SAWTRI BULLETIN

SOUTH AFRICAN
WOOL TEXTILE RESEARCH INSTITUTE
OF THE CSIR

P.O. BOX 1124
PORT ELIZABETH

VOL. 14 DECEMBER 1980 NO. 4

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Editor: P. de W. Olivier

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**SOUTH AFRICAN
WOOL AND TEXTILE RESEARCH INSTITUTE
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SA ISSN 0036-1003

**P.O. Box 1124
Port Elizabeth**

The Director and staff of the South African Wool and Textile Research Institute extend to our readers all over the world our best wishes for the festive season. May the New Year of 1981 be a prosperous one.

Die Direkteur en personeel van die Suid-Afrikaanse Wol- en Tekstielnavorsingsinstituut wens ons lesers oor die hele wêreld alles van die beste toe vir die feesseisoen. Mag die Nuwe Jaar van 1981 voorspoedig wees.

Der Direkteur und die Belegschaft des Süd Afrikanischen Woll- und Textil Forschungsinstituts, wünschen ihren Lesern in der ganzen Welt das Beste für die Festzeit. Wir wünschen Ihnen ein glückliches 1981.

Le Directeur et le Personnel de l'Institut Suid-Africiane de Recherche du Textile et de la Laine Souhaitent à ses lecteurs du monde entier, une agréable saison festivale. Puisse l'annèe 1981 vous apporter bonheur et prospèritè.

INSTITUTE NEWS

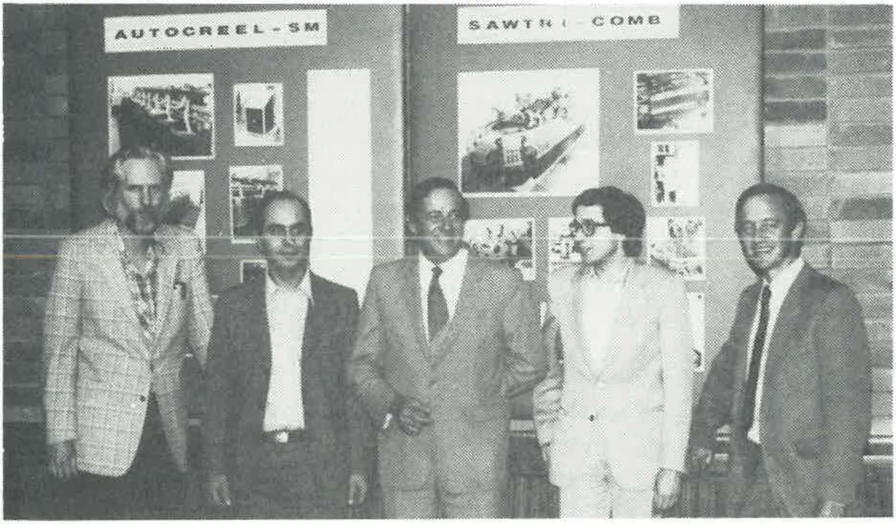
Commercialisation of SAWTRI's Inventions

The South African Inventions Corporation (SAIDCOR) of the CSIR has succeeded in forging yet another link between the CSIR and international industry by concluding two different agreements with SAVIO, the giant Italian manufacturers of textile machinery. The largest organisation of its kind in Italy, SAVIO have several factories also in Spain and the USA. The said agreements concern the SAWTRI Autocreel and the revolutionary SAWTRI Comb, both of which were developed over a number of years by SAWTRI's machine development personnel. The Department of Electronic Instrumentation of the National Institute for Electrical Engineering of the CSIR also played a significant rôle in the design of the micro precision unit which was necessary for the automation of the creel. The agreements provide for the immediate manufacture of the Autocreel by SAVIO and give SAVIO the option of obtaining a licence to use the technology of the SAWTRI comb for future commercial development. Dr L. Mezzetti, Vice President of SAVIO and Mr M. Rotondo, Technical Director of Cognetex (a division of SAVIO) visited SAWTRI in this connection on September 19th and 1st—5th December. Messrs A. Carroli and Barnaba of SAVIO spent the first week of December at SAWTRI for further discussions.

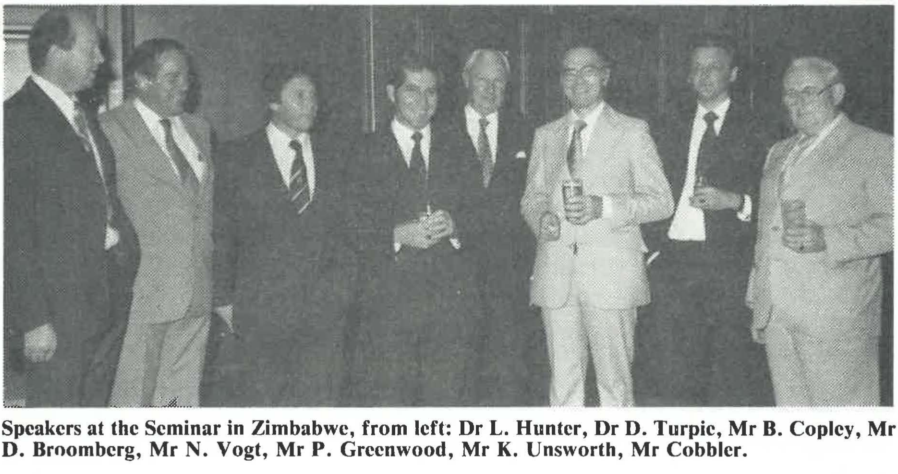
Seminar in Zimbabwe

The Director, Dr D. W. F. Turpie, the Assistant Director, Dr L. Hunter and the CSIR's Regional Liaison Officer, Mr N. J. Vogt, attended a textile seminar "New Technology in a New Zimbabwe" in Salisbury on Monday, 6th

October. The seminar was organised by the Cotton Promotion Council of Zimbabwe. Dr Hunter presented a paper on the Significance of Cotton Fibre in Subsequent Processing and Yarn and Fabric Performance and Dr Turpie addressed the delegates on the SAWTRI Autocreel and SAWTRI comb.



