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Some Spinning and Weaving trials on Existing and New South African Cotton Cultivars

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SOME SPINNING AND WEAVING TRIALS ON EXISTING AND NEW SOUTH AFRICAN COTTON CULTIVARS

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INTRODUCTION

Eleven lots of cotton comprising several cultivars from two areas (Upington and Groblersdal) were submitted for fibre analyses and spinning trials. Weaving trials were carried out on one lot only.

PART I : SPINNING TRIALS

EXPERIMENTAL

Raw Materials:

The lots used in the spinning trials, together with their area of production, are listed in Table I.

Testing:

All fibre and yarn tests were carried out under standard atmospheric conditions (20 ± 2° C and 65% ± 2% relative humidity). The samples were kept

TABLE I

LIST OF COTTONS SUBMITTED FOR SPINNING TRIALS

COTTON	AREA	
Acala SJ 1	Upington	
Acala SJ 141	Upington	
Acala SJ 185	Upington	
Acala 1517/70	Groblersdal	machine picked
CS 2	Groblersdal	
Albar 637	Groblersdal	
Alma 76	Groblersdal	
Deltapine 5826	Groblersdal	
Alma C535/302/3/3	Groblersdal	hand picked
Alma C543/542/1/1	Groblersdal	
Alma C535/311/2/1	Groblersdal	

TABLE II

INTERPRETATION OF VALUES OF MATURITY RATIO

MATURITY RATIO	CLASSIFICATION
1,00 and more	Very mature
1,00 to 0,95	Above average
0,95 to 0,90 }	Mature
0,90 to 0,85 }	
0,85 to 0,80	Below average
0,80 to 0,70	Immature
less than 0,70	Uncommon

under these conditions for at least 48 hours before any tests were carried out. Mechanical processing was carried out under atmospheric conditions of 22°C ± 2°C and 50% ± 2% relative humidity

The maturity ratio, fibre fineness and Micronaire value were determined using the IIC/Shirley Fineness Maturity Tester. The samples used on the IIC/Shirley tester were prepared on a Shirley Analyser in accordance with the instructions of the manufacturers. The classification given in Table II may be used to interpret the maturity ratios of American Upland type cottons [1].

A Fibrograph (Model 330) was used to determine the 2,5 *per cent* and 50 *per cent* span length.

The ratio of the 50 *per cent* span length to the 2,5 *per cent* span length expressed as a percentage, is normally taken as a measure of the uniformity of fibre length in the samples and is called the uniformity ratio. The classification given in Table III is widely used by the United States Department of Agriculture[2], and can be used to classify cotton according to their fibre length uniformity. Larger values indicate more uniform fibre length distributions.

A Stelometer was used for the determination of fibre bundle tenacity at both zero-gauge and 1/8-gauge (3,2 mm). Trash content was determined using a

TABLE III

INTERPRETATION OF UNIFORMITY RATIOS

UNIFORMITY RATIO	CLASSIFICATION
Below 42	Very low
42 — 43	Low
44 — 45	Average
46 — 47	High
Above 47	Very high

Shirley Analyser.

The yarn tensile properties (breaking strength, extension at break as well as the CV of breaking strength) were determined on an Uster automatic yarn strength tester. Yarn hairiness was measured on a Shirley Hairiness Meter employing the standard test in which all the hairs protruding more than about 3 mm from the yarn core are measured and expressed as the number of hairs per metre.

Mechanical Processing:

A 40 kilogram subsample of cotton from each lot was processed except for lots C535/302/3/3 and C543/542/1/1 in which case only 30 kg lots were available.

Each lot was processed through a standard blowroom line, containing three cleaning points, i.e. a porcupine beater, two-bladed beater and a Kirschner beater. Carding was carried out on a conventional cotton card having a production rate of 7 kg/hr, and was followed by two drawframe passages and a speedframe passage to produce rovings of 420 tex.

Spinning was carried out on a Platt M1 ring spinning frame equipped with 50 mm-rings (2-inch) and an SKF/PK 225 drafting system. Yarns with a linear density of 15 and 30 tex (Metric twist multiplier* = 38) were spun to establish yarn properties. End-breakage tests were carried out while spinning 20 tex yarns (Metric twist multiplier = 38) at a spindle speed of 11 000 r/min.

