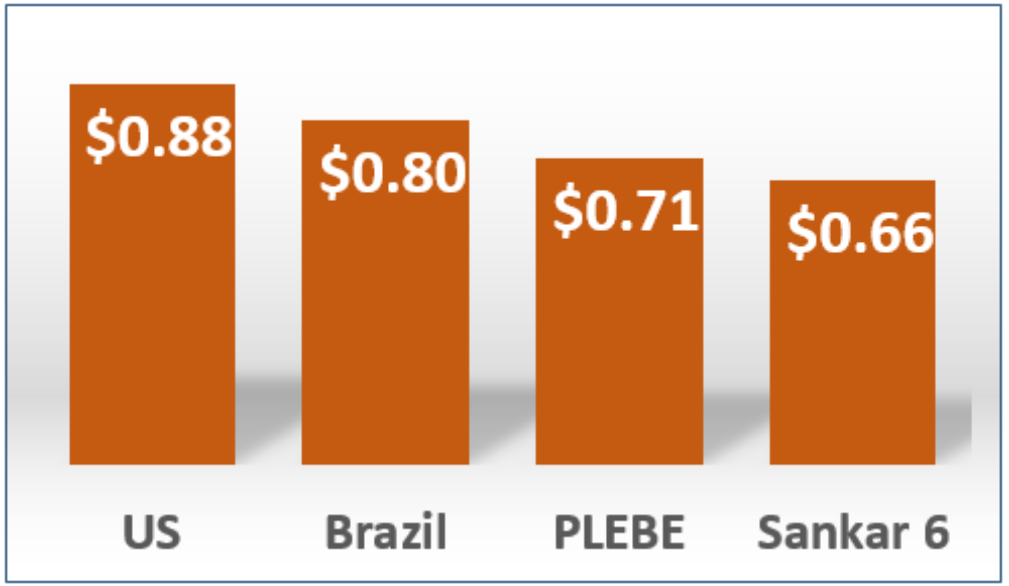
- Based on an exchange rate of **1US$ to 74 Indian Rupees**, the **profit per garment** in US dollars was:

Carded Yarn Garments



Combed Yarn Garments



Summary

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- **In comparing the price of the local Sankar 6 cotton, with the price of the imported American fibre, it may surprise many members of today's audience that the more expensive imported US cotton (8 US$ cents per pound higher) can produce a garment that generates more profit per garment for the manufacturer**.
- In the case of **carded yarn garments**, the **profitability gap** between the **Sankar6** and the **US** garments is **9 US cents** per garment.
- **The gap** is even greater **with combed yarn garments** with a **22 US cents** per garment advantage for the US.
- **Independent research sponsored by CCI over the last three years has consistently proved that the common practice of many mills to buy their cotton based on price is a huge mistake!**

Summary

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- Significantly, the consultant's report has confirmed that although machine harvested, saw-ginned cottons have more Neps and a higher short fibre content than their gentler hand harvested, roller-ginned competitors, these negative characteristics have had **NO IMPACT** on down-stream processing or garment profitability.
- In this study, the hand-harvested, roller-ginned cotton has been **OUTPERFORMED** at every stage of processing and in every parameter monitored and measured by the consultants.
- AMONGST THESE MACHINE PICKED, SAW-GINNED RIVALS, THE ALL-ROUND PERFORMANCE OF THE **US FIBRE HAS BEEN EXCEPTIONAL** IN EVERY CATEGORY.

THANK YOU…

COTTON USA

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…FOR YOUR KIND ATTENTION

A TECHNICAL & FINANCIAL COMPARISON OF MACHINE AND HAND HARVESTED COTTONS IN THE MANUFACTURE OF KNITTED GARMENTS

R Gilmartin
CText ATI, Manchester, England

ABSTRACT

CCI's paper will present the results of a research project conducted by a team of independent, specialist, textile consultants commissioned by CCI last year (2020).

