MECHANICAL PROCESSING EFFECTS ON THE WHITE SPECK PHENOMENA[1]

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Abstract

Processing factors, such as time of harvest, number of lint cleaners used at the gin, opening line cleaning in the mill, single and tandem carding, combing and rewiring of the card are studied to see the effect on white specks in the finished fabrics. This paper examines the white speck phenomena as seen in four different studies. The first study compares single carding with tandem carding. Tandem carding is shown to increase the white speck problem although it improves all other yarn and fabric qualities. The second study looks at a Midsouth cotton harvested at three different intervals (early harvest, normal harvest, and late harvest). Each of the harvested cottons have three levels of cleaning at the gin and three levels of cleaning in the mill opening line, producing nine different cleaning sequences for each harvest. The results identify the optimum balance between lint cleaning at the gin versus cleaning at the mill as related to white specks. The third study compares carding with combing. Four varieties from the 26 Leading Variety Study by AMS were carded and combed and the fabrics are analyzed for white specks. The final study compares new card wire with used card. The card wire was damaged in the middle of a study, the card was rewired, the bale samples were processed again on the new wires and the results are presented here. Both combing and rewiring are found to reduced the white speck problem, while other processing seems to open and separate the immature fibers spreading the white speck problem.

Introduction

Examining the cause of neps, it is noted that neps originate from growth, harvesting, ginning, and processing (Wegener, 1980). These growth neps consist of mostly dead or immature fiber and are the ultimate causes of white specks. In addition, neps are defined in two distinctions as either mechanical or biological. Biological neps contain biological matter such as seedcoat, leaf or bract, and often show up as dark specks. Mechanical neps are composed of entangled fibers formed by the mechanical action of processing as shown in harvesting, ginning, opening, cleaning and carding. Finer fibers are particularly vulnerable due to their lack of longitudinal rigidity. Neps are often formed from fiber breakage which causes the fiber to coil itself, often involving other fibers in its recoiling, producing entanglements (Wegener, 1980). These entanglements are devastating to immature fibers for they lack the resilience to disentangle themselves (Bargeron, 1993). While subjected to these textile processing techniques, these colonies of immature fibers are separated and divided into smaller segments that are ultimately responsible for the white specks that appear in dyed fabrics (Watson, 1992).

Defined as dye resistant neps, white specks appear as poorly dyed or undyed undeveloped fibers in a finished dyed fabric; they typically worsen during mechanical processing. In an experiment by Hebert, 96% of all neps studied contained immature fibers, while 50% of the examined neps were entirely immature fibers, and 46% of the neps in the finished fabric were white specks (Hebert, 1988). To make the situation worse, immature fibers have an accelerated rate of sorption and desorption as compared to mature counterparts, and thus dispel dye more easily (Cheek, 1988). The variety of cotton is believed to be responsible for 30% of the cause of white specks, the location of growth accounts for an additional 30%, while the remaining 40% of the sources of variation are unknown (Bragg, 1992).

Since neps are a result of mechanical actions, processing is very important. This paper is a summary of the effects of processing on white specks, from four different studies. The first study compares single with tandem carding; the second compares time of harvest, lint cleaning and mill opening line cleaning; the third compares combing with single carding and the final study compares old card wire with new card wire.

The effect of carding was studied using four varieties of cotton with a wide range and very distinct fiber properties. Two were Acalas (EA-C30, a strong, fine experimental fiber bred to mature early and EA-C32, a strong and fine fiber), a Deltapine (DP-90, a medium strength, medium fine fiber), and a Stoneville (STV- 825, a weaker, coarse fiber). The four varieties were grown in the same field and were processed identically through opening. Half was then single carded while the other half was tandem carded. As expected, tandem carding produced superior yarn and fabric properties except that of the white speck; tandem carding increased the white speck content of the fabrics, as compared with single carding.