RESULTS AND DISCUSSION

Fibre Characteristics:

Fibre bundle tenacity at zero-gauge varied from 34,0 cN/tex (70 000 p.s.i.) for C535/311/2/1 to 46,3 cN/tex (95 000 p.s.i.) for Acala SJ1 while at 1/8-gauge it varied from 18,6 cN/tex for Alma 76 to 30,0 cN/tex for Acala 185 (see Table IV). A bundle tenacity of 36,0 cN/tex (75 000 p.s.i.) at zero-gauge is the agreed minimum strength (indicated as A in Figure 1) for a cotton to be classed as an A-class for price determination under the South African price agreement. Bearing this in mind, two of these cottons (Alma 76 and C535/311/2/1) are to be

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*Metric twist multiplier = t.p.cm x $\sqrt{\text{tex}}$

Metric twist multiplier = 9,57 x (English twist factor)

TABLE IV
FIBRE STRENGTH CHARACTERISTICS

COTTON	0-GAUGE TENACITY		1/8-GAUGE Tenacity (cN/tex)	Extension (%)
	(cN/tex)*	1000 lbf per sq. inch		
Alma 76	34,4	71	18,6	8,9
Deltapine 5826	39,0	80	22,1	7,8
CS2	39,6	82	21,8	7,3
C543/542/1/1	39,3	81	25,0	7,4
Albar 637	40,3	83	23,4	7,6
Acala 1517/70	44,5	92	27,5	7,0
Acala SJ 1	46,3	95	28,4	7,3
Acala SJ 185	45,3	93	30,0	6,2
Acala SJ 141	42,5	88	27,2	7,4
C535 311/2/1	34,0	70	20,3	8,2
C535 302/3 3	43,8	90	27,3	7,4

* 1 cN tex = 1,02 gf tex

classed as B-class cottons.

The other nine cottons could be divided into two groups:

* 39,0 to 41,5 cN/tex (80 000 to 85 000 p.s.i.) — Deltapine 5826, C543/542/1/1, C52 and Albar 637
* 42,5 to 46,3 cN/tex (88 000 to 95 000 p.s.i.) — Acala SJ 141, C535/302/3/3, Acala 1517/70, Acala SJ 185 and SJ 1.

The fibre characteristics of the cottons are given in Table V and the 2,5 *per cent* span lengths are, for purposes of comparison, illustrated in Figure 2.

Three cottons (Acala SJ 1, Acala SJ 185 and Acala SJ 141) had 2,5 *per cent* span lengths which were longer than 28,6 mm (1.1/8-inch) while those of three others (C535/311/2/1, C543/542/1/1 and C535/302/3/3) were shorter than 28,6 mm but longer than 27,0 mm (1.1/16-inch). The length of the other five cottons fell within the range 24,0 mm to 26,5 mm. The latter failed the requirements of an A-class cotton which must have a minimum length of 27,0 mm.

The maturity ratios of the cottons are also given in Table V. According to the classification given in Table II, the maturity ratio of Alma 76 should be considered as well below average, if not immature. The maturity ratio of three