Standing in front of photographs of the SAWTRI AUTOCREEL and SAWTRI COMB are, from left to right: Mr J. Cizek of SAWTRI, Mr L. Barnaba of SAVIO, Dr D. W. F. Turpie, SAWTRI's Director, Mr Augusto Carolli of Cognetex, SAVIO's Division of Textile Machinery and Mr F. J. J. van Vuuren of CSIR's Saidcor.



Speakers at the Seminar in Zimbabwe, from left: Dr L. Hunter, Dr D. Turpie, Mr B. Copley, Mr D. Broomberg, Mr N. Vogt, Mr P. Greenwood, Mr K. Unsworth, Mr Cobbler.

United Kingdom Industrialist Visits SAWTRI

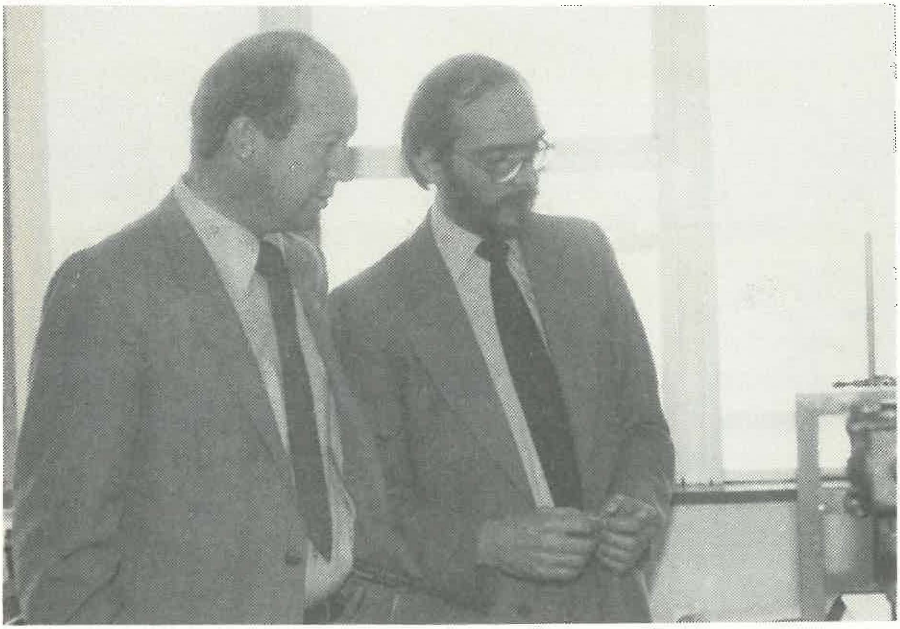
Mr Paul E. Goodwin, Technical Manager of Shirley Developments Ltd, Didsbury, Manchester, visited SAWTRI on October 2nd to discuss matters of mutual interest and latest developments in textile testing equipment. Mr Goodwin was particularly interested in SAWTRI's work on the measurement of the properties of South African Cotton and on finding the interrelationships. SAWTRI was one of the first establisments to obtain one of Mr Goodwin's firm's machines, the IIC Shirley Fineness Maturity tester.

Farmer's Study Group visits SAWTRI

On November 11th the Sidbury wool study group consisting of wool farmers and their wives paid a visit to SAWTRI to study all aspects of wool research and so increase their knowledge of the wool fibre they produce.

CSIR Regional Office Activities

The East Cape Regional Research Committee had their annual General Meeting at SAWTRI on November 18th. On the same day, a CSIR Audio-visual programme was presented for members of the East Cape branch of the Steel and Engineering Federation of South Africa (SEIFSA).



Dr L. Hunter, Assistant Director of SAWTRI, left, and Mr Paul E. Goodwin of Shirley Developments Ltd, Manchester, looking at a testing instrument in a SAWTRI Laboratory.

Other Visitors

Mr D. Yung of the Chiel Wool Textile Company Ltd, in Seoul, Korea, had discussions on December 2nd with Mr N. J. Vogt and Dr Turpie and visited the Worsted and Weaving Departments.

Three students from the Glen Agricultural College visited the Institute on December 3rd.

On December 10th Mr J. E. Ford, Senior Research Marketing Manager of the Project and Membership Department of the Shirley Institute held discussions with Dr Hunter and Mr Vogt and addressed the East Cape Section of the Textile Institute in the afternoon.

Messrs Yasushi Hamanaka, General Manager of Hamanaka Co. Ltd, Kyoto, Shigenobu Kawashima, Managing Director of Nagawa Co. Ltd, Nagoya; Rikio Hamanaka, President of Hamanaka Co., Ltd; S. Yano, General Manager Wool Department of Mitsui & Co. Ltd visited SAWTRI on 16th September. These firms are spinners of hand knitting yarns and specialise in mohair. The visitors had talks with Dr Hunter and other staff members of SAWTRI.

Members of the Sidbury farmers' group inspecting one of SAWTRI's Saurer looms.

Mr J. E. Ford of the Shirley Institute at the DREF spinning machine. Behind him are Dr L. Hunter, left, and Mr N. J. Vogt of the CSIR Regional Office at SAWTRI.

Extensions to SAWTRI Building Complex

A completely new scouring building is being erected and the new premises will include redesigned laboratories and offices.

Building extensions to existing facilities which will have a far reaching effect on the over-all research picture at SAWTRI, are under way. The space presently occupied by the scouring department will be used to house the knitting and clothing technology departments and the building extended to house beaming, warping and yarn preparation.

On the south side of the building complex a new boiler house, chilled water compressor rooms and new premises for *Phormium tenax* processing, are being erected.

Finally, new covered parking bays will be erected beyond the reservoir to the South West of the complex. The work is expected to be completed early in 1982.

Staff Appointment

Mr V. G. Russell has been appointed as senior Technical Manager in the clothing Technology Department. Mr Russell has had wide experience in the tailoring business in London's West End. He has also worked for the S.A. Bureau of Standards.

SAWTRI PUBLICATIONS

During the past 12 months the following papers, written by SAWTRI scientists, have been published:-

SAWTRI Technical Reports

No. 455 : Turpie, D. W. F. and Strydom, M. A., The Processing Characteristics of South African Wools, Part XVII: The Influence of Outsorts on the Processing Performance of Good Topmaking Fleeces.

No. 456 : Cawood, M. P. and Hunter, L., The Dimensional Properties of Textured Polyester Double Jersey Fabrics: Part II: Influence of Heat Setting Variables.