In order to study the effect of gin and mill cleaning on the production of white specks, field to fabric properties were studied for a Midsouth cotton. The cotton was harvested at three different intervals to simulate possible harvest conditions of early harvest, normal harvest, and late harvest. This resulted in a high-trash-content crop, a normal crop, and a weathered crop, respectively. Each of the harvested cottons was subjected to combinations of ginning, opening, and cleaning treatments to identify the optimum balance between lint cleaning at the gin versus cleaning at the mill as related to white specks. The cottons were processed through precleaners, followed by no lint

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cleaners, one lint cleaner, or two lint cleaners at the gin. Three different mill opening sequences were applied to each level of gin-cleaned cotton. Each sample was then single carded, producing nine different cleaning sequences for each harvest. Fibers were spun into yarns and then into fabrics for Image Analysis of the white speck content. Different combinations of cleaning were necessary to obtain the best possible fabric properties, with respect to the white speck, for each harvest.

In the comparison of carded to combed samples, four varieties from the 26 Leading Variety Study by AMS were carded and combed. Two Maxxa and two Royale varieties were employed for this research. Image analysis of the dyed fabrics showed combing reduces the white speck problem as compared with single carding.

The opportunity to study the impact of the card wire condition on the white speck problem presented itself when in the middle of a study, the card wires were damaged and subsequently replaced. Two varieties of cottons, one smooth leaf and one hairy leaf, were subjected to four different levels of lint cleaning at the gin. The bale samples were processed in Mini-spinning on the card with both the old card wire and the new card wire. The old card wire knitted samples are compared with the new card wire knitted samples. In addition, Image Analysis was done on the fabric samples by Optimas 4.0 to detect the percent white (the ratio of the percentage of area of the white specks in a specified area of fabric), as well as the size and number of white specks. The old card wire produced almost twice as many white specks as the new card wire.

Materials and Methods

Single vs. Tandem Carding

Four cotton fiber varieties were used in this project. The cottons consisted of two typically rain grown and two irrigated varieties. DP-90 is a commercial Delta Upland fiber, STV-825 is a Mississippi hybrid variety, EA-C30, experimental, bred to mature early, and EA-C32, Prema, are Acala cottons. The cottons were grown under irrigated conditions in the same field in the San Joaquin valley, CA for this study. Full size production equipment was used throughout the study. The cottons were spindle picked and then ginned at Mesilla Park, NM, followed by two saw-type lint cleaners. All yarn and fabric processing was done at the USDA Southern Regional Research Center in New Orleans. A lay down of three bales was used for each variety. Equal amounts were processed from each of the three bales to make four lots of equal weight per variety. The opening process was the same for all sixteen lots: Hopper, Superior Cleaner, Buckley beater, Kirshner beater, and then chute feed to the cards. Two of the four lots for each variety were single carded using the Mark IV card, and the other two lots were tandem carded using the Mark IV tandem card. The first drawing had eight doublings to 55 gr./yd. and the second drawing had eight doublings to 55 gr./yd. Roving was 1.25 hanks with medium soft twist. Both 30/1 and 40/1 yarns with a 3.8 T.M. were spun on a Roberts Arrow, 240 spindle spinning frame with spindle speed of 9500 rpm. Fabrics were woven from 30/1 warp yarns and 40/1 filling yarns for all varieties to produce eight fabrics. Ends down tests were run on the 40/1 yarns for 5040 spindle-hours/lot with rounds every fifteen minutes.

Effect of Gin and Mill Cleaning

Nine bales of Stoneville 112, a hairy-leaf, Midsouth cotton, were grown on the Mississippi Agricultural and Forestry Experiment Station in Stoneville, Mississippi, and ginned in the full-sized gin plant at the Stoneville Cotton Ginning Laboratory. The ginning rate was about four bales/hour, which is normal for the machinery used. The harvesting and ginning portions of the study were composed of nine treatments; for each of the three harvesting treatments there were three ginning treatments, as follows:

Harvesting Treatments

1. Early - Normal defoliation and spindle harvesting before total leaf drop.
2. Normal - Normal defoliation and spindle harvesting after total leaf drop.
3. Weathered - Normal defoliation and spindle harvesting four weeks after total leaf drop.