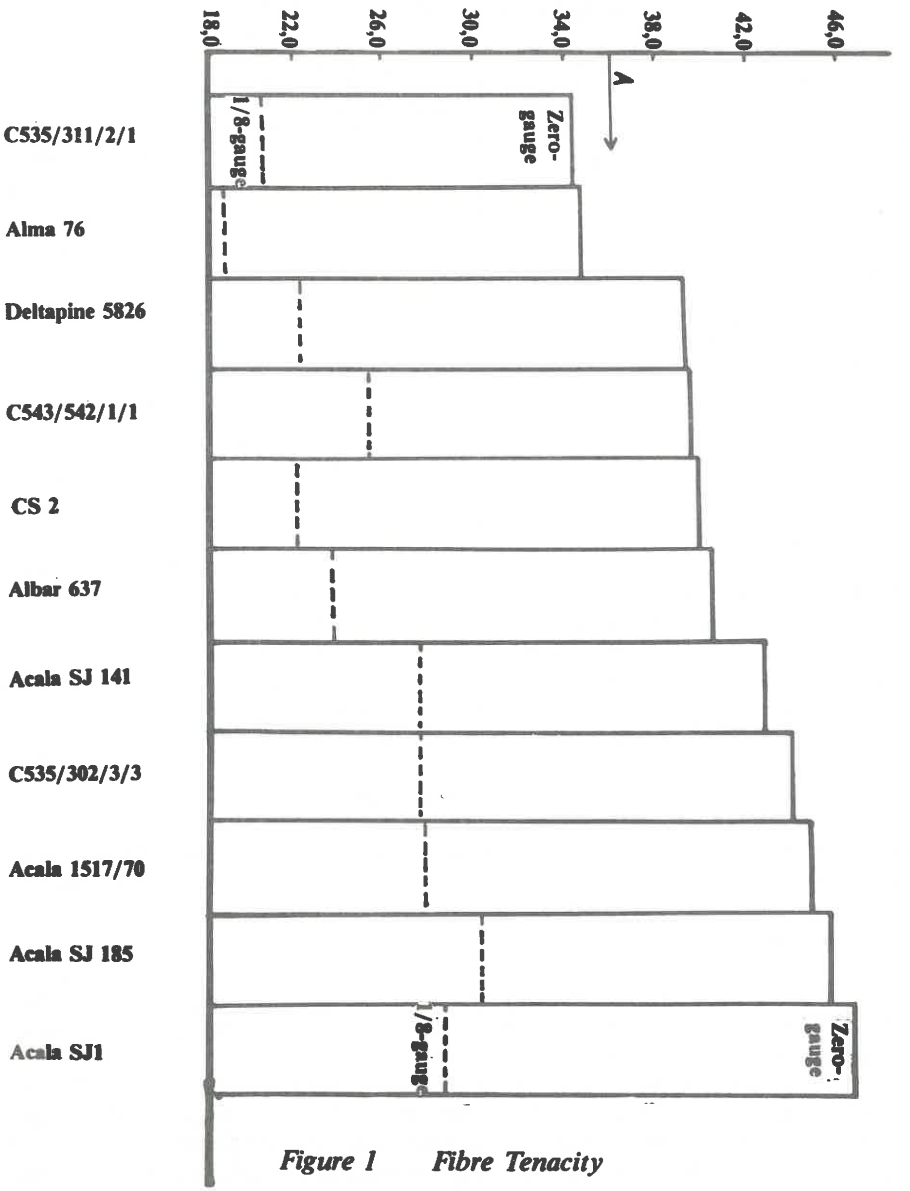

Figure 1 Fibre Tenacity

TABLE V

FIBRE CHARACTERISTICS

COTTON	Micro-naire	2,5% Span Length (mm)	Uni-formity Ratio (%)	Maturity Ratio	Fibre Linear Density (dtex)	TRASH (%)	
						Visible	In-visible
Alma 76	3,7	24,8	44	0,80	1,70	2,2	0,2
DP 5826	4,2	24,0	47	0,87	1,79	1,3	1,3
CS2	4,1	25,3	45	0,92	1,84	2,9	1,3
C543/542/1/1	4,1	27,5	46	0,84	1,73	2,3	1,4
Albar 637	4,9	26,5	47	0,88	1,87	1,4	0,8
Acala 1517/70	3,6	25,6	45	0,85	1,58	1,9	1,0
Acala SJ 1	4,0	29,2	45	0,84	1,75	1,3	1,4
Acala SJ 185	4,7	29,2	47	0,92	1,85	1,3	0,8
Acala SJ 141	5,0	29,5	47	0,93	1,98	1,6	0,8
C535/311/2/1	4,8	27,3	47	0,95	1,94	3,3	1,5
C535/302/3/3	3,5	27,7	48	0,83	1,52	2,1	1,1

cottons (C535/302/3/3, Acala SJ 1 and C543/542/1/1) could be considered as below average. The other cottons could all be considered as mature.

The Micronaire values and trash contents are also given in Table V. The Micronaire values of Acala SJ 185 and Acala SJ 141 are probably higher than the average for Acala type cottons, since the trash content is determined by the method of picking and the percentage trash extracted during ginning, and is, therefore, not an intrinsic fibre characteristic. It is, therefore, not possible to comment on the differences in trash content.

When the fibre linear densities (dtex) given in Table V are interpreted in conjunction with the maturity ratios, as it should be done, the differences in fibre fineness become small and insignificant, except for Acala 1517/70 and C535/302/3/3 which were significantly finer than any of the other cottons.

Processing performance:

The percentages blowroom waste and card waste (licker-in waste plus flatstrip waste) are given in Table VI. These figures largely reflect the trash content figures given in Table V.

The most regular rovings were produced from Acala SJ 1, Acala SJ 185 and Acala SJ 141. This was expected as they had superior fibre length characteristics compared to any of the other cottons. The shorter cottons with the smaller fibre length uniformity ratios produced the most irregular rovings.