No. 457 : Smuts, S., Hunter, L. and Gee, E., The Identification of Mohair in Blends with Other Animal Fibres by using their Frictional Properties.

No. 458 : Strydom, M. A., Studies on Pigmented Wools, Part II: Processing Performance of Willeyed Karakul during Topmaking.

No. 459 : Barkhuysen, F. A. and van Rensburg, N. J. J., Resin Treatment of Cotton Fabrics in the Slack State in Liquid Ammonia.

No. 460 : Hunter, L., Spencer, J. D. and Gee, E., Some Typical Properties of Cottons Grown in South Africa from 1977 to 1979.

No. 461 : Shiloh, Miriam, Hunter, L. and Smuts, S., The Effect of Fibre Properties and Weave Crimp on the Hygral Expansion of Wool Fabrics.

No. 462 : Hunter, L., Gee, E., Spencer, J. D. and Taylor, H., The Effect of Wool Fibre Properties on Spinning Limits and Yarn Properties for the Dref II Spinning System.

No. 463 : Publication delayed.

No. 464 : Cawood, M. P. and Robinson, G. A., The Dimensional Changes of Outer Fabrics and Interlinings during Fusing, Part I: The Effect of Temperature and Time when using a Continuous Fusing Press.

No. 465 : Hunter, L., Shiloh, Miriam and Smuts, S., The Effect of Fibre Properties on the Tensile and Flat Abrasion Properties of Some Woven Wool Fabrics.

No. 466 : Robinson, G. A., Cawood, M. P. and Dobson, D. A., The Effect of Take-Down Tension on Yarn Breakage During Knitting and Certain Fabric Properties of All-Wool Interlock.

SAWTRI Special Publications

Hunter, L., Textiles: Some Technical Information and Data, Part X: Cotton (December, 1980).

Cawood, M. P., Textiles: Some Technical Information and Data, Part VI: Fusing (September, 1980).

SAWTRI Editorial Committee: Opening Address, Conference Summary and Summaries of Papers and Discussions of the 6th Quinquennial International Wool Textile Research Conference, Pretoria, Aug/Sept., 1980.

Other Publications

Turpie, D. W. F., Textiles — A Fascinating World of Research, *Scientiae,* **21** (3), 2 (1980).

Turpie, D. W. F., Future Research on Mohair at SAWTRI, *Angora Goat and Mohair Journal,* **22** (1), 13 (January 1980).

1980 Conference Papers

The following papers presented by SAWTRI authors have been published in the Proceedings of the 6th Quinquennial International Wool Textile Research Conference, Pretoria (Aug./Sept., 1980).

Hunter, L., The Effects of Wool Fibre Properties on Processing Performance and Yarn and Fabric Properties, Vol. I, p.133.

Mozes, T. E. and Turpie, D. W. F., Treatment of Wool and Mohair Scouring Wastes with Bitterns, Vol. III, p. 93.

Turpie, D. W. F. and Hunter, L., The Effect of Raw Wool Blending on Worsted Processing Performance and Yarn and Knitted Fabric Properties, Vol. III, p.203.

Turpie, D. W. F., Cizek, J. and Klazar, J., An Introduction to the SAWTRI Comb, Vol. III, p.279.

Turpie, D. W. F. and Gee, E., The Properties and Performance during Top-making and Spinning of a wide Range of South African Wools, Vol. III, p.293.

Hunter, L. and Gee, E., The Effect of Staple Crimp, Resistance to Compression and Fibre Diameter and Length Characteristics on the Physical Properties of Wool Worsted Yarns, Vol. III, p.327.

Hunter, L., Smuts, S. and Gee, E., The Effect of Staple Crimp, Resistance to Compression and Other Fibre Properties on the Physical Properties of Knitted and Woven Fabrics, Vol. IV, p.1.

Hunter, L., Smuts, S. and Turpie, D. W. F., The Effect of Certain Mohair Properties on Yarn and Fabric Properties, Vol. IV, p.67.

Cawood, M. P., Robinson, G. A. and Dobson, D. A., Repco Wrapped Core-Spun Wool Yarns in Knitwear, Vol. IV, p.123.

Robinson, G. A., Cawood, M. P. and Dobson, D. A., Cockling in Fully Fashioned Knitwear, Vol. IV, p.169.

Van Rensburg, N. J. J. and Barkhuysen, F. A., The Shrinkresist Treatment of Wool with Acid Colloid Solutions prepared from Methylol-melamine Resins, Vol. V, p.19.

Weideman, E., Van Rensburg, N. J. J. and Van der Walt, L. T., The Shrinkage of Untreated, Chlorinated and Resin treated Wool in Organic Solvent-Water Mixtures, Vol. V, p.151.

Van der Walt, G. H. J. and Van Rensburg, N. J. J., A Study of the Drying of All-Wool and Wool Blend Fabrics by Dielectric and Conventional Heating Systems, Vol. V, p.349.

Maasdorp, A., The Significance of Temperature and Acid Type on the Exhaustion of Chromium VI onto Dyed and Undyed Wool Fabric, Vol. V, p.449.

Maasdorp, A., A Low Temperature Afterchrome Technique, Vol. V, p.469.

SAWTRI Publications Abroad

SAWTRI has made arrangements with the Textile Institute in Manchester whereby SAWTRI publications may be obtained from the Textile Institute. Overseas readers who wish to obtain such publications may now contact the Textile Institute in Manchester, should it be more convenient for them to do so.

Additional 1980 Quinquennial Conference Document

SAWTRI has published the complete summaries and discussions of papers presented at the 1980 Conference in Pretoria. This publication also contains the opening address by the State President and Dr Ken Baird's conference summary. Copies of the publication have been sent to all delegates who attended the Conference with the Institute's compliments. Readers who would like to receive copies may order them from SAWTRI at R10,00 per copy.

PREPARING GINNED COTTON FOR PURPOSES OF AIRFLOW MEASUREMENT

by S. SMUTS and L. HUNTER

ABSTRACT

Airflow measurements of micronaire, fineness and maturity obtained on hand prepared (hand carded) samples were compared with those obtained on samples which had been prepared by a passage through a Shirley Analyser which is the accepted procedure. Only thorough hand carding, which was very time consuming, generally gave satisfactory estimates of fineness and maturity as measured on Shirley Analysed samples. It therefore seems that mechanical preparation is the only reliable and practical method. Micronaire readings were generally less dependent upon the sample preparation.