Ginning Treatments

1. Drier (66ºC), 6-cylinder cleaner, stick machine, drier (52 °C), 6-cylinder cleaner, extractor-feeder, gin stand, and no lint cleaner.
2. Drier (66ºC), 6-cylinder cleaner, stick machine, drier (52 °C), 6-cylinder cleaner, extractor-feeder, gin stand, and one lint cleaner.
3. Drier (66ºC), 6-cylinder cleaner, stick machine, drier (52 °C), 6-cylinder cleaner, extractor-feeder, gin stand, and two lint cleaners.

Gin and mill cleaning was conducted as a completely randomized design. Cleaning was replicated three times for each harvest. The cottons were sent to the Southern Regional Research Center (SRRC) for fiber, yarn, and fabric processing and analyses.

The nine bales were further cleaned in the mill at SRRC. Opening line and picker rate for the test was about 700 pounds/hour (318 kg/hour), which is normal for the machinery used. The Hollingsworth card production rate was 60 pounds/hour (27 kg/hour) for single carding. The opening and carding portions of the study were composed of three treatments, for each of the three opening treatments, as follows:

Mill Opening Treatments

A. SP = Hopper, Superior Cleaner, picker
B. SSP = Hopper, Superior Cleaner, second pass through Superior Cleaner, picker

C. SRP = Hopper, Superior Cleaner, Rando Cleaner, picker

The card sliver was then drawn twice with eight doublings producing a 55 grain/yard sliver.

Spinning Treatments
A one hank roving was made and then ring spun on a Roberts Arrow frame. Twenty tex (30/1) yarns were made at 10, 000 rpm spindle speed, with a 4.0 T. M. for filling yarns.

Cloth Construction
Twenty tex (30/1) yarns from each lot were woven as filling into a 5-harness filling face sateen with a thread count of 64 x 108, and a 21 tex (28/1) combed, common warp. The experimental yarns cover approximately 85% of the surface.

Carding vs. Combing
The combing study is a small part of the 26 Leading Variety Study by AMS. The 26 bales of cotton collected for this study were processed on modern textile processing equipment. The cotton was opened, blended and cleaned on Truetzchler equipment and carded on a Truetzchler Card at 70 pounds per hour. Drawing sliver was produced on a Reiter Breaker Drawing Frame. The combed samples were run through the Platt Saco Lowell Model 53 Lapper, followed by the Platt Saco Lowell Model 52 comber (16 - 17% Nominal waste) followed by the Rieter RSB 51 Draw Frame. Carded stock and combed stock were then processed through the Platt Saco Lowell Finisher Drawing Frame. Roving was produced on a Saco Lowell Long Draft Roving Frame, 10 x 5, 1 Apron type, and 36/one rings spun yarns were produced on a Saco Lowell Long Draft Spinning Frame, 2 Apron type. The fabrics are a 5-harness filling faced sateen with a common combed warp, 30/1 warp yarns. The experimental yarns have approximately 85% surface coverage.

Condition of Card Wires
Due to their inherent differences in leaf hairiness, two varieties of cottons were selected from the 1985 crop at Stoneville, Mississippi both with unique properties that affect their ability to be cleaned. For convenience, these cottons were assigned codes, S for the smooth leaf Deltapine 50, and H, for the hairy leaf Stoneville 506. As expected, the smooth leaf produced a cleaner grade of cotton than did the hairy leaf since the leaf hairs tend to attach themselves to the fibers and resist removal during processing. Both cottons were grown in the same area in non-irrigated fields without the use of growth regulator chemicals, and were spindle harvested.