The project's primary objective was to evaluate the impact of Neps in US and Non-US cottons on the processing, quality and cost of ring spun yarns and knitted garments. The study was conducted with similar quality cottons from Brazil, India, West Africa and the USA.

A secondary objective was to compare the performance of hand harvested, roller-ginned cottons with cottons that were machine picked and saw-ginned at all stages of the process, from bale to garment. Indian and West African cottons were selected for the hand harvested varieties, Brazilian and US fibres for machine picked cottons. The Indian cotton had been roller-ginned, the West African, Brazilian and US cottons saw-ginned.

The research was carried out at two mills in the Indian sub-continent chosen by the consultants. For yarn manufacturing, they selected one of India's leading spinning mills producing high quality yarns for both knitting and weaving.

For the knitting to garment making segment of the project, they selected a company who was an important customer of their spinning mill partner producing high quality knitted garments with facilities for knitting, dyeing, printing and embroidery, as well as garment making.

The project work itself was divided into two main parts. First, a technical evaluation covering all aspects of manufacturing from raw material testing, yarn manufacturing, knitting, dyeing and finishing through to final garment inspection. Then, a cost/benefit analysis of the performance of the four fibres to be compared.

We will present from the consultant's detailed and extensive 108-page report, the key data and information that support the observations and conclusions that we have drawn from the consultant's work.

INTRODUCTION

Cotton Council International (CCI), the export promotion arm of the National Cotton Council of America (NCC), is a non-profit trade association that promotes U.S. cotton fibre and manufactured cotton products around the globe with the COTTON USA™ Trademark.

Every year we commission research projects to investigate aspects of US cotton that our customers have raised with us during our mill visits or during the various promotional events that we hold in our main markets. We always have these projects undertaken by reputable, independent, third party, textile industry consultants.

We often hear complaints from our customers about the high content of Neps that they find in their deliveries of US Upland cotton.

Last year, one of the projects we commissioned was to look in more detail at the technical impact that Neps, both biological and mechanical, have in the manufacture of both carded and combed yarns and their transformation into dyed, knitted garments. (See examples of Neps **Figure 1** and **Figure 2**.)

Figure 1 – Mechanical Neps removed from card waste samples

Figure 2 – Seed Coat Neps removed from waste samples

Previous independent research projects had demonstrated the technical and financial advantages of using US Upland cotton in the manufacture of high quality knitted garments.

In last year's study we wanted to take that earlier work and go deeper into the impact that Neps have on yarn and fabric quality and indirectly highlight the impact of Neps created due to harvesting systems (machine versus manual picking) and ginning methods (Roller and saw ginning).

The consultants compared cotton from four different origins in their study:

- USA
- India - Sankar 6
- Brazil
- West Africa - PLEBE

Indian and West African cottons are normally harvested by hand, Brazil and US cottons are normally machine picked.

West African, Brazilian and US cottons are normally saw-ginned. Indian cottons are less aggressively roller-ginned and should contain fewer Neps than the saw-ginned varieties.

The project was conducted in India.

Yarn manufacturing took place at a large, well-established mill producing high quality carded and combed, compact spun ring yarns.

The processes from knitting to garment manufacturing were monitored at one of the yarn mill's customers producing high quality knitted garments.

Both companies were considered leaders in their fields.

METHODOLOGY

The research was done by a team of senior consultants from PT Sriwijaya Tex Tech Solution of Indonesia. Their quality of work and the members of their team were well known to CCI. All the technical data contained in their report had been personally collected by the consultants who had monitored and supervised all stages of the manufacturing process.

The main body of the consultant's report contained the detailed technical results of the performance of each of four cottons being compared at every process, from blow-room to garment manufacture.

The technical results were then quantified financially based on the true costs of the partner mills where the research was conducted.

YARN MANUFACTURING

The cottons compared in the study were those used in regular production by the spinning partner to spin **carded and combed knitting yarns of count Ne 30/1**, with the exception of the Brazilian fibre that was purchased especially by the partner for the trial.

As expected, the Neps per gram and the SFC were higher in the three saw-ginned cottons (US/Brazil/W Africa) than the hand-harvested, roller-ginned Indian Sankar 6.