INTRODUCTION

Because airflow measurements on cotton are not very sensitive to relative humidity changes[1–3], particularly within the range 25% to 80% RH, the accurate control of atmospheric conditions is not an essential prerequisite for such tests, when only estimates of the properties are required.

Lord[4] found the average difference between micronaire results obtained on raw (i.e. hand fluffed and large pieces of leaf, seed and other trash removed before weighing) and Shirley analysed material to be negligible. He[5] stated, however, that to obtain precise airflow estimates of maturity and fineness it is essential to prepare samples in a standard manner, to blend the fibres and make them uniformly open — mechanical opening *must* be carried out to give a fleece or web of substantially random orientation. He went on to state that *raw* cotton of *variable* degree of openness gave inaccurate maturity and fineness values. Others have also found that proper sample preparation was essential[1, 2, 6, 7], especially if reliable fineness and maturity estimates were to be obtained by the airflow[2, 6, 8] technique.

Preparation by passing the samples through a Shirley Analyser is the accepted procedure for preparing cotton for air-flow tests although hand carding (hand opening) is also sometimes used. It seems, however, that sample preparation by hand does not give reproducible fineness and maturity estimates when compared with results obtained on samples prepared mechanically[8]. It has also been pointed out that hand carding has certain disadvantages[7]. For example it is not recommended for very trashy cottons[9], it is somewhat subjective and also very time consuming.

The aim of this work was to determine the effectiveness of different degrees of hand carding in preparing a range of ginned cotton samples for airflow measurements of micronaire, fineness and maturity.

EXPERIMENTAL

Ginned cottons were selected to cover a range of micronaire and trash contents. At each of three micronaire levels three levels of trash content were selected.

Three five gram samples of each of these cottons were prepared in the following ways:

(1) ginned cotton (i.e. not prepared);
(2) hand carded only (on average about 5 minutes spent on the preparation of each sample);
(3) hand carding plus some trash removal (on average about 10 minutes spent on the preparation of each sample);
(4) more thorough preparation by hand carding (on average about 20 minutes spent on the preparation of each sample);
(5) very thorough preparation by hand carding (on average about 45 minutes spent on each sample);
(6) prepared by passing through the Shirley Analyser (the standard procedure).

The prepared samples were pre-conditioned in an oven at 40°C/20% RH for 2½ hours, conditioned overnight at 20°C/65% RH and then tested (all on the same day) on a IIC-Shirley Fineness/Maturity Tester. After testing, the three subsamples for each state of preparation and for each micronaire/trash content combination were combined and the "residual" trash content determined on the Shirley Analyser in the standard manner.

RESULTS AND DISCUSSION

In all cases the results obtained on the samples which had been passed through the Shirley Analyser were taken to represent the actual or true values.

The difference between the airflow measurement obtained on samples prepared by any one of the procedures and that obtained on samples prepared in the standard manner (i.e. Shirley Analysed) was plotted against the preparation procedures which were arranged in order of thoroughness of preparation (Figs 1 to 3). These graphs illustrate the effect of preparation and initial trash content on the measured values. The micronaire values were hardly affected by either the state of preparation or initial trash content of the cotton. Only in the case of the coarsest and most trashy cotton was the micronaire reading seriously affected by the thoroughness of the fibre preparation. Both fineness and maturity, however, were sensitive to both the state of preparation and the initial trash content. Samples which had only been ginned gave lower maturity and higher fineness (coarser) values with the higher trash content cottons deviating most from the true value. Merely hand carding of the samples was not adequate, particularly for cottons with a high level of trash. Even after

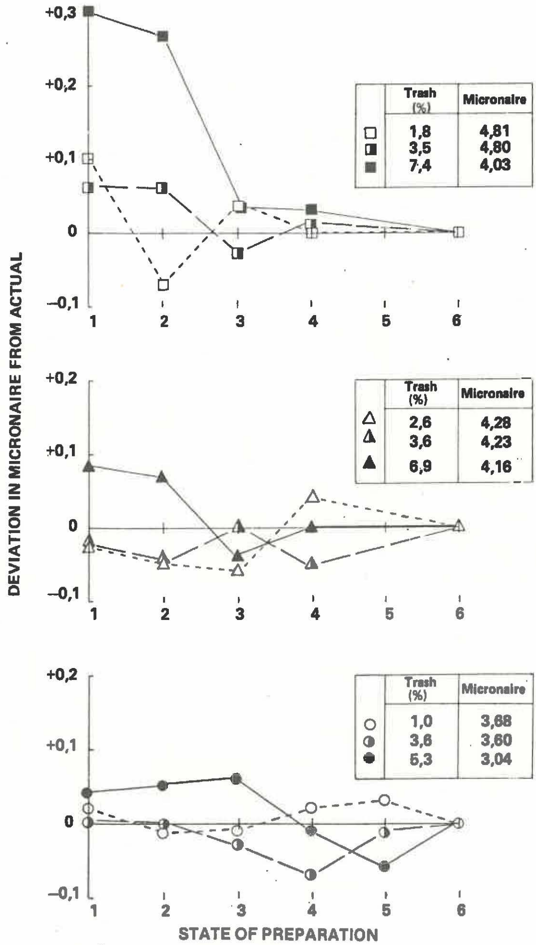


FIGURE 1

The Effect of Preparation on Micronaire

Key to State of Preparation

(1) Ginned cotton
(2) 5 mins hand carding
(3) 10 mins hand carding
(4) 20 mins hand carding
(5) 45 mins hand carding
(6) Shirley analysed

