A STUDY OF THE EFFECTS OF SOME COTTON FIBER PROPERTIES ON YARN EVENNESS

By

MOHAMED SALAH EL-DIN SAYED GARAWAIN
B.Sc. (Agric.), Cairo University, 1959

THESIS

Submitted in partiel fulfilment of the requirements
for the degree of

MASTER OF SCIENCE
in
AGRONOMY

رسالة

Agronomy Department
Faculty of Agriculture
Ain-Shams University

مكتبة
المكتبة المركزية
جامعة عين شمس

1971

Central Library - Ain Shams University

EXAMINATION OF THESIS SHEET

Major field : Agronomy

Title of Thesis : A Study of the Effects of Some Cotton Fiber Properties on Yarn Evenness.

By : Mohamed Salah El-Din Sayed Garamain

Approved by :

.....

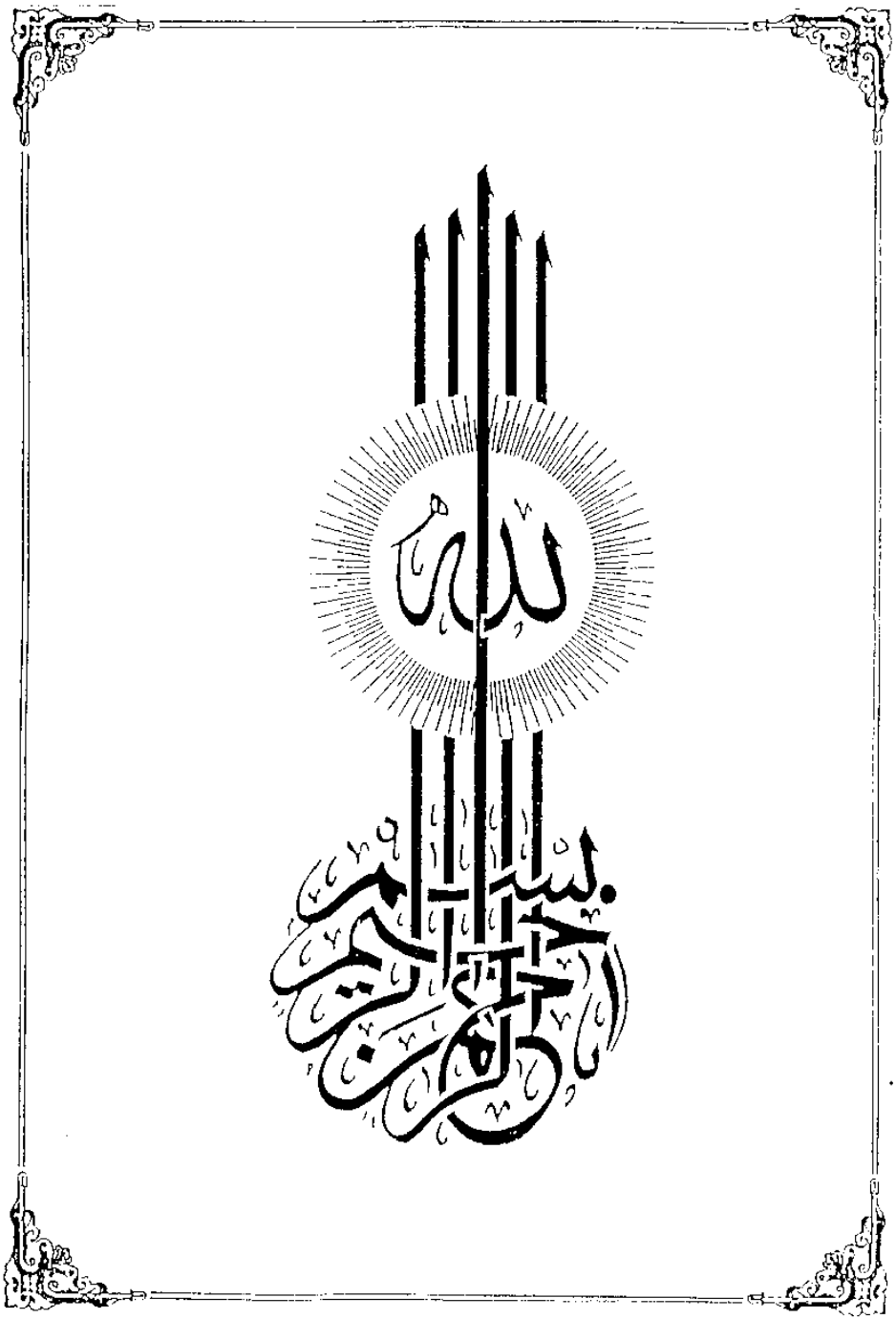
.....