Ginning and Lint Cleaning
Each variety was ginned under four regimens at the U. S. Cotton Ginning Laboratory in Stoneville, Mississippi. The four gin cleaning treatments involved 0, 1, 2, 3, lint cleaners, with three replications of each, one bale per replicate as follows:

0 lint cleaners: stick machine and extractor-feeder/gin stand

1 lint cleaner: dryer (175° F), 6 cylinder cleaner, stick machine, dryer (ambient), 6 cylinder cleaner, extractor-feeder/gin stand, and 1 lint cleaner

2 lint cleaners: dryer (175ºF), 6 cylinder cleaner, stick machine, dryer (ambient), 6 cylinder cleaner, extractor-feeder/gin stand, and 2 lint cleaners

3 lint cleaners: dryer (175ºF), 6 cylinder cleaner, stick machine, dryer (ambient), 6 cylinder cleaner, extractor-feeder/gin stand, and 3 lint cleaners

Lint was baled under calibrated compression and shipped to ARS Quality Research Station at Clemson, SC for mill cleaning. Yarns were spun from these lots using the Mini-spinning system.

Fifty Gram Mini-Spinning Evaluation
The 50 gram samples were spun into a 27-tex yarn (22/1). Landstreet's methods were followed with the exception of the half skeins; full skeins were used in this study. Skein breaking tenacity (Cotton count x lbs.) Was determined by ASTM methods. Two subsamples were tested on each cotton. Yarns were knitted into two sleeves (one in greige form, the other dyed) for each sample on a Lawson-Hemphill 3 ½" Diameter (FAR) Fiber Analysis Knitter, 220 needle cylinder, 20 needles per inch, 15 tightness index, 29.91" per course, plain Jersey knit (Weft).

Unfortunately, the card wire was damaged during the processing of the gin/mill cleaned samples. Eight bale samples (four smooth leaf & four hairy leaf) had been processed on the old card wire and after the card was rewired the bale samples were processed on the new card wire. Resultant fabrics are discussed in this paper.

Dyeing
The same scouring and dyeing procedures were used for all of the studies. The fabric is finished with a 0.1% Prechem 70, 0.3% T.S.P.P. boiloff, a caustic scour of 1.1% Prechem SN, 1.1% Mayquest 80, 0.1% Prechem 70 and 0.7% Sodium Hydroxide (Caustic Soda), followed by the same boiloff procedure. The fabric was then bleached (0.1% Prechem 70, 0.5% Mayquest BLE and 3.0% Peroxide (Albone 35)) followed by an acid sour (0.1% Acetic Acid) and dyed with 4% Cibacron Navy F-G Blue, 0.5% CalCon, 8% Sodium Chloride, 0.8% Na2 Co3 (soda ash) and 0.5%

Triton Tx-100. This dye has a high propensity for highlighting white specks in finished fabrics.

Image Analysis

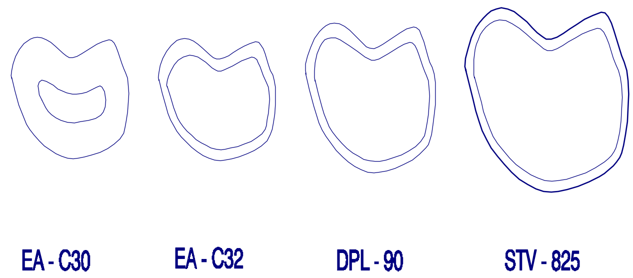
Image analysis was done by the Optimas 4.0 system on a Gateway 2000 P5-75 computer complete with a dual monitor set up with a Sony Trinitron RGB Monitor. A Microimage Video Systems RGB/YC/NTSC color camera was used to extract the image and was placed 18.125 inches above the fabric sample. A ring light, to assist in the uniformity of the lighting, was 15.25 inches above the fabric and around the lens of the camera. In addition, two 15 W fluorescent lamps, 18 inches in length were placed 11 inches from the center of the sample, and 11.25 inches above the sample. The system was engaged and allowed to equilibrate for one hour. Using the % Areas and data collection macros, the ratio of the white speck area to the sampling area, or the % white, and the number of specks are detected. The black and white configuration was enabled to perform the analysis. A calibration was done to ensure the correct sample area was being used.

