

COTTON YARN EVALUATION

W. D. L. STANLEY

Regional Research Station, Angunakolapelessa

ABSTRACT

Major quality characteristics of cotton yarn have been defined and their importance described. Variety HC 101, selected on the basis of economic characteristics and fibre properties, was subjected to spinning and yarn tests in the Cotton Technological Laboratory at Angunakolapelessa, as well as at the Spinning & Weaving Mills in Colombo. It was observed that HC 101 could be spun into 50s yarn in the laboratory and 40s yarn in the mill. Spun yarns were both average in evenness.

INTRODUCTION

Fibres and yarn properties are of importance in the design of textile structures, and to a large extent they govern the appearance and behaviour of various types of fabrics. But in determining quality, spinning performance is also important.

Spinning. In the words of Sir W. L. Bolls, "Cotton is grown to be spun". The bulk of the cultivated cotton (except for a small quantity used for miscellaneous purposes such as stuffing) is first converted into yarn by the spinning process before being used in the form of fabrics, cords, etc. Hence, spinning occupies an important intermediary step in the utilization of cotton. Depending on its end-use the yarn spun from cotton is expected to have certain important quality characteristics.

For instance, if the yarn is to be used for weaving a fine fabric of good quality, then it should also be very fine and have relatively high strength and regularity. During further processing or utilization of the yarn, it has to withstand various stresses and strains. Taking into consideration the end-use, certain minimum strength and evenness requirements have been specified for yarns of different fineness or counts and these strength standards are used to judge the spinning quality of a cotton.

The commercial value of a cotton is related to its spinning performance as judged by yarn quality and cottons which can be spun into fine yarns of high quality fetch higher prices than others which produce coarser low quality yarns. Although a large number of equations for predicting the spinning performance as judged by yarn strength have been suggested, the accuracy with which the yarn strength can be predicted is limited, probably due to certain unknown characteristics of the fibre and also to the less understood interaction of the fibre and the processing machinery.

Machinery Requirements in Spinning. Spinning may be briefly described as the process of simultaneously twisting and drawing an attenuated strand of fibres into a yarn. For this purpose the cotton has to be preliminarily treated. Firstly ginned cotton has to be opened out and cleaned free of trash and other foreign matter. This is usually carried out by a sequence of machines collectively referred to as blow-room machinery. Next, fibres are further teased out from lumps in the form of a web by carding and rolled as a sliver. Sometimes, when fine counts of yarn are desired to be spun, it is necessary to pass the material through a comber to eliminate short fibres below a certain length. The carded, or the combed sliver, is then passed through draw frames and speed frames to parallelise and attenuate the fibre strands. The material (roving) from the last speed frame is then passed through the ring frame where the final draft and twist are given to obtain yarn of the required count.

Yarn Tests. Yarn occupies the intermediate position in the manufacture of fabrics from raw cotton. Yarn testing is therefore essential both for estimating the quality of the raw cotton and for controlling the quality of the fabric produced. The important characteristics of yarn usually tested are linear density or count, twist, tensile properties, appearance and evenness or regularity. Of these the first three are very important as they are used for designating the yarn.

Various factors such as sampling, conditioning, atmospheric conditions during testing, method of test, and testing instruments used affect the results of tests. To give reliable information about the material, sampling must be true and representative of the bulk lot. Sampling procedures are designed to take account of and minimize variation between spindles and along the length of the bobbin.

COTTON YARN EVALUATION

Atmospheric conditions where the samples are stored, conditioned and tested, affect principally the determination of count and strength. Standard atmospheric condition of 65% relative humidity with the specified tolerances are maintained in the testing room at the Angunakolapelessa laboratory. To obtain accurate and reproducible results the various testing instruments are also periodically checked and calibrated to maintain their efficiency.

Twist in Yarns. When spinning fibres into yarns, the strand in a more or less parallel form is twisted on its own axis and drafted at the same time to form a yarn. Twist is essential to keep the component fibres together. Strength, dye take up, feel of the manufactured product are all dependent on the twist in the yarn. With increase in twist, yarn strength increases at first, reaches a maximum and then decreases. The twist may be defined as "the spiral disposition" of the components of yarn which is generally expressed as the number of turns per unit length of yarn, eg. turns per inch, turn per metre. Hence, the determination of twist in yarns would involve both the direction of twist and the number of turns per unit length.

Depending on the end-use, two or more single yarns are twisted together to form "plied yarns" or "folded yarns" and a number of plied yarns are twisted together to form "cabled yarns". Among the plied yarns, the most commonly used are the doubled yarns, wherein two single yarns of identical twist are twisted together in a direction opposite to that of the component yarns. Thus for cabled and plied yarns, the direction of twist and the number of turns per unit length of the resultant yarn as well as of each component have to be determined for a detailed analysis.