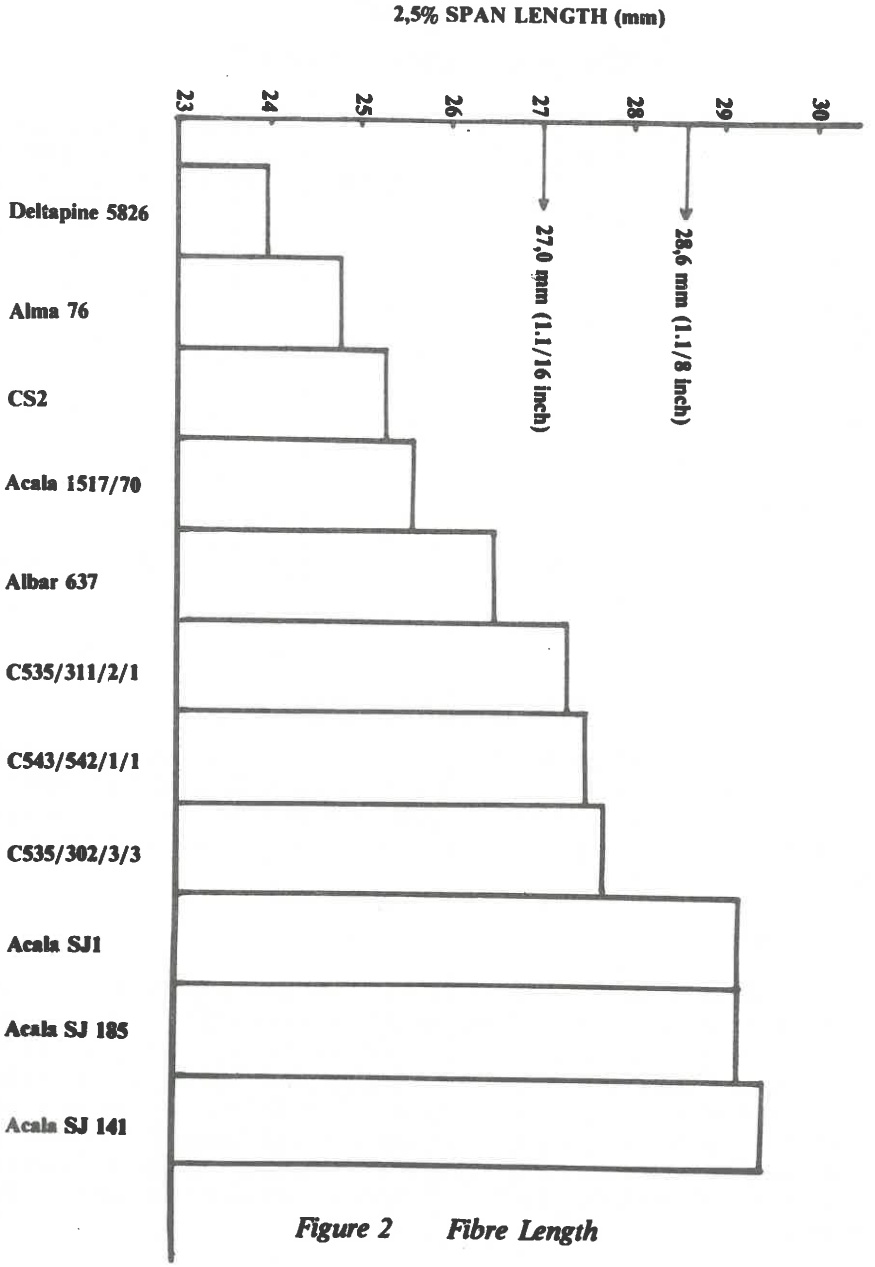

Figure 2 Fibre Length

TABLE VI
PROCESSING PERFORMANCE

COTTON	Blowroom Waste (%)	Card Waste (%)	Roving Irregularity (CV %)	End-Breaks per 1 000 Spindle Hours*
Alma 76	1,2	2,8	7,4	28
Deltapine 5826	1,0	2,4	6,7	27
CS 2	1,8	3,7	7,1	27
C543/542/1/1	1,8	2,6	6,6	13
Albar 637	1,0	2,6	6,5	27
Acala 1517/70	1,1	2,8	7,1	23
Acala SJ 1	1,3	2,0	5,7	20
Acala SJ 185	1,1	1,9	6,0	24
Acala SJ 141	1,3	1,9	5,4	14
C535/302/3/3	1,7	2,8	6,5	19
C535/311/2/1	2,4	3,2	6,4	15

*20 tex yarn, spun at 11 000 r/min.
Twist multiplier = 38 (850 t.p.m)

The number of end-breaks per 1 000 spindle-hours differed very little from each other except for Acala SJ 141, C535/311/2/1 and C543/542/1/1 which gave values somewhat lower than those of the others. All the values were, however, lower than the generally accepted commercial value of 40 end-breaks per 1 000 spindle-hours.

Yarn Characteristics:

The characteristics of the 15 tex and 30 tex yarns are given in Tables VII and VIII respectively, and the single thread tenacities are illustrated in Figure 3.

In a recent survey by SAWTRI[3] it was found that only 16 *per cent* of 102 locally spun carded cotton yarns (with average linear density of 40 tex) had tenacities lower than 12,7 cN/tex (13 gf/tex). Only 20 *per cent* of the yarns with linear densities between 25 and 35 tex had a tenacity below 12,7 cN/tex. It is suggested that this figure be taken as a realistic minimum strength (indicated by M in figure 3) for the purpose of evaluating the strength of the 30 tex yarns in this report.

TABLE VII

CHARACTERISTICS OF 15 TEX YARNS

COTTON	C.S.P. (Ne x lbf)	SINGLE THREAD TENACITY		Extension (%)	Yarn Irregularity (CV %)	Neps per 1 000 m of Yarn	Yarn Hairiness (Hairs per metre)
		cN/tex*	CV (%)				
Alma 76	1546	9,8	10,9	7,5	23,3	820	5,2
Deltapine 5826	1916	12,8	11,4	7,7	22,3	628	9,9
CS2	1955	12,1	11,7	6,8	22,8	1061	8,9
C543/542/1/1	2100	12,9	11,0	6,7	21,9	819	4,8
Albar 637	1888	11,8	11,0	6,1	21,6	568	28,2
Acala 1517/70	2266	14,5	9,4	6,6	20,9	866	7,0
Acala SJ 1	2498	15,1	9,3	6,7	20,3	453	8,7
Acala SJ 185	2600	16,7	9,7	6,4	20,2	560	10,4
Acala SJ 141	2438	15,1	10,0	6,8	20,6	493	11,6
C535/302/3/3	2412	15,0	9,4	7,5	20,7	856	5,4
C535/311/2/1	1865	12,0	9,1	6,6	22,5	979	5,9

