Methods of increasing the stretchiness of cotton fabrics

Ahmed Ramadan Abd El Hamid Mohammed El-Tantawi.
Faculty of Applied Arts, spinning weaving and knitting Department, Damietta University,
en_a.r5050@hotmail.com

Abstract:
In response to getting more stretch and elasticity from 100% cotton fibers as woven fabric not made from lycra or spandex yarns and so on. In this survey, the researcher examines the relationship between different spinning methods for Egyptian cotton using twill fabric structure under a variety of weave factors on different weft densities to study the stretch and recovery from cotton fiber. The dependencies of the weft yarn spinning method and weft density were established. The effect of weave structure was determined. It founded that stress on the yarn will relax as a function of time due to the viscoelastic character of textile materials. The maximum wanted stretch direction will be limited to jamming in the anther direction. The max elasticity rate we get by increasing weft per cm for combed cotton but max resilience we can get at minimum weft per cm for carded cotton, Both max (elasticity& resilience) rates at same average float. The woven samples presented in this paper share three common design goals: low cost, stretchability, and long-running by comparing with their peers.

Keywords:
Stretch And Resilience Properties
Spinning Methods
Average Float.

Paper received 4th of January 2021, accepted 19th of February 2021, Published 1st of May 2021

Introduction:

Not only actual behavior of fabric structure is precisely calculable but also geometry many features of the cloth are essentially dependent on the geometrical relationship. These fabric parameters are a tool for an innovative fabric designer in creating fabrics for diverse applications; By studying well, the woven fabric geometry will certainly provide simplified formulae to facilitate calculations and specific constants which are of value for cloth engineering, problems of structure, and mechanical properties (2).

Initially., To design a cotton fabric having the optimum combination of proprieties for end-users, it is desirable if not essential to know how each of the proprieties in question is affected by changes that can be made in the construction of the clothes. The garment quality, appearance, and performance are determined by fabric mechanical and surface proprieties

The most significant characteristic of textiles that contributes to wearer comfort is stretch. Elastic fibers (spandex/lycra) are commonly recognized as being used to offer stretch and recovery to fabrics that are considered to provide the garment with a dimension of comfort. (17).

Woven fabrics made from non-stretch yarns yet having high levels of stretch and recovery are described., The fabrics include about 50% of synthetic fiber components and are woven such the warp and filling are approximately balanced by weight before warp contraction, with 50% warp density or less (21).

Woven fabrics generally require the inclusion of special stretch yarns to provide them any significant degree of stretch and recovery comparing to knit fabrics. Even when currently available specialty yarns are utilized to import stretch to woven fabrics, the fabrics provide less than optimal performance. For example, elastomeric yarns tend to expensive and don't favorably stand the high temperatures used in many textile manufacturing and treatment operations, and their recovery doesn't tend to be very durable. Similarly, torque stretch yarns can be used to achieve 15-20 % stretch in certain fabrics, but their recovery performance is only marginal, they tend to be relatively expensive, and they tend to have a negative effect on the aesthetics of fabrics (7,24).

Manufacturing processes designed to import mechanical stretch to woven fabrics have generally been limited to those which apply some length-wise tension while fabrics edges are not stretched outwardly to any significant extent, however, such fabrics heretofore only achieve a maximum stretch of about (12%) (19).

The beginning of the geometry of fabric has a senior effect on their behavior, for example, the weft dimensions decrease, and weft crimp increases when the cloths are stretched in the warp direction. In real fabrics the cross-sections of yarn significantly different for various fabrics. The

This work is licensed under a Creative Commons Attribution 4.0 International License

cross-section can be a circular, elliptical, race track, or any other shape. It all depends on the weave float and packing of yam in the fabrics so that the cross-section of yarn can vary in different fabric proprieties. Pierce [18] suggest that textile yarns may be assumed to be perfectly elastic and isotopic materials as they possess rigidity., Their resistance to bending affects the form of the yarn in fabrics and has a marked effect on the balance of crimp. Olofsson [17] assumed that yarn will take shape produced by such forces and that cross yarn will flow into the available space. The yarn takes up the shape of elastic being bent by point loads acting at the intersections. This assumption gives valuable information on the inter yarn force, the balance of crimp between warp and weft, and the degree of setting [3].

