THE STANDARD SPINNING TESTS CURRENTLY USED IN THE COTTON RESEARCH INSTITUTE FOR EVALUATING EGYPTIAN COTTON PROGRAM

MOHAMED A. M. EL-SAYED and SUZAN H. SANAD

Cotton Research Institute, Agricultural Research Center. Giza. Egypt

prof.negmmohamed@yahoo.com

INTRODUCTION

Improving cotton quality through introducing new varieties is one of the most important objectives of the cotton research program carried out by the Cotton Research Institute (C.R.I.). Cotton quality is a composite characteristic; it includes the various fiber properties that affect processing and the quality of the end product. The various fiber characteristics, staple length, strength, fineness and maturity beside yarn properties are the most obvious. Various methods for their determination and assessment of cotton quality are available.

More recently, the Cotton Research Institute, in its effort to continuously improve the Egyptian cotton competitiveness in world markets, modernized the pilot spinning mill, which was established in 1934 as well as adding a new completely spinning machines as semi-industrial condition, to evaluate (i) the promising varieties in isolate field, (ii) spinning test of the new varieties which launched in the market, (iii) testing the potential spinning performance of the commercial varieties and (iiii) evaluation the spinning new Egyptian cottons strains to help the breeders in introducing. This spinning test lies not only in the practical opinions expressed as to the quality of the varieties examined, but also in the fact that it provides a useful link between the breeders and industry; by this means new varieties can be launched in the market to the notice of spinners much earlier than would otherwise happen, and the breeders on their side are able to gain some idea of the trade reaction to new cottons.

Abdel-Salam (1) reported that the methods of quality measurement and evaluation of promising varieties, strains and commercial cottons have developed through three distinct stages:

1. In the early days, quality assessment depended mainly on the grader's skilled judgment and later on fiber length and fineness.
2. As from 1936, assessment depended on yarn strength supported by fiber length and fineness and,
3. As from and mid 1960s, a new system has been developed that takes into account several important quality parameters including fiber length, fineness and maturity, strength and elongation and yarn strength, neppiness and regularity.

Historical background

Three scientists pioneered the development of the Egyptian cotton they are Dr. Lawrence Balls, Mr. C. H. Brown, and Mr. H. A. Hancock, regarding breeding maintenance and quality respectively. Balls dealt mainly with production and quality, Brown pioneered breeding activities while Hancock was interested essentially in varietals maintenance as well as spinning.

In 1910, there was a technical problem of the Egyptian cotton crop, it seemed to defy solution: there was a highly elaborate, specialized and conservative spinning industry which paid certain prices for certain cottons; no-one know why. There was also a brilliant crop of graders, who supplied what the spinner wanted, and their word was law about any new cotton; no-one know enough to analyze their intuitions, even among themselves. In addition, deterioration continuously in the Egyptian cotton.

As Dr. Lawrence Balls studied of physiological and genetics recounted in "The Cotton Plant in Egypt" narrowed down to contact with market requirements it became increasingly obvious that valuation of new cottons by "expertise" was leading anywhere, and consequently it sometimes led backwards. An outline of Dr. L. W. Balls's knowledge at this stage was written up in the "Development and Properties of Raw Cotton," which concludes with reference to Mr. J W.

McConnel's suggestion of the need for a Spinner's Testing House. This leads to the next stage of the history of the Spinning Test Mill in Giza.

The spinning test mill at Giza commenced operations in 1934, the "Ring Spinning Technique" to be described in the following was a product of the brain of H. A. Hancock, especially as regards the diverse but convergent lines of research which established its basis.

Ring Spinning Technique

1. The first phase: basic 1000 grams technique

Development of the Basic 1000 grams technique

The 1000 grams technique was derived from Balls (2) «Handbook of Spinning Tests for Cotton Growers ». The technique was intended to be used on conventional machinery and its development is an illustration of the close relationship which exists, and has existed for many years, between Egypt, where cotton growing is the main activity of the country, and Lancashire, whose main activity has been the spinning of cotton. It is worthwhile to notice that: The spinner thinks of the test of cotton as one where the cotton is stable whilst the machinery is varied to enable the best results to be produced. The breeder thinks of the test as one where the machinery is constant whilst the cotton samples are variable.

1.1. Reasons for choosing 60's as the standard count

60's carded counts were a reasonable compromise, tending towards the lower end of the Egyptian range, but the resting of a number of samples in a wide range of counts showed that for estimation of relative value by lea product, 60's counts could be adopted without the introduction of bias.

The results obtained when Egyptian cottons were spun in three counts, ranging from 20's to 100's. It is relative order which is important, and this was not disturbed by spinning counts finer or coarser than 60's.

When tests are required on cottons of low grade or on samples which are known to be weak, it might be necessary to lower the counts to 40's.

1.2. Choice of twist factor

The twist factor used at Giza was 3.6, and it is near to that commonly quoted as the twist factor for maximum strength for Egyptian types of cotton in single yarns. Lower twist factors have been used, but 3.6 appear to be entirely satisfactory for the purpose for which it is intended.