*1 cN/tex = 1,02 gf/tex

The yarn spun from *Alma 76* can, therefore, be considered as far *too weak*. The strength of those yarns spun from Albar 637, C535/311/2/1, C52 and Deltapine 5826 are equal to or just stronger than the "minimum" of 12,7 cN/tex. The other six cottons (C543/542/1/1, Acala 1517/70, C535/302/3/3, Acala SJ 141, Acala SJ 1 and Acala SJ 185) produced yarns having strengths well above this suggested minimum value (see Figure 3). The yarns produced from these six cottons were stronger than 94 *per cent* of those tested in the SAWTRI survey[3].

The irregularities of the 30 tex yarns were all well below those of the Uster 50 *per cent* experience values[4], but they were, nevertheless, clearly divided into two groups (see Table VIII). The irregularities of the 30 tex yarns spun from Acala 1517/70, Acala SJ 185, Acala SJ 141, Acala SJ 1 and C535/302/3/3 were significantly lower than those of the other six cottons. The irregularities of the 15 tex yarns spun from these five cottons also compared very well with the Uster "statistics" which are generally accepted as representative of the irregularity of carded cotton yarns from various countries. The 15 tex yarns spun from the other six cottons (Alma 76, Deltapine 5826, C52, C543/542/1/1 and C535/311/2/1) all had irregularities which could be considered as high.

According to the nep content of the resultant yarns, the cottons could also be divided in two distinct groups. Acala SJ 414, Acala SJ 185, Acala SJ1, Acala 1517/70, Albar 637 and Deltapine 5826 had a relatively low number of

TABLE VIII

CHARACTERISTICS OF 30 TEX YARNS

COTTON	C.S.P. (Ne x lbf)	SINGLE THREAD TENACITY		Extension (%)	Yarn Irregularity (CV %)	Neps per 1 000 metres or Yarn
		cN/tex*	CV%			
Alma 76	1901	11,2	7,6	7,6	16,1	307
Deltapine 5826	2309	13,5	8,1	7,8	16,1	248
CS2	2162	13,7	8,4	7,0	16,1	376
C543/542/1/1	2495	14,9	7,5	7,2	15,9	297
Albar 637	2139	13,5	8,8	6,4	16,1	224
Acala 1517/70	2554	16,0	7,3	7,0	15,4	353
Acala SJ 1	2745	16,8	8,2	6,7	15,1	130
Acala SJ 185	2930	17,4	7,3	6,5	15,2	90
Acala SJ 141	2674	17,0	7,6	7,1	15,1	93
C535/302/3/3	2755	17,1	7,3	8,1	15,1	367
C535/311/2/1	2134	12,7	8,8	7,5	16,3	360

*1 cN/tex = 1,02 gf/tex

neps per 1 000 metres of yarn (for both the 15 tex and 30 tex). The other five cottons all had relatively high nep contents.

The hairiness of the 30 tex yarns is also given in Table VII. For this particular set of readings, differences between the means of less than 3 hairs per metre are not significant at the 95% confidence level. The hairiness ranged from a minimum of 5,2 (Alma 76) to a maximum of 28,2 hairs per metre (Albar 637). It is difficult to relate these differences to any of the measured fibre characteristics, and neither is it possible to explain the extreme hairiness of Albar 736 when compared with the other ten cottons.

With so many factors involved it is difficult to rank the cottons according to quality, unless all the relevant factors are taken into account. The cottons were, therefore, ranked according to individual fibre and yarn properties, with each property given an equal weight. These rankings are given in Table IX where eleven characteristics were considered. The best value for any of these characteristics were given a ranking of one and the worst value a ranking of eleven or lower depending on how many of the cottons had an equal value for a particular characteristic. The worst total ranking is, therefore, 109 and the best 11. The total rankings are plotted in Figure 4.