In studying the effect of the condition of card wires, knitted socks were analyzed. A metal insert was slipped into the sock to keep the samples under uniform tension. The region of interest, ROI, was ten and one-half square inches. Six samples per sock for the ginned samples were analyzed, yielding a total area of 63 square inches for ginned sock samples. All other studies involved woven fabric samples in which the ROI was set at 12 square inches with 24 images analyzed for a total viewing area of 288 square inches. To ensure that white specks were being detected properly, the threshold was set using several samples and remained the same for the duration of the testing. The threshold dictated what was detected as white and thus contributed to the % white of the sampled area. All fabric testing was done randomly; the operator manipulated the fabric so as not to detect the same area twice.

Results & Discussion

Single vs. Tandem Carding

Table I indicates that the Acalas are similar for most fiber properties and have the smallest perimeters, with DP-90 the next largest and the STV-825 the largest. The experimental Acala, EA-C30, was developed to mature sooner and this can be seen in the cell wall thickness as compared with the EA-C32. The thicker cell wall also results in EA-C30 being more circular than the other Acala cotton. The STV-825 is the least circular. EA-C30 also has the highest micronaire value followed by the DP-90, STV-825 and the Acala EA-C32 with the lowest value. AFIS IFF, immature fiber fraction, shows that EA-C30 has the smallest percentage of immature fibers while EA-C32 has the largest percentage of immature fibers.



Selected physical properties are shown in Table 1.

Table 1

Property	**EAC-30**	**EAC-32**	**DP-90**	**STV-825**
Fibrograph Length (in)	1.14	1.16	1.1	1.08
AFIS IFF (%)	10.96	15	13.92	14.96
Stelometer 0" gage	39.58	39.4	34.3	32.03
Arealometer :				
Wall Thickness	3.08	2.47	2.59	2.54
Perimeter	49.97	50.16	53.28	55.63
Micronaire	4.37	3.57	3.8	3.6

Varietal results

As demonstrated in Figure 1, EA-C32 has the most fabric white specks followed by STV-825, DP-90, and EA-C30. The %IFF correlates well with the white speck content of the finished fabric which is most apparent in the comparison of the two Acala varieties. EA-C30 has the best spinning efficiency and yarn CV%, followed by EA-C32, DP-90, and STV-825. Yarn and fabric strength are highest for the EA-C32 followed by EA-C30, DP-90, and STV-825.

Mechanical Processing Effects

The yarns and fabrics made from these varieties show that tandem carding is superior to single carding in improving all aspects of yarn and fabric quality, except that tandem carding causes an increase in white specks in the dyed fabrics (See Figure 1). These four varieties have a wide range of fiber properties and were analyzed to find relationships to the finished fabrics properties. The strongest relationships are found in the AFIS data. The percent of immature fibers is a major factor contributing to the number of white specks for both the single and tandem carded samples. The lengths of the fibers strongly influence the size of the white specks for the tandem carded samples; the more opened and longer the fiber, the more surface area it covers. Due to EA-C30's fiber qualities--length, strength and fineness, but with a thick cell wall and a low percent of immature fibers, it produces the best yarns and fabrics overall, and exhibits good spinning efficiency.

Effects of Gin and Mill Cleaning

The dyed fabrics were subjected to Image Analysis to consistently record the number, size, and percent area occupied by white specks in a predetermined area of fabric. Obviously, the best fabrics are those with the fewest and smallest, white specks. The size and number vary according to the percentage of white area, thus, the results concentrate on the percent white detected. The % white values indicate, the normal harvest has the smallest area of white specks followed by the early and then the late harvest (Figure 2). Image analysis indicates that zero lint cleaners at the gin produces the fabrics with the smallest % white, which increases with both one and two lint cleaners (Figure 3). Overall for mill cleaning, the more aggressive the cleaning the greater the % white (Figure 4), as can be easily seen in the early harvest (Figure 5).