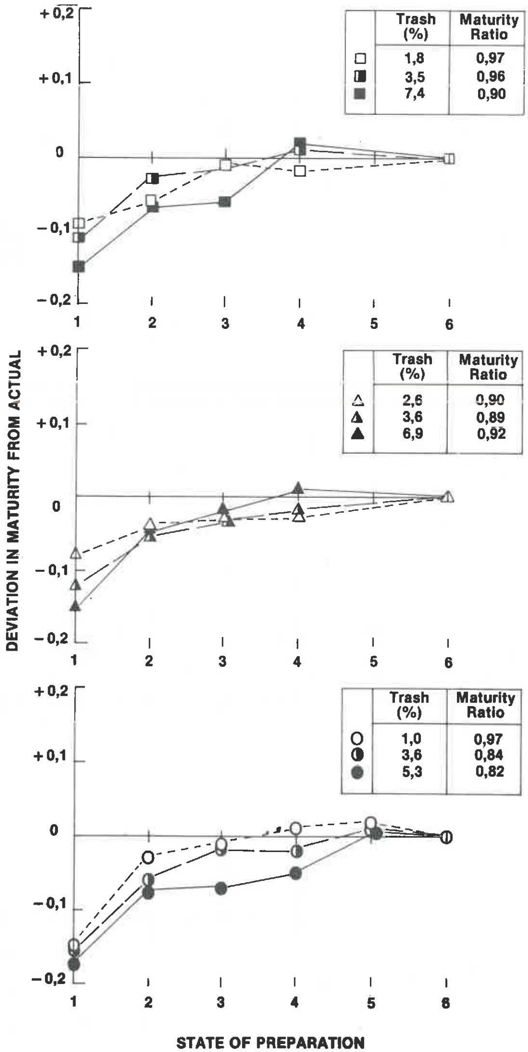


FIGURE 2

The Effect of Preparation on Maturity

Key to State of Preparation

(1) Ginned cotton
(2) 5 mins hand carding
(3) 10 mins hand carding
(4) 20 mins hand carding
(5) 45 mins hand carding
(6) Shirley analysed

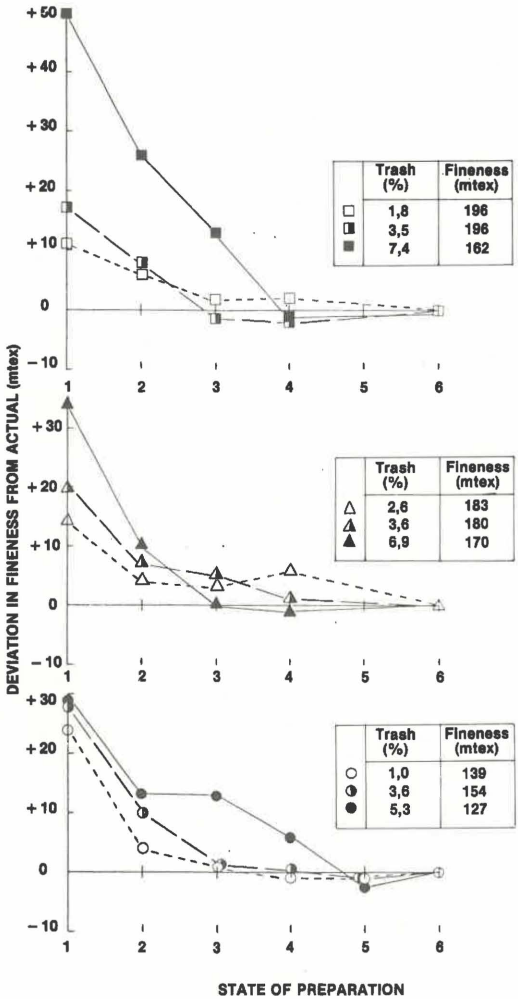


FIGURE 3

The Effect of Preparation on Fineness

Key to State of Preparation

(1) Ginned cotton
(2) 5 mins hand carding
(3) 10 mins hand carding
(4) 20 mins hand carding
(5) 45 mins hand carding
(6) Shirley analysed

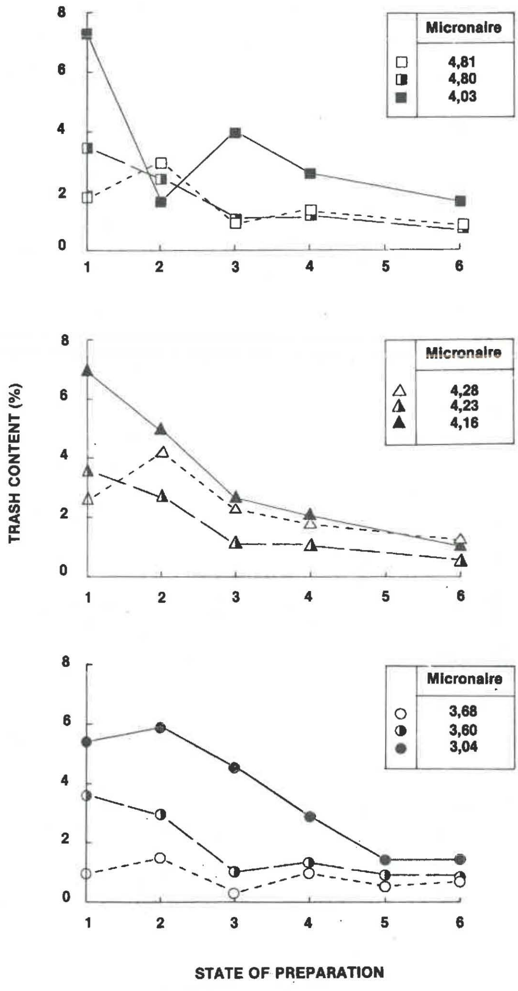


FIGURE 4

The Effect of Preparation on Trash Content

Key to State of Preparation

(1) Ginned cotton
(2) 5 mins hand carding
(3) 10 mins hand carding
(4) 20 mins hand carding
(5) 45 mins hand carding
(6) Shirley analysed

reasonably thorough hand carding there were still relatively large deviations from the true values, with the effect of trash content still present. Very thorough hand preparation gave results which were comparable with those obtained on samples which had been passed through the Shirley Analyser but, obviously, to prepare samples in this manner is extremely time consuming and therefore impracticable. If the initial trash content is not high then a ten minute hand carding procedure per subsample would appear to be adequate but even so the time factor is still great (especially if three subsamples had to be prepared).

The thoroughness (efficiency) of preparation may also be gauged from a plot of the "residual" trash content (i.e. trash present in the sample after hand carding) against the preparation procedure (Fig 4). These curves follow the same pattern as those in Figs 1 to 3.