In the blow-room and carding, the testing results showed that with the appropriate machine settings, all the Neps in the saw-ginned cottons were easily removed.

The IPI values of the Ne 30/1 Carded and Combed yarns spun are shown in Table I and **Table II** below.

Table I

Description	IPI Value	Origin
Ne 30/1 CARDED yarn	143	US
	194	W Africa
	288	Brazil
	539	Sankar 6

Table II

Description	IPI Value	Origin
Ne 30/1 COMBED yarn	14	US
	21	W Africa
	16	Brazil
	19	Sankar 6

Machine settings in the blow-room and carding were identical for all the four cottons being studied. Normally these would be fine-tuned to suit the fibre.

Waste lost in the blow-room and carding is shown in **Table III**.

Table III

Waste lost in Blow-room and Carding	11.38%	US
	12.42%	W Africa
	15.48%	Brazil
	12.24%	Sankar 6

Examples of Fine Cleaner waste are shown in **Figure 3**.

Figure 3

The consultants observed that the Brazilian cotton contained a high volume of trash and bark. Examples of barks are shown in **Figure 4**.

Figure 4

The **Trash content** in each cotton was measured (see Table IV). The **overall cleaning efficiency** in the blow-room and carding ranged from **93.25%** with US cotton to a low of **82.4%** with Brazilian cotton. A **Nep removal efficiency of 85.98%** was achieved with the US fibre. The SCN (Seed Coat Neps) reduction in carding was also superior with all the saw-ginned fibres (See **Table IV** for details.)

Table IV

	US	**W Africa (PLEBE)**	**Brazil**	**Sankar 6 (Indian)**
Trash Content	3.12%	2.82%	5.00%	3.38%
Nep Removal Efficiency	85.98%	80.43%	77.63%	69.13%
SCN Reduction in Carding	90.77%	75.41%	86.44%	64.42%

With the same machine settings in Combing, there was a significant difference in the **Noil percentages** being extracted from the four fibres (see **Table V**), with Brazil being the highest at **18.13%.**

Table V

	US	**W Africa (PLEBE)**	**Brazil**	**Sankar 6 (Indian)**
Noil Percentages Extracted	13.90%	15.87%	18.13%	16.87%
SFCn Reduction achieved during Combing	55.80%	54.40%	51.20%	47.90%

Even though the volume of mechanical Neps is higher in saw-ginned cottons, they are easily removed in carding and combing and result in higher yarn quality as the yarn test results in the following paragraphs show.

With the Ne 30/1 carded yarns, the IPI results achieved with US cotton were remarkable considering that in the blow-room the US fibre had the highest Nep Count/g (324.13) of the four cotton sources tested. (See **Table VI**).

Table VI

Cotton Cops - Neps +140%/km - Carded Yarn	
US	626
W Africa PLEBE	713
Brazil	1141
Indian Sankar 6	1642

The total IPI normal/km results for the four cottons <u>confirmed the superiority of the US cotton</u>. The US cops had a total IPI normal of 143 compared to 539 for the hand-harvested, gentler ginned Sankar 6. (See **Table VII**.)

Table VII

Total IPI Normal/km Results	
US	143
W Africa PLEBE	194
Brazil	288
Indian Sankar 6	539

For many of the critical yarn quality parameters, the US yarn test results were below the 5% curve on the 2018 Uster statistics for Ne30/1 carded yarns. The Sankar 6 30/1 carded yarns were the equivalent of only 63% on the Uster curves.

With the same count (Ne30/1) combed yarns, for many of the tested parameters there was no significant difference in the results for the Indian, West African and Brazilian yarns.

The US combed yarn had the lowest Total IPI normal result of the other fibres, (see **Table VIII**).

Table VIII

Total IPI Normal/km Results – Combed Yarn	
US	14
W Africa PLEBE	21
Brazil	16
Indian Sankar 6	19

Once again, for many of the key parameters, the yarn test results for the **US combed cops** placed them **below the 5% curve** on the **Uster** statistics compared to **approximately 20%** for the other three cottons.