Figure 5 shows the individual data for the 27 samples. The first nine data points are the early harvest, the next nine the normal harvest and the final nine the weathered harvest. The first three data points for each harvest are no lint cleaning in combination with mill cleaning SP, SSP and SRP. The second set of three data points is one lint cleaner with the various mill cleanings, and the third set is the two lint cleaner samples with the various mill cleanings. For the early harvest, as the number of lint cleaners increases, so does the white speck content. Similarly, the white speck % white increases with aggression of mill cleaning. The early harvest has had less weathering as compared with the normal and weathered harvest. Its fibers are less brittle, more resilient, and therefore less prone to fracture during processing. Mechanical action is responsible for breaking up the fiber clumps, both mature and immature. The normal harvest does not demonstrate the dramatic trends of the early harvested samples since it has experienced some weathering effects that result in fibers that are brittle, although not as brittle as the weathered harvest. Overall the % white increases with increased lint cleaning, but the mill effects are less readily seen, except in the case of two lint cleaners. Two lint cleaners show that the more aggressive the mill cleaning, the greater the % white due to the severe mechanical processing. The weathered harvest produces brittle fibers. The only acceptable fabric has minimum gin and mill cleaning. Further processing causes the fracture of the fibers and increases the % white as gin and mill cleaning increase until the two lint cleaner level is reached. For the two lint cleaners, the cleaning is substantially aggressive, and thus is breaking up the immature clusters to such an extent that they are falling out as short fibers. However, the two lint cleaners with all the mill cleaning sequences retain higher % white values than all of the no lint cleaners samples proving that aggressive cleaning is not the solution.

The best case scenarios for the early harvest were, no lint cleaners and the SP or SSP mill cleaning sequences. The normal harvest, zero lint cleaners and the SP, SSP, or SRP mill cleaning sequences were acceptable. For the weathered, the no lint cleaners with the SP mill cleaning sequence provided the only acceptable fabric.

Carding vs. Combing

Both the combed Maxxa cottons and the combed Royale cottons display, on average, a 50% less % white as detected from image analysis when comparing the carded Maxxa and Royale cottons (See Figure 6). Subsequently, the count of the white specks is less for the combed samples than that of the carded samples. The size of the white specks is slightly smaller in the combed samples than in the carded samples, which supports the theory that carding is opening the white specks. Overall, the combed fabrics were superior to the carded fabrics.

Condition of Card Wire

Unfortunately, in the midst of a cleaning study, the card wires were damaged and needed replacing. Bale samples were subjected to both the old and new card wires, thus permitting comparisons to be made. These samples were subjected to lint cleaning only. The comparisons are limited to smooth vs. hairy, and old vs. new card wires, and number of lint cleaners. These samples provide an excellent opportunity to study the effect of the condition of card wires on the phenomenon of white specks. Consistently, the new card wires produce a lower % white than the old card wires by an average 60% (See Figure 7). Blunt teeth and wide settings can cause fibers to roll which results in neps that ultimately appear in the final fabric. The new card wires are obviously more efficient in removing immature fiber bundles that are the ultimate cause of white specks. Thus, by monitoring the condition of the card wires and keeping them in the best condition as possible and replacement as necessary, the % white can be dramatically reduced.

Comparing the smooth leaf with the hairy leaf cotton, for the old card wires the hairy cottons have a higher % white than the smooth leaf cotton. With the new card wires, the average for the cottons are the same. The samples show an increase in % white as the number of lint cleaners increases. This is as expected since the more aggressive the cleaning, the more broken up the immature fiber colonies, thus increasing the % white throughout the fabric sample. The smooth leaf cotton without lint cleaning distinctly lowers % white as compared to 1, 2, and 3 lint cleaners with the old card wire. For the new card wire 3 lint cleaners show a distinct increase for % white as compared with 0, 1, or 2 lint cleaners. The hairy leaf cotton shows 0 and 1 lint cleaner to be similar while 2 and 3 lint cleaners have a higher % white with the old card wire. The new card wire shows that 3 lint cleaners have an increased % white as compared with 0, 1 and 2 lint cleaners.