.....

Committee in charge

Date : / / 1971

Central Library - Ain Shams University



Central Library - Ain Shams University

A C K N O W L E D G E M E N T

The writer wishes to express his deep appreciation and gratitude to Dr. M.I. El-Ghawas, Professor of Agronomy, Faculty of Agriculture, University of Ain-Shams, Dr. K.A. El-Shouny, Lecturer of Agronomy, Faculty of Agriculture, University of Ain-Shams, and Dr. M.E. Abdel-Salam, Cotton Technologist, Cotton Technology Research Division, Ministry of Agriculture, for their supervision, advice, valuable guidance and helpful criticism throughout the investigation and during the preparation of the manuscript.

Thanks are also due to Mr. A.H. Abou-Sehly, General Director of Cotton Technology Research Division, and the staff of the Cotton Fiber Research Section for their encouragement and help.

Central Library - Ain Shams University

Central Library - Ain Shams University

Central Library - Ain Shams University

Egyptian cotton, still one of the chief sources of foreign exchange earnings upon which industrial development largely depends, is usually exported as raw material but more recently a good deal is exported as yarn and fabric. This is a direct result of expanding the national textile industry.

To maintain the outstanding position of Egyptian cotton in the world markets, when exported either as raw cotton or as manufactured end products, in the face of the ever increasing competition from man-made fibers as well as from the improved cottons produced in other countries, concentrated efforts should be exerted and directed towards improving their quality. Improvement could be achieved through breeding of better varieties, better cultivation practices and harvesting as well as improved ginning, spinning and weaving.

Although spinners are always in favour of maintaining the quality of existing varieties rather than the introduction of new ones, they are always on the look out for new varieties of cotton which will allow them to produce higher yarn quality for the same cost. Since the spinner's raw material is the breeder's final product - usually a variety

Central Library - Ain Shams University

[illegible] cotton [illegible]. Out of [illegible] hundreds of strains obtained through hybridization and selection - yarn quality should be taken into consideration in order to screen the mass of genetic material according to industrial trends prevailing at the time.

For a long time yarn strength had been considered the sole criterion for the evaluation of the new varieties, but recently it had been realized that it cannot be considered in isolation as a wholly satisfactory measure of yarn quality. It had been widely accepted, from the industrial point of view, that yarn evenness is not only a desirable characteristic in its own right on the score of yarn, and consequently cloth appearance, but also brings in its train a number of other second-order consequences of great importance, mainly; (a) greater strength and strength regularity, extensibility and extensibility regularity (b) better luster, (c) fewer end-breakages in spinning, winding, warping and weaving, and consequently increasing processing efficiency, (d) higher spinning limit and (e) greater resistance to surface abrasion.

Still, the recent wide use of high drafting systems on roving and spinning frames demand better fiber characteristics such as higher uniformity of length, higher fiber

Central Library - Ain Shams University

REVIEW OF LITERATURE

1. Definition and importance of evenness :

Unevenness of yarn is defined as the variation of the linear density of a continuous strand or portion of strand. The principal measure for expressing unevenness is the coefficient of variation unevenness(ASTM:D 1425-T-1960). Booth (1964), mentioned that the most useful property to measure in order to derive a numerical assessment of yarn unevenness is the variation in weight per unit length.

In reviewing the literature, it will be found that many investigators use the terms unevenness or evenness, irregularity or regularity and nonuniformity or uniformity, which in fact, mean the same thing, that is the variation of linear density.

Cotton yarn evenness is one of the principal properties which was the subject of many studies because of its application in the assessment of the spinning quality of cotton. It is also used as fundamental way for detecting mechanical faults in the processing machines.

Townsend (1951), stated that "the most important property of yarn is the number of fibers in its cross-

Central Library - Ain Shams University

section ... variation ... this number ... yarn is the most fundamental measure of irregularity". Booth (1964), suggested that since the variation in the number of fibers in cross-section of a yarn is associated with the variation in weight per unit length, therefore, measurement of the latter is a sound and commonly used method of assessing unevenness.

Gentry (1964), realized that yarn evenness measurements are needed because the appearance of a fabric is directly affected by the magnitude of thick and thin places in the yarn.

A review of the work so far done would reveal that yarn unevenness has mainly three important effects from the practical point of view; (a) its effect on yarn strength; since, a yarn breaks - should a break happen - at the thinnest place, and since the more uneven the yarn is the thinner the weakest place becomes, (b) its effect on spinning efficiency; the yarn, roving, or silver may break at the thin weak places during the passage through the machines, and since these places increase when the yarn is uneven, so making it necessary to join or "piece" the broken ends before production can be resumed, and (c) its effect on

Central Library - Ain Shams University

...undesirable unevenness in the yarn leads to uneven-
ness in the cloth, which when excessive may spoil the
appearance of cloth.