In Winding, the clearer cuts per 100kms in all categories were lower with the US cotton than any of the other fibers.

With the **Ne 30/1 combed yarns**, there was **very little difference** in the cuts per 100km results **between all four cottons**.

In the Classimat tests, on both the carded and combed yarns, the US yarns performed significantly better than the competitors, especially on the carded yarns where the results were 33% lower than the PLEBE yarns, 48% lower than Brazil and 68% better than the Sankar 6.

In the ring-frames, the consultants monitored the performance of all four cottons in terms of end breaks per 1000 spindle hours and Pneumafil waste percentages.

For carded and combed yarns the end breaks per 1000 spindle hours and the Pneumafil waste were recorded as shown in **Table IX** below.

Table IX

	US	**W Africa (PLEBE)**	**Brazil**	**Sankar 6 (Indian)**
CARDED YARNS - end breaks per 1000 spindle hours	20.2	38.3	29.9	37
Pneumafil waste recorded for each cotton	0.15%	0.30%	0.25%	0.30%
COMBED YARNS - end breaks per 1000 spindle hours	32.0	42.5	49.9	54.0
Pneumafil waste recorded for each cotton	0.15%	0.35%	0.35%	0.40%

Finally, the results of the **waste losses** recorded by the consultants for both yarn types, carded and combed **from bale to cop** were as shown in **Table X** and **Table XI**.

Table X

CARDED YARNS - YIELD % ACHIEVED	
US	88.50%
W Africa (PLEBE)	87.20%
Brazil	84.70%
Sankar 6 (Indian)	87.40%

Table XI

COMBED YARNS - YIELD % ACHIEVED	
US	74.60%
W Africa (PLEBE)	71.30%
Brazil	66.10%
Sankar 6 (Indian)	70.50%

The report confirmed that in almost every aspect of yarn manufacturing, the machine harvested, saw-ginned cotton out-performed the hand harvested, roller ginned fiber.

KNITTING

The single jersey fabrics chosen for the project were knitted on a circular weft knitting machine with the following specifications:

- Diameter 32 inches
- Gauge 28
- Total Needles 2808
- Number of Feeders 102

For the trials:

- The Fabric Width was 30 inches
- The Loop Length was 27.5 cm
- The machine speed was 39 rpm.

The consultants monitored the performance of the machine used for the knitting trials in terms of **machine stops per roll** of fabric produced, **translated into stops per 100 kgs of yarn knitted** for each of the four fibers (**Table XII** below).

Table XII

	US	**W Africa (PLEBE)**	**Brazil**	**Sankar 6 (Indian)**
Ne 30's CARDED yarn, stops per 100 kgs during knitting	4.5	9.4	19.3	10.8
COMBED yarns - stops per 100 kgs	2.0	3.3	13.5	6.8

The consultants commented that **the majority of stops were caused** by **yarn breaking on the cones** or by “fluff” (**fiber loss**) **building up** in the slub catchers on the machines.

They observed that the **fiber loss with the US cotton was significantly less** than the other three cottons although, with the exception of the Brazilian yarn, fiber loss in all the cottons during knitting was minimal, probably due to the yarns being **Compact** spun.

They found that the majority of the **Brazilian stops** were **caused by trash** still present in the yarns (an example is shown in **Figure 6** below).

Figure 5

The knitted, undyed fabric was inspected using the standard 4-point system based on frequency and size (diameter & length) of the defect.

For **carded** and **combed** yarns, the greige inspection results were as shown in **Table XIII** below.

Table XIII

GREIGE INSPECTION RESULTS	US	W Africa (PLEBE)	Brazil	Sankar 6 (Indian)
CARDED YARNS - points per 100 square yards fabric knitted	2.4	4.6	4.5	4.9
Translated into points per 100 kg of yarn knitted	16.9	31.2	32.6	31.9
COMBED YARNS - points per 100 square yards fabric knitted	1.3	1.7	5.2	2.6
Translated into points per 100 kg of yarn knitted	9.7	11.7	36.6	18.2

DYEING & FINISHING

The consultants **dyed 50% of the fabric knitted into** a **White** colour, **25%** into **Navy Blue** and the remaining **25%** into a **Red** shade.