2. Second phase: the normal 60 grams micro spinning technique

2.1. Development of the normal 60 grams Micro-spinning technique

The 1000 grams technique operated successfully over a period of years and, as the staff became more dexterous and the supervision more expert was able to process more and more samples each year. But the demand from breeders was insatiable; not only did they require more and more samples tested, but they wished to have results from smaller and smaller quantities of cotton, so that selection could be made as early as possible in the development from hybridized strains to pure lines by continued setting. From time to time, attempts were made to reduce sample size without reduction in the accuracy of the results. One of the first steps was to fit counting devices to the deliveries of all machines, and to work out counter numbers such that a sample would produce the absolute minimum of waste at each stage. When the technique was finally established on a basis of 60 grams per sample, steps were taken to mechanize the procedure.

60 grams was arrived at by empirical means and so stabilized because it was found that below 60 grams not enough material could be produced on two roving bobbins to enable a spinning of 24 leas from each sample, required in order that results could be compared directly with those of the 1000 grams technique, Dunkerley (3).

2.2. Detailed Description of the Giza Installation for 60 grams Samples, Hancock (4, 5, and 6).

Sampling: Experience has shown that a safe procedure is to draw the working sample from about 20 sub-lots taken from all parts of the bulk, whatever its size. Increased variability in repeat tests, ascribed to insufficient sampling, has been detected in experiments where the bulk was divided into less than about 10 sub-lots. A glass-topped bench marked out by lines into divisions of equal area is found convenient for spreading the bulk into sub-lots, and an Avery balance reading in grams is used for weighing.

Carding: The chief departure from normal technique is in the carding. A lap of normal width would be only 8 inches long for a micro sample ; and, in order to lengthen the lap, the card feed plate is blocked so that the available carding width is reduced to one-third. The first card lap is hand-made in three sections, each section being taken up by one complete revolution of the dish feed roller. There is a normal weight of cotton per unit area on the card cylinder wire, but the sliver delivered is only one-third the normal weight, because only one-third of the doffer width feeds. This fine hank sliver is hand wound into a sheet, on a drum one-third the width of the second card, the sheet being broken across and rolled up into a uniform lap for second carding.

The second card delivers sliver similarly fine, too weak for feeding to the Draw-frame: without stretch, and it also must be made into a lap. When doing so, the opportunity of a wrapping is taken. A long spring balance reading to half grams is used for weighing the whole of the fine second card sliver, the sample being reduced to a fixed weight by pulling off the surplus after the style of a butcher weighing sausages. The fixed weight of sliver is then wound uniformly on to a drum, and the sheet broken across and rolled up forms a lap for feeding to the draw-frame.

Drawing: Every sample is given two drawings, both first and second drawing sliver being of normal weight (0.26 hank). The procedure when making the draw-lap for first drawing was effectively a control wrapping using the whole of the sample, and no further wrapping is usually necessary until the ring frame is reached. The only exceptions are certain low quality cottons which are found to run fine at the draw-frame, perhaps due to stretch. These cottons are always known in advance, and for them the draft wheel is changed, the draw-frame gearbox being used so as to speed up the wheel changes.

First drawing sliver is divided into eight, controlled by a feeder counter driven from the delivery rollers. Small boxes are used instead of cans, and second drawing proceeds as usual from the eight ends. Since there is no waste due to wrappings, the quantity of cotton lost at drawings is slight-not more than six grams at the two operations. Only about 20 grams of cotton are lost in the two cardings, thanks to the low absorption of Roubaix card wire, so that about 34 grams out of the original 60 grams reach the slubber.

Slubber, Inter., Rover: The 12 samples of a group are assembled and treated simultaneously from now on. There are two doffing at each of the three-speed frames, the roving bobbins each building to 17 layers of 8-hank roving. The outer layer of the 24 rover bobbins in the group is run off, and used for a wrapping on which the ring draft change is calculated. The groups do not arrive all at the same mean hank, although they are given identical treatments.

Spinning: Draft wheels are changed for each group of 12 samples according to the roving wrapping alone ; this is much faster than spinning yam for wrappings, but seems to be just as accurate in getting the counts right. Two leas are spun, and then all bobbins are stepped up one spindle, number 12 sample going back to the spindle vacated by number of sample. This process is repeated until all 12 samples have spun two leas on all 12 spindles, thus eliminating the spindle error within groups; 24 leas of 6os twist yam are thus produced per sample sent for testing on four ring bobbins. For some types of sample the number of leas is cut down to 20, stepping up ten spindles only.

Yarn Strength Testing. The bobbins sent up, and the yarn on them, are indistinguishable in the laboratory from the bobbins and yarn of kilogram spinning. For reasons not yet clearly established, micro samples tend to be of slightly weaker yam than normal spinning ; but the decrease is detectable only in experiments specially laid out for the purpose, and the established quality scale from our normal spinning is substantially maintained in the micro spinning. Two standard Good brand lea testers are used and results are quoted as "Lea Strength x Counts Products" with the same corrections as for kilogram samples. About 1,400 leas are broken per day, a senior technical man and five assistants being concerned in the testing, weighing, and calculations.