Based on these rankings, Acala SJ 185, Acala SJ 141 and Acala SJ 1 had the highest quality among the eleven cottons tested, while Alma 76 had the

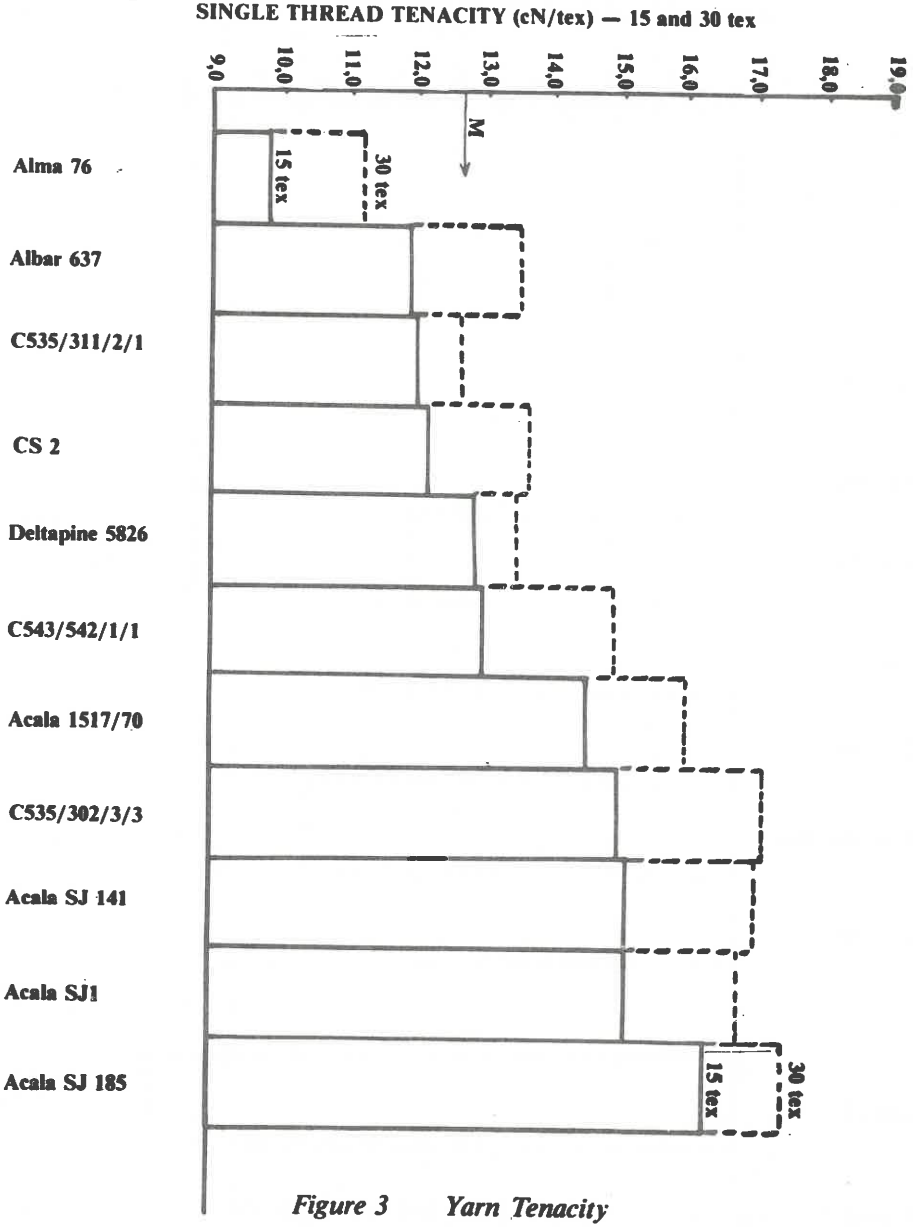

Figure 3 Yarn Tenacity

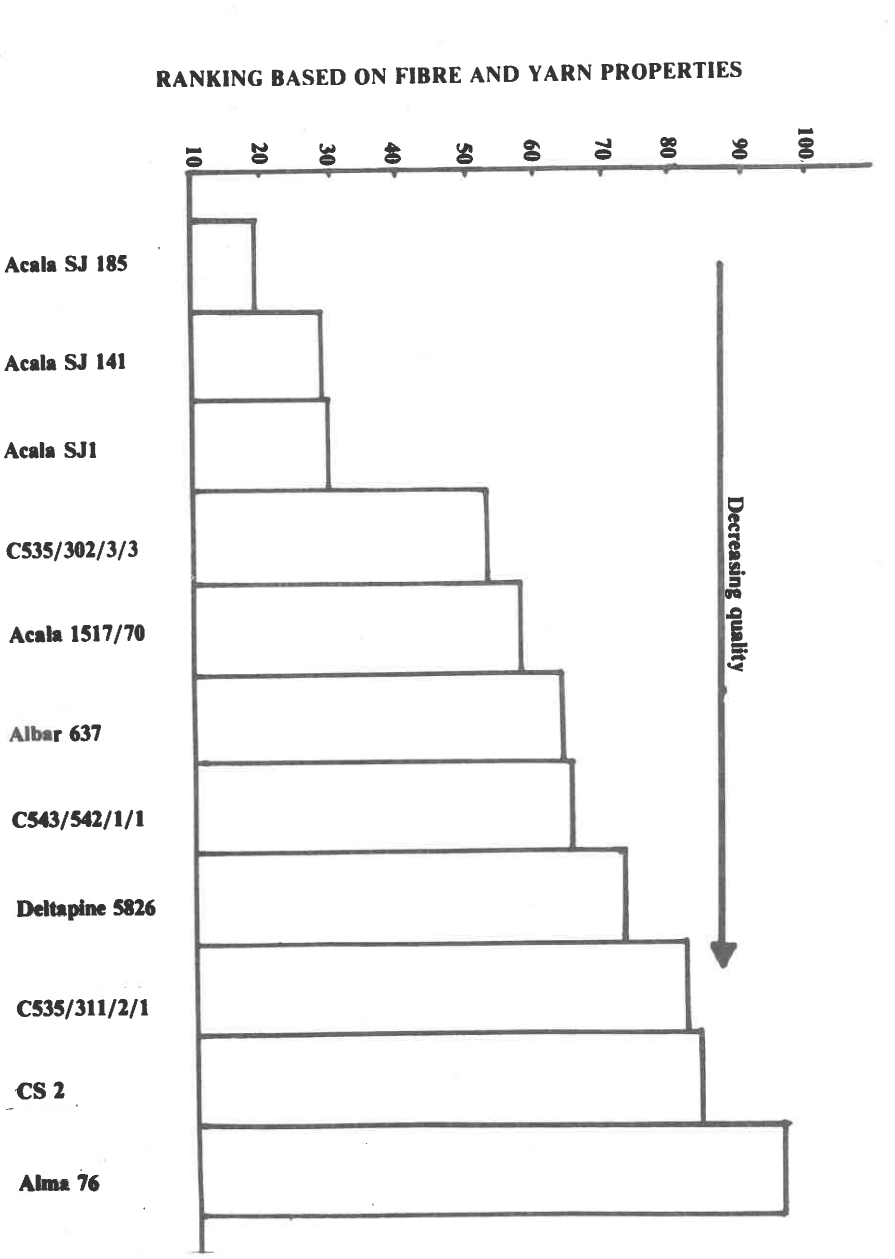

Figure 4 *Ranking according to fibre and yarn properties*

TABLE IX

RANKING ACCORDING TO FIBRE AND YARN PROPERTIES

COTTON	Fibre Length	Uniformity Ratio	Fibre Tenacity O-gauge	Fibre Tenacity 1/8-Gauge	Maturity Ratio	Yarn Tenacity (15 tex)	Yarn Tenacity (30 tex)	Yarn Irregularity (15 tex)	Yarn Irregularity (30 tex)	Neps in Yarn (15 tex)	Neps in Yarn (30 tex)	TOTAL
Alma 76	10	5	10	11	9	11	11	11	5	9	4	96
Deltapine 5826	11	2	9	8	5	7	8	7	5	5	6	73
CS2	9	4	7	9	3	8	7	10	5	11	11	84
C543/542/1/1	5	3	8	6	7	6	6	6	4	6	8	65
Albar 637	7	2	6	7	4	10	9	5	5	4	5	64
Acala 1517/70	8	4	3	3	6	5	5	4	3	8	9	58
Acala SJ 1	3	4	1	2	7	2	4	2	1	1	3	30
Acala SJ 185	2	2	2	1	3	1	1	1	2	3	1	19
Acala SJ 141	1	2	5	5	2	3	3	3	1	2	2	29
C535/302/3/3	4	1	4	4	8	4	2	9	1	7	7	53
C535/311/2/1	6	2	11	10	1	9	10	8	7	10	10	82

(The lower the value the better the fibre property)

lowest quality. The other seven cottons steadily decreased in quality from C535/302/3/3 to CS2 as arranged in Figure 4.

SUMMARY

Eleven cottons from two areas (Upington and Groblersdal) were analysed for fibre properties and subjected to spinning trials to assess the processing performance and yarn properties.