The partner mill had installed Then Air Flow technology machines from Fongs. The fabrics were stentered, using the partner's standard settings for the fabric, on a Brückner machine. The dyed fabrics in all colours were examined using the partner's

4-point inspection system. The fabrics were also tested for Shrinkage, Spirality, Colour Fastness and the Delta-Values for each dye recipe.

The Partner's 4-Point system graded any fabric with a points value of greater than 28 points per 100 square yards inspected as a reject.

None of the fabric processed from any of the four fiber sources failed the inspection process in any colour. The results are shown in **Table XIV**.)

Table XIV

30's CARDED FABRIC RESULTS - POINTS PER 100 SQ YDS				
	US	**W Africa (PLEBE)**	**Brazil**	**Sankar 6 (Indian)**
RED Fabric	1.92	16.65	5.3	4.7
NAVY BLUE Fabric	0	11.30	5.8	12.9

Both the consultants and the Partner's inspection teams commented on the low presence of Neps and "white spots" in the finished fabrics.

The consultants took 25 square centimeter samples from each fabric and physically counted the Neps and the White Spots in each sample. The results are shown in **Table XV**.

Table XV

	US	**W Africa (PLEBE)**	**Brazil**	**Sankar 6 (Indian)**
WHITE Samples	3 Neps/0 Spots	6 Neps/0 Spots	4 Neps/0 Spots	5 Neps/0 Spots
RED Samples	3 Neps/0 Spots	24 Neps/0 Spots	5 Neps/0 Spots	20 Neps/1 Spot
NAVY BLUE Samples*	2 Neps/1 Spot	4 Neps/2 Spots	5 Neps/1 Spot	10 Neps/2 Spots
***** *Technically the most difficult of the three colours to dye and finish*				

As in Yarn Manufacturing, the D&F results showed that in terms of both fabric quality and the negative impact of Neps, the fabrics knitted with machine picked, saw-ginned cottons, outperformed the hand-harvested, roller-ginned Indian fibre.

- All four fibers met the Partner's 5% Spirality and Shrinkage standards.
- **The US cotton produced the best results in both these tests.**
- The "Whiteness Index" results for all four fibers were good.

- There was no significant difference in the testing results for Colour Fastness and the Delta-E values between any of the four fibers being tested.

GARMENT MANUFACTURING

The consultants manufactured T-shirts produced with the carded and combed yarns spun from each fiber source in White, Navy Blue and Red. For the partner mill, an important measure of performance is "**Yarn to Garment Realization**" percentage. This is calculated by monitoring and measuring fiber loss from bale to garment.

The results obtained are shown in **Figure 6** and **Figure 7**.

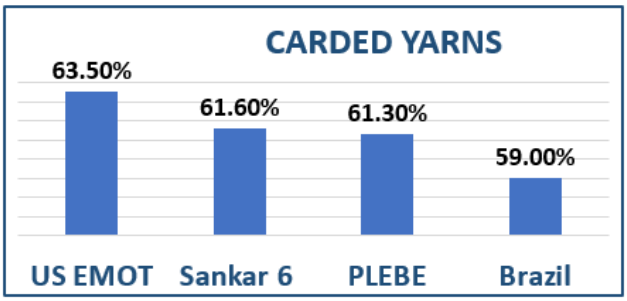

Figure 6

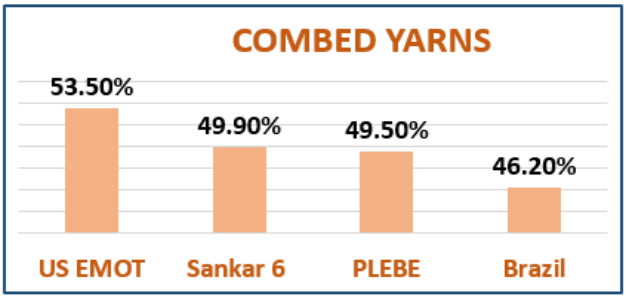

Figure 7

The consultants commented that poor Brazilian results with both carded and combed yarns was due mainly to the fiber losses during yarn manufacturing and knitting.