CONCLUSIONS

Although airflow estimates of cotton fibre micronaire were found to be relatively insensitive to the state of sample preparation it is clear that thorough hand carding (and trash removal by hand picking) is imperative if good airflow estimates of fineness and maturity are required, especially for very trashy cottons. Adequate preparation by hand carding is, however, very time consuming. These findings corroborate those of other workers who found that reliable air-flow estimates of fineness and maturity require mechanical opening of the fibre by, for instance, passing the fibre sample through a Shirley Analyser.

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A NOTE ON THE EFFECT OF TWIST FACTOR ON SPINNING POTENTIAL MEASURED BY THE MSS TECHNIQUE

by M. A. STRYDOM and E. GEE

ABSTRACT

A set of 18 wool tops, varying in mean fibre length (37 mm to 69 mm), mean fibre diameter (19,1 μm to 26 μm) and staple crimp (2,8 to 6,2 crimps/cm) were each spun to two levels of no. of fibres in the cross-section each at three different twist factors. It was found that the largest contribution to the observed variations in the MSS at a constant yarn linear density was made by variations in the number of fibres in the yarn cross-section and mean fibre length. The effect of twist factor was found to be small, an increase of about 30 rev/min being observed for an increase of 1 unit in the tex twist factor. Analysis of the results also showed that the finer the yarn being spun for a given mean fibre diameter, the more sensitive the MSS results were to changes in mean fibre length.

INTRODUCTION

It has been shown by Turpie[1] and Gee and Turpie[2] that the MSS (Mean Spindle Speed at Break) technique is a quick and efficient method for assessing spinning potential. This test involves only about 1,5 hours actual spinning and essentially involves increasing the spindle speed at a given rate in steps of 500 rev/min, and counting the number of end breaks at each speed. The MSS value is then calculated by determining the weighted average spindle speed at which an end breaks. Turpie[1] then went on to show that for all-wool yarns, the MSS decreased with decreasing yarn linear density and mean fibre length and increasing mean fibre diameter. Since then, the MSS technique has not only become firmly established at SAWTRI as a routine test method in the study of the processing performance of South African wools, but also for ranking different tops in terms of their spinning potential.

In an attempt to identify other variables which have an effect on the values obtained using the MSS test, it was thought that *yarn twist* may be important. The amount of twist inserted into a yarn during spinning not only depends on the wool fibre characteristics, but also on the intended use of the yarn. For example, for certain knitting end uses or for worsted-spun weft yarns, a fairly "soft" twist is required (i.e. tex twist factors around 17 to 20) while common twist factors for weaving yarns are 30 or above[3]. Since twist is directly related to production, the commercial spinner normally uses his experience to determine the lowest twist which is sufficient to produce a commercially acceptable spin, plus an additional amount, if necessary, to cover the specified requirements of tenacity or appearance in the fabric. It is reasonable to assume that a spinner who wishes to use the MSS technique would test his tops at the required twist factor at which the wool is to be spun, and with this in mind, it was decided to investigate whether changes in twist factor would have an effect on the relative importance of certain fibre properties on spinning performance as measured by the MSS technique.

EXPERIMENTAL

Eighteen lots, representing a 3x3x2 factorial design (3 levels each of mean fibre diameter and of mean fibre length, each either overcrimped or undercrimped relative to the Duerden standard), were tested. The relevant fibre details are given in Table I. Each lot was spun on 18 spindles of a Rieter H6

TABLE I

PHYSICAL PROPERTIES OF THE TOPS

Lot Code	Mean Fibre Diameter (μm)	CV (%)	Mean Fibre Length (Almeter, mm)	CV (%)	Crimp Frequency (crimps/cm)	Crimp Ratio*
BR50	18,1	21	51,0	44	5,6	0,89
BR57	18,5	23	53,0	49	6	1,07
CRM 1	19,6	18	62,3	54	6,2	1,18
BR42	19,6	23	58,0	57	4,1	0,83
PLS10	19,9	25	37,0	43	5,2	1,09
PLS1	20,8	23	39,0	36	3,4	0,81
OSP 2	21,1	22	59,0	59	4,1	0,99
BR47	21,1	23	55,0	38	3,7	0,79
PP75	21,1	23	63,0	44	3,6	0,89
PLS 7	21,6	23	49,0	38	3,4	0,81
PLS 4	21,9	25	39,0	47	3,3	0,83
OSP 13	22,2	22	52,0	41	4	1,12
OSP 10	22,4	23	66,0	41	3,7	1,01
OSP 12	22,9	23	69,0	51	3,2	0,93
BR 14	23,1	20	73,0	58	3,7	1,08
BR 44	23,2	24	66,0	41	3	0,91
PP 89	23,4	22	45,0	36	3,4	1,02
BR 63	26,0	27	62,0	55	2,8	1,06
Variable	X_1	X_2	X_3	X_4	—	X_5

*Ratio of actual crimp frequency to crimp frequency of a Duerden wool of the same diameter

TABLE II

MSS RESULTS FOR DIFFERENT TWIST FACTORS AND YARN LINEAR DENSITIES

Lot Code	Calculated No Fibres in Yarn Cross-Section	Equivalent Yarn Linear Density (tex)	MSS at Tex Twist Factor		
			23,4*	30,4*	37,4*
BR 50	31	11	7272	7354	7895
	38	13,5	7687	8979	9479
BR 57	30	11	7270	7654	6854
	41	15	10875	10770	9291
CRM 1	33	13,5	10541	10770	9583
	41	16,5	12833	13583	12750
BR 42	32	13,5	9833	10791	10166
	43	18	13027	13333	12972
PLS 10	41	18	7111	8194	9472
PLS 1	32	15	**	5750	5812
	42	19,5	7083	8000	8916
OSP 2	29	15	10354	10333	8654
	41	19,5	11972	11722	10888
BR 47	31	15	8062	9652	9645
	40	19,5	11305	12759	11444
PP75	31	15	9652	11187	9770
	40	19,5	13027	12972	12027
PLS 7	33	16,5	8833	9472	8833
	41	21	10277	11944	10722
PLS 4	31	16,5	**	6000	7694
	40	21	7527	8777	9333
OSP 13	31	16,5	7611	7861	7722
	39	21	8583	11277	10000
OSP 10	30	16,5	8166	9777	8888
	42	23	11416	12916	12527
OSP 12	32	18	10472	10694	10472
	41	23	13000	13138	12805
BR 14	32	18	11388	10666	10416
	40	23	13055	13055	12516
BR 44	31	18	8722	9916	9444
	39	23	9916	11777	11027
PP 89	30	18	6166	5833	7861
	42	25	9472	11555	10833
BR 63	31	23	7916	8944	8694
	41	31	9694	11388	11111
Variable	X_6	X_7	Y		