II. Causes of unevenness :

One of the main processes to which cotton fibers are subjected, during spinning, in order to arrange them in the form of yarn, is drafting. It is carried out on the draw frame, roving frame, as well as the ring frame.

Drafting is the process of attenuating or increasing the length per unit weight of slivers and rovings. It is the main operation by which the sliver is drawn out into a very fine strand consisting of approximately straight and parallel fibers.

The first work reported on unevenness of yarns produced by roller drafting was that of Balls (1928), which was corroborated by Foster (1930). Both agreed that there are certain variations in yarn thickness which are characterized by wave-like patterns with apparent cyclic repitition of thick and thin places. On close examination, these irregularities were observed to have been caused mainly by lack of positive control over short fibers during the process of drafting.

Central Library - Ain Shams University

[illegible] cotton yarns is the perfect drafting. Perfect drafting is described as drafting which merely spaces the leading fiber ends farther apart, so causing the distances apart of these ends to be multiplied by the amount of drafting. This kind of drafting is easy to describe on paper and simple to understand, but it cannot be realized in practice.

The difference between the influence of actual drafting and perfect drafting on unevenness is due to the following reasons :- (a) in actual drafting, the fibers in the sliver or roving are not all the same length, and are not perfectly straight and parallel. The variability in fiber length which is largely a property of the cotton variety, causes a wave-like irregularity, called "the drafting wave". This part of unevenness is the main cause of unevenness on machines which are in good mechanical condition, and (b) in actual drafting there are mechanical faults in the machinery such as roller nips which do not always remain in fixed position, rollers do not always run at steady speeds; and rollers sometimes slip, so the fibers under them do not move at the speed of the rollers which cause periodic irregularities (Foster 1958).

Total unevenness in cotton yarns could be divided into the two following parts :

Central Library - Ain Shams University

1- [illegible] :

The coefficient of variation of the random fiber arrangement is that for a yarn prepared on perfect machinery with perfect drafting. Therefore, it is determined solely by fiber properties, mainly fineness and fineness variability.

Martindale (1945), showed that the most uniform strand of material which our present machines can produce is one in which the fiber ends are laid in a random order in the sliver, roving, or yarn. For such a strand of material the unevenness is given by the formula :

$$Vr^2 = \frac{(100)^2}{N} + \frac{Vm^2}{N}$$

where :

Vr = Coefficient of variation of yarn weight per unit length.

N = the average number of fibers in yarn cross-section, and

Vm = Coefficient of variation of the fiber weight per unit length.

Later, Foster (1950), suggested that in the case of cotton, this formula could be simplified into the following $Vr^2 = (106)^2/N$ considering that it takes into

Central Library - Ain Shams University

[illegible] fiber length [illegible] fiber weight along the length of each fiber. Thus, Martindale (1945), concluded that, for a particular fiber and count of yarn there is a limit or basic unevenness upon which our present machinery cannot improve. He emphasised also the importance of the number of fibers in the cross-section, since the higher the number the lower the basic unevenness, therefore, fine fibers are expected to produce a more even yarn for a given count than coarse fibers.

Westernberg (1947), pointed out that an ideal yarn cannot be considered as a cylindrical body, but that it possesses a natural unevenness caused by the current methods of spinning, where the sequence of the fibers is at random. It is shown that in practice the coefficient of variation appears to be much higher than those predicted by Martindale formula (1945). The drafting wave is indicated as a possible cause of this difference.

Foster (1950), considered that, if, for example, we could employ a drafting mechanism which always exerts perfect control on each fiber, then any unevenness initially present in the card sliver could be reduced by doubling and the coefficient of variation of the yarn approaches

Central Library - Ain Shams University

that of the most even yarn. If one hope to make a perfect machines which do not perform any operation that tends to make the yarn more regular, then the produced coefficient of variation is due to the random fiber arrangement which has been called limit unevenness by Martindale (1945).

Foster (1950), found also that in coarse yarns the unevenness due to random fiber arrangement is fairly small, but in fine yarns it becomes comparable with the drafting waves. Its main effect is to add to the short range unevenness of the yarn.

2- The added unevenness :

The substantial amount of unevenness which is caused by the drafting waves introduced at all drafting machines as well as the part of unevenness introduced by mechanical faults in the machines which cause periodic variations can be regarded as representing the added unevenness. This part of unevenness is determined by fiber properties as well as mechanical defects.

a) The added unevenness due to fiber properties :

Cotton varieties have naturally variable fiber properties such as fiber length, fineness, maturity, strength and elongation, which influence appreciably

Central Library - Ain Shams University