After their completion, all the garments produced during the trial were inspected to the partner's normal quality standards. The partner had **three grades of inspection, Pass, B Grade and Rejection.**

The percentages of carded yarn garments graded as a **Pass** are shown in **Table XVI** and the percentages of carded yarn garments rejected are shown in **Table XVII**.

Table XVI

%'s Carded Yarn Garments Passed	
US	94.50%
Brazil	87.60%
Sankar 6	86.10%
PLEBE	79.10%

Table XVII

%'s Carded Yarn Garments Rejected	
US	0.98%
Sankar 6	2.57%
Brazil	2.66%
PLEBE	3.18%

For **Combed** yarns, the percentage of garments that achieved a **Pass** level in **all 3 colours** are shown in **Table XVIII**.

Table XVIII

%'s Combed Yarn Garments Passed (All 3 colours)	
US	95.00%
Brazil	90.50%
PLEBE	79.64%
Sankar 6	75.40%

The percentage of **Combed** yarn garments that were rejected are shown in **Table XIX**.

Table XIX

%'s Combed Yarn Garments Rejected	
US	0.95%
Brazil	2.76%
PLEBE	3.20%
Sankar 6	2.72%

The consultants commented that the **hand-harvested cottons**, **PLEBE and Sankar 6**, contained **very high levels of contamination** in both **carded and combed garments.**

The second most frequent **cause of a B grade** rating was **thick and thin** yarns.

No garments in any of the four cottons were rejected or graded B for Neps.

FINANCIAL COMPARISON

For the four cottons compared in this study, the yarn manufacturing partner paid the following prices per pound in US dollars:

US	$0.79
PLEBE	$0.78
Brazil	$0.77
Sankar 6	$0.71

Using the cost data of the two project partners, the consultants calculated the **profit per garment** generated by each of the four compared cottons. Based on an exchange rate of **1US$ to 74 Indian Rupees**, for the **carded yarn** garments, the profit per garment is shown in **Table XX**.

Table XX

CARDED YARN GARMENTS PROFIT PER GARMENT	
US	$0.75
Brazil	$0.66
Sankar 6	$0.66
PLEBE	$0.60

For the **combed yarn**, the results are shown in **Table XXI**.

Table XXI

COMBED YARN GARMENTS PROFIT PER GARMENT	
US	$0.88
Brazil	$0.80
PLEBE	$0.71
Sankar 6	$0.66

SUMMARY

In comparing the price of the local Sankar 6 cotton, with the price of the imported American fiber, it may surprise many members of today's audience that the more expensive imported US cotton (8 US$ cents per pound higher) can produce a garment that generates more profit per garment for the manufacturer.

In the case of **carded yarn garments**, the **profitability gap** between the Sankar 6 and the US garments is **9 US cents** per garment.

The gap is even greater with **combed yarn garments** with a **22 US cents** per garment advantage for the US.

Independent research sponsored by CCI over the last three years has consistently proven that the common practice of many mills to buy their cotton based on price is a huge mistake!

Significantly, the consultant's report has confirmed that although machine harvested, saw-ginned cottons have more Neps and a higher short fiber content than their gentler hand harvested, roller-ginned competitors, these negative characteristics have had NO IMPACT on down-stream processing or garment profitability.

In this study, the hand-harvested, roller-ginned cotton has been OUTPERFORMED at every stage of processing and in every parameter monitored and measured by the consultants.

Amongst these machine picked, saw-ginned rivals, the all-round performance of the US FIBRE HAS BEEN EXCEPTIONAL IN EVERY CATEGORY.