*Tex Twist Factor = X_8 **No spin possible worsted ringframe fitted with crowned spindles for producing collapsed balloons, at three different levels of twist. The text twist factors in each case were 23,4 30,4 and 37,4. Two yarn linear densities were spun for each lot, corresponding as close as practically possible, to 30 and 40 fibres in the yarn cross-section, respectively. The yarn linear density range corresponding to these two values varied from 11 and 13,5 tex (for the 30 and 40 fibres in the cross-section levels, respectively) for the finest wool (BR50, 18,1 μm) to 23 and 41 tex for the coarsest (BR63, 26 μm).

The mean spindle speed at break (MSS) was calculated in the usual manner for each lot[1, 2] and multiple linear regression analyses were carried out with the MSS values as the dependent variable (Y). The fibre properties (X_1 – X_3), and tex twist factor (X_8) were used in the model as independent variables, together with either number of fibres in the yarn cross-section (X_6) or yarn linear density (X_7). The MSS values, together with X_6, X_7 and X_8 are given in Table II.

RESULTS AND DISCUSSION

Table II shows that at the lowest twist factor, two lots (PLS 1 and PLS 4) could not be spun at 31-32 fibres in the yarn cross-section, even at the lowest practical spindle speed of the frame (which is around 5 000 rev/min). This was probably due to the fact that both these lots were very short (see Table I). Taking the mean values for MSS at each twist factor (i.e. the overall mean and the means for the 2 sub-sets representing 29-32 and 38-42 fibres in the cross-section) it would appear that the MSS was the highest at the 30,4 twist factor, suggesting that there might be an optimum twist factor for maximum spinning performance. It is known that such a relationship exists between yarn tenacity and twist factor[5], but since only three different levels of twist were selected for this study, it was not considered sufficiently accurate to make such a deduction from the available evidence concerning the mean MSS values only. It was therefore decided to attempt verification of curvature by multiquadratic regression.

The following two best-fit equations, significant at the 95% confidence limits (Y = MSS; in rev/min); were obtained:

$$Y = 4{,}69\, X_6X_3 - 1{,}99\, X_2X_3 - 0{,}51\, X_3X_5 + 0{,}66\, X_8X_4 + 1943 \quad \ldots\ldots(1)$$

$$n = 106$$

$$r = 0{,}91$$

$$Y = -8{,}33\, X_7X_3 - 833\, X_1 - 135\, X_2 - 145\, X_7X_5 + 8{,}18\, X_8X_7 + 1{,}13\, X_4^2 - 2{,}64\, X_8X_4 + 286\, X_3 + 697\, X_7 + 7339 \quad \ldots\ldots\ldots\ldots(2)$$

$$n = 106$$

$$r = 0{,}92$$

Equation (1) shows the relationship featuring the number of fibres in the yarn cross-section, while equation (2) features yarn linear density instead. In both cases the contribution of X_8^2 was rejected as being statistically non significant, confirming that for this particular data set the effect of twist factor on MSS could be considered linear for all practical purposes. This aspect is to be studied in greater detail when a more comprehensive range of twist factors will be considered.

To assess the relative contribution of the various terms to the observed statistical fit of the data, their partial correlations were calculated. This showed that 75% of the observed variation in MSS could be explained by variations in number of fibres in the cross-section, and mean fibre length. This confirms the overwhelming importance of these two parameters determining spinning potential. Equations 1 and 2 also show that the MSS results were only slightly affected by changes in the twist factor.

The effect of changes in the mean fibre length and mean fibre diameter on MSS can also be assessed from these two equations. These are of more prac-

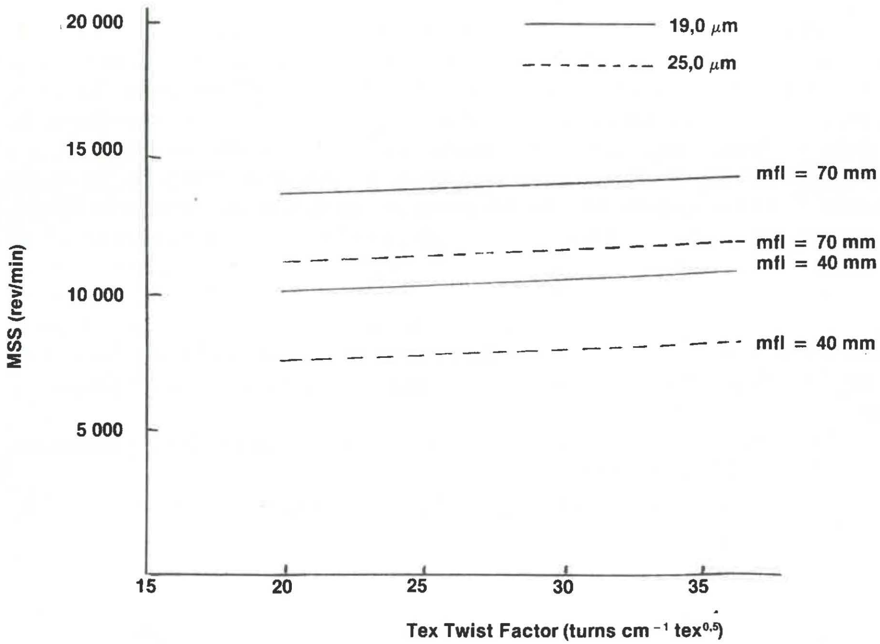

FIGURE 1

The Effect of Twist Factor on MSS at a Constant Yarn Linear Density (20 tex).
CV_ℓ = 45%; CV_d = 23% and Crimp Ratio = 1

tical significance to the spinner as tops are bought primarily on the basis of length and quality (fineness). The prediction result is that by increasing the mean fibre length by 10 mm the MSS values increased by 1 100 rev/min while reducing the mean fibre diameter by 1 μm effected an improvement of 844 rev/min in the MSS values. Similar observations have been made by Turpie and Gee[4].