Time per test: When the technique was first started in 1939, the rate of working was 24 samples per day of 6 hours, the limiting factor being the time for drawings. By 1942 more experience had been gained and the rate of working was 48 samples per day. In the 1943 season the mill ran steadily on a basis of 60 samples per day, results being reported on the fourth or fifth day after arrival of the samples, and this output is being exceeded in the 1944 season. This rate of working is possible only with the mass production methods suitable for a standard product, and no other yam but 6os twist is ever spun for micro samples.

2.3. Accuracy of micro spinning tests on 60-gram samples

Throughout this paper the spinning-test result is discussed only in terms of the lea strength x counts product (or, shortly, the lea product) of 6os carded ring twist yam.

The new test has been used largely for groups of cottons straddling only a part of the Egyptian quality range, as in comparing related strains of new hybrids; but even over a restricted range, the accuracy cannot be determined by reference to statistical tests alone. In a group of nominally identical repeat spinning, an estimate of the significance can be made in terms of deviations from the mean lea product of the group; but such estimate of accuracy evades the wider question of what the group mean represents

2.4. The Standard Deviation of the 60 grams Technique

The reduction in size of sample to 60 grams had an effect on the accuracy of the results, the Standard Deviation being raised to about 1.5% as against 1% for the 1000 grams samples. To produce results of the same degree of accuracy, two spinning tests would be required on each sample.

The total variance was made up from three parts, the genetic difference which we were attempting to measure, and the combination of the spinning and testing errors with the errors of sampling. It was found that the error of one micro-spinning test on the normal 60 grams technique was less than the sampling error, and both these errors together were much less than the variance within the material is processed.

2.6. Using the results from the 60 Grams Micro-spinning technique.

As developed in Pilot spinning mill, the results from 60 grams samples, or micro-spinning technique, are still used in:

a) To guide breeders in the selection of new varieties.

b) To control deterioration in cotton seed propagation lots.

c) To assist exporters in the preparation of even running Lots.

d) To inform spinners of the relative values of lots on offer.

In 1959, an important application of the micro spinning technique method (60 gram) was to test the breeding and maintenance program and also to test the commercial lots of Long-Staple varieties for spinning value in order to select their seed for sowing. In 1961, the machinery and staff at Giza spinning mill were unable to cope with all the tests in the time allowed before the sowing date. Therefore it was necessary to select 50% of the samples submitted without

Regard to their spinning value, and to submit the data at later date. To overcome this difficulties, the spinning technique was minimize the size of sample in order to shorten the time of spinning by 40 gram cotton lint in addition 60 gram only for propagation lots, and that leads to increase the spinning out-put by 50%. For 40 gram type of sample the number of leas is cut down to 12 instead of 24 leas given from the 60 gram sample, but this system is canceled in 2004/2005 season.

3. The third phase: The new system for evaluation 5 kilo-grams ring and compact spinning technique.

This system has been developed more recently by the author to evaluate:

a) The promising varieties in resolute field,
b) Spinning test of the new varieties which launched in the market,
c) Testing the potential spinning performance of the commercial varieties,
d) Evaluation the spinning test for new Egyptian cottons strains to help the breeders in introducing.

3.1. Machinery sequence.

The machines used in the pilot spinning mill procedure are: Compact Bale Opener "BO-C"; compact Opener "TO-C" with needle beater and contifeed; Chute feed and "DK-780" carding machine working with short and long term Auto leveler; HSR 1000 draw-frame machine, working with short and long term Auto leveler. All spinning preparation is by Trützschler, Germany. High-speed frame “PCX 16-A 36 spindles; RST 1 ring and compact spinning” Olfil System” on one frame consists of 96 spindles, the high-speed frame and ring spinning machine are by Marzoli, Italy. Schlafhorst Autocoro 338 winding machine and Schlafhorst Autocoro 24/288 Open-End spinning machine.

3.2. Avoidance of machine errors.

Experiment had shown that the error introduced by the spindles of the ring spinning frame were very small and could be neglected "between bobbins, the coefficient of variation of yarn count less than 1%. The same result was noticed with the yarn bobbin position for the tested part due to the impact of inverter motors on spindle speed and bobbin bled which emphasized the yarn tension between the front roll and the pigtail guide steady linearly as the yarn builds up (filling wind) from the empty to full bobbin.

3.3. Winding machine

Cotton Research Institute install the new generation of Schlafhorst Autoconer 338 type RM machine winder, which consists of ten heads. Five heads is suitable for coarse and medium yarns up to 40's and the others for the fine yarns up to 140's.

3.4. Fiber and yarn testing

HVI Spectrum and micromat instruments were used to get a full fiber data along with the yarn test.

The quality of a yarn is usually assessed in terms of its tensile strength and its evenness. It is true that for some purposes other properties such as appearance, friction, etc., may be more important than tensile strength, but whatever its end use a yarn must be strong enough to withstand the tensions imposed in the various processes, and the most useful practical measure of cotton quality is the strength of the yarn that can be spun from it. In the test for yarn strength commonly used in the industry and therefore adopted for spinning test work, a single yarn strength and elongation, Lea count strength product and yarn evenness and hairiness. During routine testing, both the three systems are usually recorded for assessing the yarn quality.

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