Overall the new card wire reduces the effect of lint cleaning on white specks. 0, 1 & 2 lint cleaners produce similar fabrics, while 3 lint cleaners have a significant increase in % white for the new card wire. The distinctions are more obvious with the old card wire for increased levels of lint cleaning. When comparing the effect of ginning, each additional lint cleaner produces an increase in percent white. The hairy leaf variety has higher percent white values than the smooth leaf cotton.

Conclusions

Single vs. Tandem Carding

Tandem carding was superior to single carding in improving all aspects of yarn and fabric quality, except that tandem carding causes an increase in white specks in the dyed fabrics. The percent of immature fibers is a major factor contributing to the number of white specks for both the single and tandem carded samples. The lengths of the fibers strongly influence the size of the white specks for the tandem carded samples.

Gin and Mill Cleaning Sequences

Due to a weaker fiber creating weaker yarns and fabrics, the weathered harvest is significantly different from the early and normal harvests. It is interesting to note that there is one combination of gin and mill processing sequences that allows the manufacturer a low white speck fabric with acceptable yarn and fabric qualities. Defined by good overall properties, a good fabric for the consumer is a compromise of such items as fabric tearing strength and appearance. Based on the percent white of the samples, the minimum gin cleaning and the minimum mill cleaning are recommended for the weathered harvest. More aggressive cleaning of these fragile weathered fibers damages them thus worsening all quality factors. The normal harvest has three cleaning combinations that produce fabrics with similar high quality results. Any combination of mill cleaning with no lint cleaners in the gin will produce the best fabric when considering appearance. The early harvest also produces its two best fabrics using minimum gin cleaning in combination with minimum and mid range mill cleaning.

Carding vs. Combing

As made evident by the dramatically lower values of % white, combing proved itself as a viable option to aid in the reduction of white speck content in fabrics. Carding cleans the fibers, removes some short fibers, and partially parallelizes them, while combing is doing its job by removing remaining short fibers and immature fibers, consequently reducing the % white of the fabrics.

Condition of Card Wires

Based on the data gathered by image analysis, the condition of the card wire is very influential on the white speck phenomenon. An 80% difference exists between the old card wires and the new card wires when comparing samples subjected to the same level of gin cleaning. The new card wire fabrics have dramatically lower % white values than the new card wires even when comparing mill cleaning. Damaged card wires with blunt teeth and wide settings cause fibers to roll which results in neps, which may contain immature fiber, that ultimately appear in the final fabric. Perhaps the hairs of the hairy cotton contribute to the entanglement of immature or dead fibers which result in a more prevalent white speck problem than the smooth leaf cotton.

Generally, only length, strength and micronaire are considered main influences in yarn and fabric quality. However, additional fiber properties, such as percent of immature fibers, contribute to fabric quality and should be considered so that the appropriate processing can be planned to minimize white specks. Overall, the more aggressive the cleaning, the higher the percent white. Thus, when confronted with the possibility of a white speck problem (high level of immature fibers), minimal gin cleaning and less aggressive mill cleaning are recommended. If the immature fiber level is extreme, combing should be included in the protocol. If white specks are increasing even when processing normal levels of immature fibers, the card wire should be checked.

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1. This manuscript has been referred for the 1996 Beltwide Proceedings

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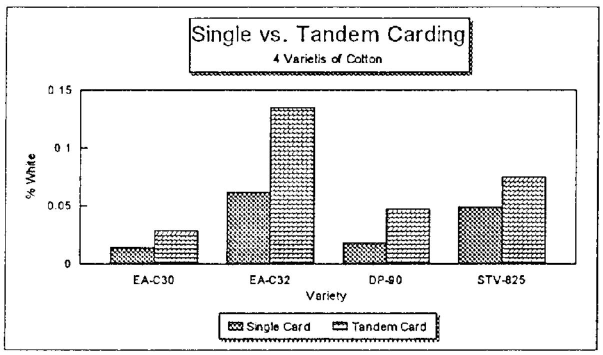