For illustration purposes the effect of twist factor on the observed trends of MSS with regard to yarn linear density, mean fibre diameter and mean fibre length is shown in Figs 1, 2 and 3. The regression curves have been calculated from the equations assuming a crimp ratio of 1,0; a CV of mean fibre diameter of 23% and a CV of mean fibre length of 45%. These figures show the large effect of mean fibre diameter and mean fibre length compared with the effect of twist factor on MSS. Fig 2 also shows that the finer the yarn being spun at a constant mean fibre diameter, the more sensitive the MSS is to changes in the

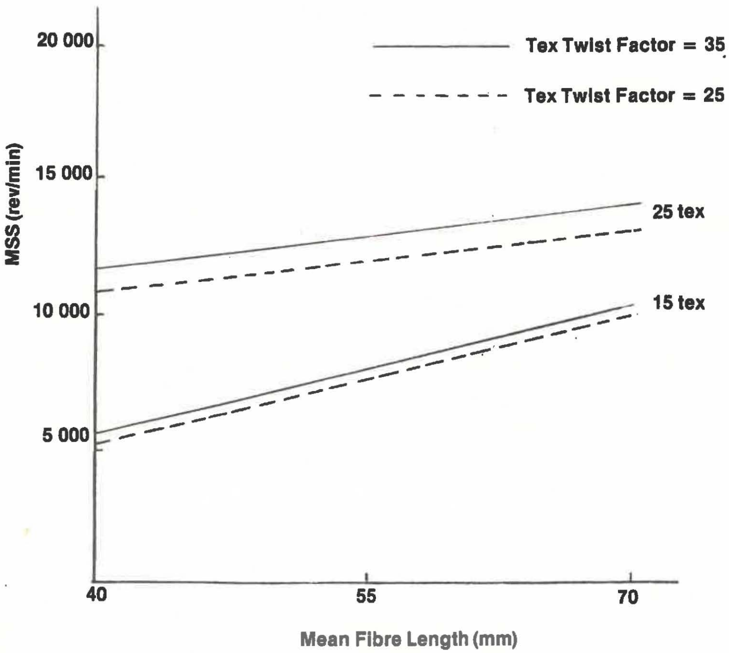

FIGURE 2

The Effect of Mean Fibre Length on MSS at a Constant Mean Fibre Diameter (22 μm). CV_{ℓ} = 45%; CV_d = 23,0% and Crimp Ratio = 1,0

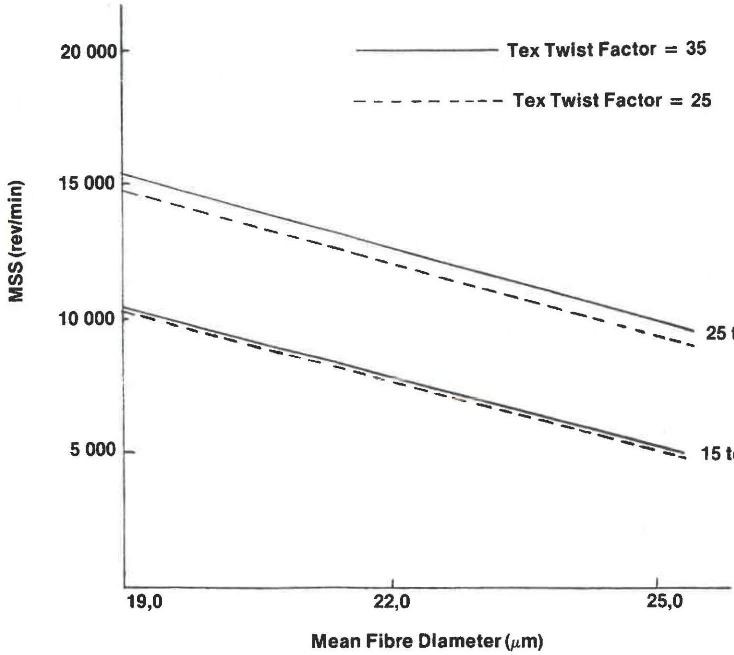

FIGURE 3

The Effect of Mean Fibre Diameter on MSS at a Constant Mean Fibre Length (55 mm) CV_ℓ = 45%; CV_d = 23% and Crimp Ratio = 1,0

mean fibre length. Both Fig 2 and Fig 3 show that there is no significant difference in the slope of the curves for the 25 and 35 twist factors, suggesting that within the range of values for the various parameters covered in this study, there was no effect of twist factor on the relationship between MSS and mean fibre diameter or mean fibre length.

SUMMARY AND CONCLUSIONS

The effect of twist on the assessment of spinning potential by the MSS technique was studied using 18 tops varying in mean fibre diameter, mean fibre length and crimp ratio. From each wool lot, two yarn linear densities (corresponding to approximately 30 and 40 fibres in the yarn cross-section) were spun at three levels of twist, namely at tex twist factors of 23,4 34,4 and 37,4. Multiple linear regression analysis of the MSS results showed that the effect of twist on MSS was small compared with the combined contribution of mean fibre length, mean fibre diameter or, equivalently, fibres in the yarn cross-section. Increasing the twist factor increased the MSS values slightly, the magnitude of the increase depending on the CV of mean fibre length and yarn linear density. Using average or typical values for certain of the variables in the regression equations it was shown that increasing the tex twist factor by 10 units increased the MSS by only about 260 rev/min compared with an improvement of 833 rev/min obtained by using a top 1 μm finer or an improvement of 550 rev/min when obtained using a top 5 mm longer. It also emerged that the finer the yarn being spun from a given mean fibre diameter, the more sensitive the MSS was to changes in mean fibre length. Further studies will be aimed at determining whether spinning potential is a quadratic function of twist, as is the case with yarn tenacity.

ACKNOWLEDGEMENTS

The authors wish to thank Mr S. G. Marsland for carrying out the MSS tests and Miss C. I. Watermeyer for assistance with the statistical analyses. The South African Wool Board's permission to publish this report is appreciated.

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Published by
The South Arican Wool and Textile Research Institute,
P.O. Box 1124, Port Elizabeth, South Africa,
and printed in the Republic of South Africa
by Nasionale Koerante Beperk, P.O. Box 525, Port Elizabeth.