The three Acala cottons from Upington as well as Acala 1517/70 and C535/302/3/3 generally had the best fibre and yarn characteristics. They produced yarns with tenacities well in excess of the average tenacity of commercial carded yarns in South Africa.

Alma 76 had poor fibre characteristics and produced irregular yarns with a tenacity well below the suggested minimum. The other five cottons (Albar 637, C535/311/2/1, C52, Deltapine 5826 and C543/542/1/1) were of average fibre quality and produced yarns with tenacities very close to the suggested minimum of 12,7 cN/tex (13,0 gf/tex).

Judged on the overall fibre and yarn characteristics (listed in Table IX), the three Acala cottons from Upington were far superior to any of the other while Alma 76 was inferior in quality.

PART II: WEAVING TRIAL (LOT C535/311/2/1)

INTRODUCTION

Approximately 25 kg of lint from lot C535/311/2/1 was converted into 25 tex yarn. The processing details were identical to those described in Part I and the yarn was spun to a nominal twist multiplier of 40. The yarn properties were determined as described in Part I.

EXPERIMENTAL

Weaving:

The yarn was autoclave steamed at 100° C for 10 minutes under a vacuum of 660 mm Hg and then allowed to condition in an atmosphere of 65 *per cent* RH and 20° C before further processing. After steaming the yarn was electronically cleared by means of an Uster Classimat, with clearing levels set at B4 C3 D2.