Figure 1

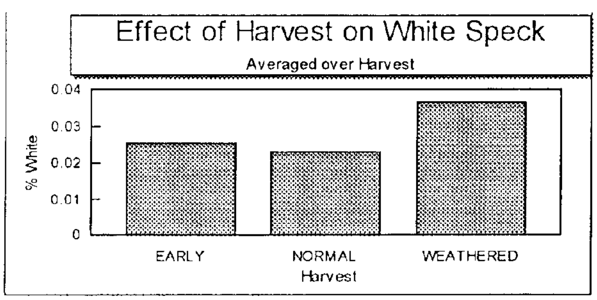

Figure 2

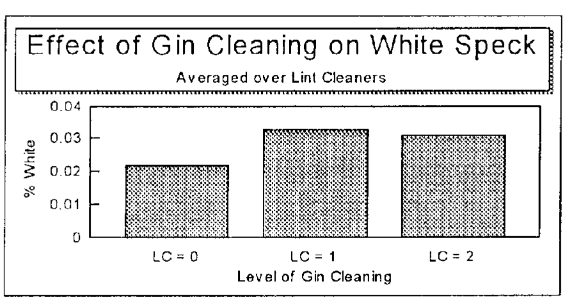

Figure 3

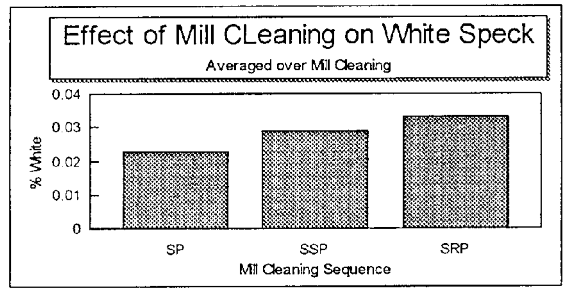

Figure 4

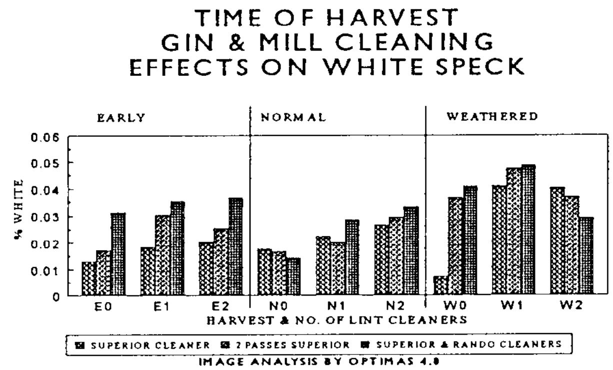

Figure 5

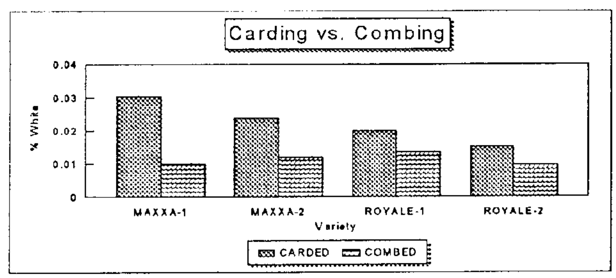

Figure 6

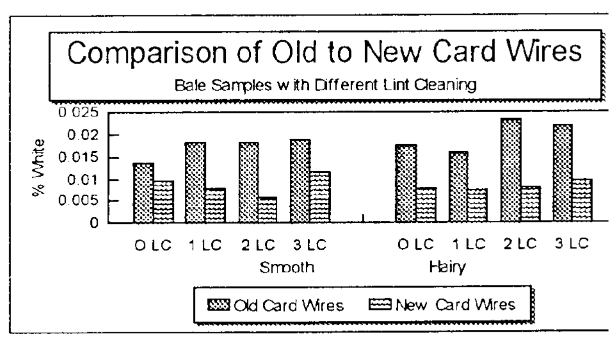

Figure 7