Linear Density or Count of Yarn. Fineness of yarn is usually expressed in terms of its linear density or count. There are a number of systems and units for expressing yarn fineness, depending on the material used for preparing the yarn and the locality where the yarn has been manufactured. Available systems are grouped into direct and indirect systems. In the direct system fineness is expressed as the weight per unit length of yarn, and in the indirect system it is expressed as the length per unit weight of yarn. The systems used till recently were indirect, the most important being the English cotton count (Ne), and the metric count (Nm). In the English cotton count system, the count of a yarn represents the number of hanks each of 840 yards which together weigh one pound. In the metric system, the yarn number represents the number of 1000 metric skeins of yarn which together

weigh one kilogram. Recently the International Standards Organization (ISO) and various organizations of textile scientists, technologists and manufacturers have been advocating the tex system for yarn numbering. In this system, which is a direct system, the tex number (t) represents the weight in grams of one kilometer of the yarn. It should be noted that while the other systems mentioned earlier are specific for cotton only, the tex system is applicable to yarns made from natural as well as synthetic fibres, and is hence useful for replacing the several different systems that are being used in the various sectors of the textile industry throughout the world.

Yarn Strength and Extensibility. Breaking strength of a yarn determined under certain specified conditions is an index of yarn quality although this factor alone does not entirely represent the performance of the material during actual use of further processing. Other factors such as extensibility, elastic modules, resistance to abrasion are also important depending on the end-use of the particular yarn.

Yarn strength is dependent on various factors. Quality characteristics of the fibre from which the yarn has been spun, the drafting system used and the twist inserted during spinning influence the strength of yarn. In addition the conditions under which tests are carried out also affect the value of yarn strength. For example, amount of moisture in the yarn influences the test results. Cotton yarns when fully wet show higher strength than when dry, while the opposite is the case with viscose rayon yarns. Hence, to eliminate the effect of variation due to moisture content of the yarn, all yarn strength tests are carried out after conditioning in a room at the standard atmospheric conditions of 27°C temperature and 65% relative humidity. During routine testing, both the breaking load and extension of yarn at break are usually recorded for assessing the yarn quality.

Yarn Evenness. Another important factor contributing to the quality of yarn is its evenness or regularity as this affects not only yarn strength but also the appearance of the fabric woven from it, especially in the case of fine fabrics. Strength of yarn is influenced by the number of weak spots along its length and the more irregular a yarn is the greater will be the number of weak spots. Consequently, during the subsequent processing of irregular yarn the chances of yarn breakage will be greater, thereby lowering both the efficiency of the process and the quality of the fabric and increasing production costs. Various factors such as the quality of the raw cotton used and the processing machinery employed contribute to the unevenness of the resultant yarn. The extent of irregularity is measured qualitatively by visual method and quantitatively by various instruments.

COTTON YARN EVALUATION

MATERIALS AND METHODS

Although in the early trial stages the selection of a cotton variety is made mainly on the basis of economic yield, fibre properties and the spinning performance estimated on the basis of fibre properties, it is essential in the final stages to subject in samples to extensive spinning tests before making a final selection.

Before spinning, certain preliminary treatments have to be given to the selected variety of cotton. HC 101 for instance was ginned to free the lint from cotton seed. The lint obtained was opened and cleaned to make it free of trash and other foreign matter by using blow-room machinery. Next the fibres were teased out from lumps in the form of a web by carding & tease rolled as a sliver. The carded sliver was passed through a draw frame and speed frame to parallelise and attenuate the strand of fibres referred to as roving. The roving was set on the micro-spinning plant to produce three types of yarns, having 25^s , 35^s and 55^s as their linear density or count.

In actual practice when two or more counts of yarns are spun from the same sample of cotton under identical conditions, the experimentally determined values of count strength product will be observed to decrease with increase in count and as such there is always an optimum spinning capacity which is the measure of optimum spinning quality of the cotton. This is termed as the highest standard count (HSC) for which the cotton is adjudged suitable. Yarns obtained from HC 101 was tested for strength and counts. The count strength product was computed in respect of each yarn spun from the observed values of strength and count. The computed values of count strength product were plotted against count on a graph paper in which the standard count strength product values had also been plotted. The point of intersection of the two lines corresponding to the standard count strength product and computed count strength products had a value for the count, and this count value was read from the graph.

As the highest standard count for HC 101 was 50^s , the micro spinning plant was set to spin 50^s yarn. This yarn again was subjected to evenness test to measure its regularity using evenness tester and it was found that the evenness was 21.18. Evenness was assessed using table.

In the estimation of optimum spinning capacity, or the highest standard count for the cotton HC 101, the sample used in the laboratory was very much smaller than normally handled in textile mills. Further, mill conditions differ from the controlled conditions maintained in the laboratory. Hence in order to see how HC 101 performed under mill conditions, the laboratory arranged mill tests and compared them with those obtained at the laboratory.

As the test results are influenced by the atmospheric conditions of humidity, the atmospheric condition in the entire spinning section in the mill was maintained constant at 65% relative humidity with the specified tolerances.

RESULTS AND DISCUSSION

With the intention of assessing the superiority of HC 101 towards spinning performance, full scale spinning tests were carried out and also the same variety was tested at the mill to compare with the laboratory tests. Table 2 indicates standard values of count strength product and observed values of count strength product in respect of the yarn spun from HC 101. Figure 1 shows the graphical representation of both the above mentioned values. Point of intersection of the two straight lines in Figure 1 indicates that HC 101 can be spun into 50^s yarn.