The warp was prepared on a Hergeth Sample Warper. The following sizing recipe was used for sizing of the warp:

3400 g Solvitose XI (Scholten Foxhol)
454 g Bevaloid 174 binder (Bevaloid)
360 g Bevaloid 356 anti-static wax (Bevaloid)
90 g Bevaloid 581B defoamer (Bevaloid) added to 40,2 litres of water at 96° C.

The percentage size pick-up was 11 *per cent*. The fabric produced was a plain all cotton sheeting (SABS Spec. 338 — 1971 for Cotton Sheeting) with 25 ends and picks per cm. The weaving efficiency was calculated as before[5].

Scouring and Bleaching:

The loomstate fabric was scoured in a Longclose winch containing a 0,2 g/ℓ Lissapol NX and 5 *per cent* sodium carbonate solution. The fabric entered the winch at 40° C, the temperature was then raised to the boil and maintained for 1 hour before rinsing twice.

Bleaching was also carried out in the above winch containing the following solution:

2,8 ml/ℓ hydrogen peroxide
2,0 g/ℓ Prestogen PC (BASF)
0,6 g/ℓ sodium hydroxide

The fabric entered the winch at 40°C, the temperature was then raised to 95°C and maintained for 1,5 hours. It was subsequently rinsed and treated with 0,5 g/ℓ sodium hydrosulphite at 60°C for 20 minutes.

The fabric was hydro-extracted, stenter-dried and subsequently allowed to condition for 48 hours in an atmosphere of 65 *per cent* RH and 20°C before testing.

RESULTS AND DISCUSSION

Yarn Properties:

The properties of the 15 tex and 30 tex yarns spun from this cotton have been given in Tables VII and VIII respectively and compared with the yarn properties of the other cottons discussed in Part I. For the sake of completeness the properties of the 25 tex yarn used in the weaving trial are given in Table X. The yarn properties of a 25 tex Deltapine 5826 cotton used in a previous weaving trial[5] are also given for purposes of comparison.

The single thread tenacity of the C535/311/2/1 cotton was approximately 21 *per cent* lower than that of the Deltapine 5826 cotton. The irregularity as well as the nep content of the 25 tex yarn produced from the C535/311/2/1 cotton were higher than those values of the 25 tex yarn produced from the Deltapine 5826 cotton.

Weaving Efficiency:

The warp weaving efficiency was 94 *per cent*, which is the same as that for Deltapine 5826[5], woven previously under similar conditions.

Fabric Properties:

The mechanical properties of the de-sized and bleached fabrics are given in Table XI. The properties of similar bleached plain sheeting fabric produced from Deltapine 5826[5] are also given in Table XI. These latter values can be used to assist in the evaluation of the fabric properties of lot C535/311/2/1, but it must be remembered that differences in finishing details could have influenced the fabric properties. Direct comparison of the properties of the fabrics produced from the two cottons is, therefore, not strictly valid.

TABLE X

YARN CHARACTERISTICS (25 TEX)

	C535/311/2/1	Deltapine 5826*
Measured yarn tex	24,5	25,2
Count-Strength-Product (Ne X Lea Strength in lbf)	2061	2261
Single thread tenacity (cN/tex)	12,3	15,5
CV of single thread strength (%)	9,0	9,2
Extension at break (%)	8,2	9,1
Yarn Irregularity (CV%)	20,5	17,6
Neps per 1 000 metres	536	181
Thin places per 1 000 metres	167	24
Thick places per 1 000 metres	573	182

*Hand picked Deltapine 5826 tested in 1974 when comparing hand and machine picked lint[5].

TABLE XI

FABRIC PROPERTIES

	C535/311/2/1		DELTAPINE 5826*
	De-sized	Bleached	Bleached
Fabric mass per unit area (g/m²)	138	138	156
Fabric sett: Ends per cm	29	29	28
Picks per cm	27	27	26
Warp breaking strength (Newton)	380	401	423
(CV%)	2,7	6,6	6,6
Warp tenacity (cN/tex)	10,7	11,3	12,0
Weft breaking strength (Newton)	414	432	475
(CV%)	3,5	4,1	8,1
Weft tenacity (cN/tex)	11,6	12,2	14,5
Extension at break: Warp (%)	18,5	17,4	25,2
Weft (%)	15,3	14,4	22,8
Bursting strength (kN/m²)	961	902	1128
Abrasion resistance:			
Mass loss at 10 000 cycles (%)	5,1	5,0	4,6
Tear strength (N)	—	8,5	10,1

*Hand picked Deltapine 5826 tested in 1974 when comparing hand and machine picked lint[5]

All the tensile properties as well as the abrasion resistance of the fabric produced from lot C535/311/2/1 were, however, lower than those of the fabric produced from the Deltapine 5826 lot. The observed differences in yarn strength are, therefore, reflected in the tensile properties of the fabrics.

ACKNOWLEDGEMENT

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