Test results obtained from the mill in respect of count strength product are given in Table 3 and the graphical form is given in Figure 2. Figure 2 also presents the graphical form of the standard count strength product values. It shows that the optimum spinning count at the mill is 40^s. Regularity measured in respect of the 40^s yarn spun at the mill was found to be 21.9, which again indicates that the yarn is average in evenness. Figure 2 further reveals that in spite of the enhanced spinning capability of HC 101 at the laboratory where the optimum spinning count was 50^s, at mill trial it has been reduced to 40^s. This reduction in spinning count under mill conditions is to be expected.

CONCLUSION

HC 101 is the standard cotton variety recommended by the Department of Agriculture. This recommendation is based on economic yield and fibre characteristics, but when this variety is subjected to spinning and yarn tests, it shows that it can be spun into 40^s commercially which is suitable and for the

COTTON YARN EVALUATION

manufacture of sarong and shirting materials. This emphasises the need for yarn evaluation as one of the vital components in determining the economic value of any cotton variety to be grown commercially.

ACKNOWLEDGEMENT

The author is grateful to Prof. Lakdas D. Fernando for kindly scrutinizing the scripts and offering useful suggestions.

REFERENCES

- Booth J, E. An Introduction to Physical Methods of Testing Textile Fibres, Yarns and Fabrics, Textile Institute (First Published in 1961 by Hey Wood Books) (39 - 67)
- G. Rovel Elliot B. Hand Book of Textile Testing and Quality Control, John Wiley and Sons (317 - 326)
- Sundaram. V., Iyengar, R. L. N., Bolls. W. L. Hand Book of Methods of Tests for Cotton Fibres, Yarns and Fabrics. (3 - 58)
- Skinkle, Joan. H. Textile Testing, Chemical Publishing Co. (46 - 70)

Table 1. Ranges of values of Uster Evenness for different evenness classes of yarn (100% carded cotton yarn)

<i>Count</i>	<i>Very even</i>	<i>Even</i>	<i>Average</i>	<i>Uneven</i>
20	Below 16	16 – 18	19 – 20	Above 20
30	„ 17.5	17.5 – 19.5	19.5 – 21.5	„ 21.5
40	„ 18.5	18.5 – 20.5	20.5 – 22.5	„ 22.5
50	„ 19.5	19.5 – 21.5	21.5 – 23.5	„ 23.5

Table 2. Laboratory test results for the yarn of HC 101

<i>English count</i>	<i>Observed strength (lb)</i>	<i>Observed values of C. S. P</i>	<i>*Standard values of C. S. P</i>
20		–	1340
25	66.80	1670	–
30		–	1440
40		–	1560
45	37.20	1674	–
50		–	1650
55	29.74	1636	–

C. S. P refers to Count, Strength Product

Table 3. Mill test results for the yarn of HC 101

<i>English count</i>	<i>Observed strength (lb)</i>	<i>Observed values of C. S. P</i>	<i>*Standard values of C. S. P</i>
20		–	1340
25	63.28	1582	–
30		–	1440
35	44.68	1564	–
40		–	1560
45	34.38	1547	–

C. S. P refers to Count Strength Product

- Source: Handbook of methods of tests for cotton fibres, yarns and fabrics (Sundaram, V and Iyengar, R. L. N)

COTTON YARN EVALUATION

Fig. 1

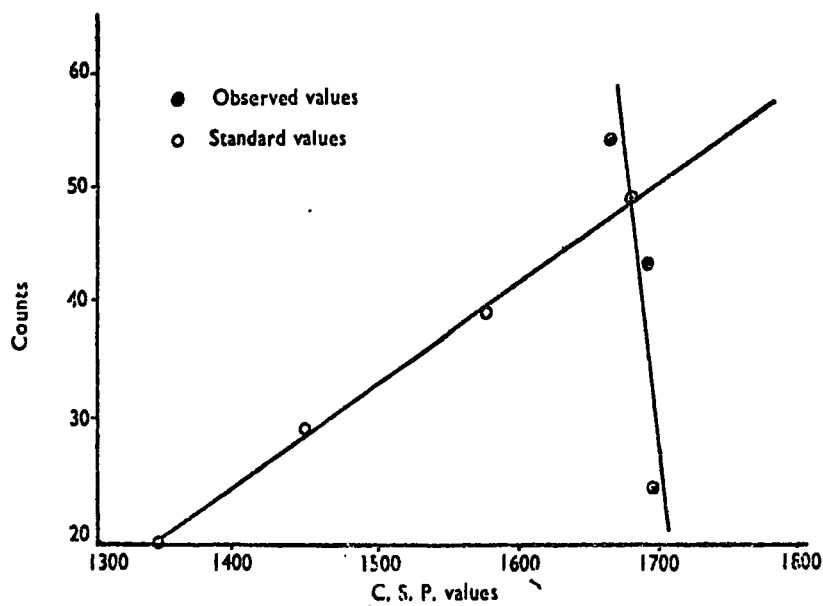


Fig. 2