The specimen's crimp effects in stress value when measuring strength value is normally pulled out by a suitable small tension in measuring linear density, and it can be removed by a pre-tension at the start of the test, as this point was conceptualized and investigated by; If a crimped fiber is inserted in the tester without any initial tension, generalized *load– elongation curve* will have the form shown in Fig.1. The origin of the curve may be put at A, where it diverges from the zero lines, but this point is difficult to locate precisely. A better procedure is to put the origin at O, the extrapolated point corresponding to a hypothetical straight fiber. The crimp is given by AO and may be expressed as a percentage of the initial length. Studies of the methods of measuring and defining crimp have been made by [Betra. S. K., 1974] [3].

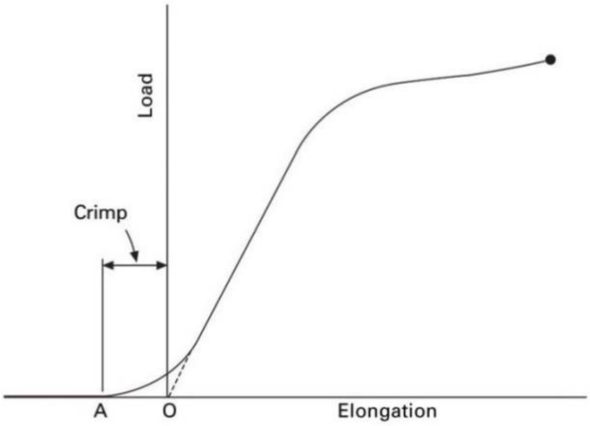


Fig .1 Loads –elongation behavior of yarns.

So that, the reason for this *phenomenon* discussed in this paper, this paper expects to find a parameter for more stretch and recovery proprieties from 100% cotton yarns because there exists a great need for methods of providing cotton fabrics with stretch and recovery characteristics at levels greater than heretofore achievable and it will help in an appeal generation garment industry for better understanding of the weaving process of cotton fabrics from both theoretical and practical point of view, it will decrease the cost of needed of stretch and recovery characteristics of fabrics especially in sportswear, non-wearable e-textiles, and medical textile, also it will be better for the proprietors of woven fabric, especially human skin proprieties ones.

In the literature, many studies deal with the performance properties of woven stretch fabrics. As part of these studies, some studies investigate the stretch fabrics: Stretch means to lengthen, widen, and distend for woven and knitted fabric [23].

As follows, there are two types of stretch fabric dependent on the degree of stretchability [10,22]:

a. Power or action stretch-fabric: this type indicates a high degree of extensibility and quick recovery. The stretch factor ranges here from 30% to 50% or more, Such kinds of stretch fabrics are suitable for knitwear, athletic clothes.
b. Comfort stretch-fabric applied to the fabrics with less than (30-35) % stretch factor. Such fabrics are used for everyday clothing that needs only a conservative degree of elasticity with stretch-fabric, comfort is achieved by reducing garment containment imposed on the body. These types of stretch fabrics are suitable for outerwear garments as women's slacks.

Other commercial classifications of Stretch Fabrics as (*1-way, 2-way, and 4-way*) Stretch fabrics. (*2-way*) stretch fabrics have warp stretch or weft stretch (some call them 1-way stretch fabrics). They are comfortable enough to wear, but they are not appropriate for garments such as sports or athletic wear. Another feature of (*2-way*) stretch cloth is that it doesn't return to its original shape. The term one-way stretch can also refer to knits and their percentage of stretch. It is a very low level, which means that such fabrics stretch very little (0% - 25%)., (*4-way*) stretch fabrics can extend in both directions – crosswise and longwise, which creates better elasticity and makes them perfect for sportswear. Stretch jersey fabrics also have warp and weft stretch, because they are knitted, not woven. All types mentioned above are made from (Lycra, spandex, and elastane), the names of the same synthetic fiber, made of polymer- polyurethane rubber.

Stretch of fabrics measured in percentage, is defined as the ratio of elongated length and intimal length. Currently, fiber elongation values are classified into five different categories [5]: very low (<5.0%), low (5.0-5.8) %, average (5.9-6.7) %, high (6.8-7.6) %, very high elongation (>7.6%).

Sawhney [1] reported that stretch fabrics woven or knitted are mostly produced at present from elastane fibers. Other man-made fibers such as nylon are also used, Only to a very restricted degree. Mourad [12] reported that elastane fibers also known as spandex fibers have better stretch and elastic recovery. El-Ghezal and others [19] decided that core-spun yarns are commonly used in the production of stretch fabrics., they focused on studying the effect of elastane's ratio as well as finishing process on the elasticity and dynamometric properties of fabrics which weft yarns are cotton covered elastane-core spun yarns with the same twist factor and various elastane's ratio. It was revealed that, during the blaze and mercerizing process, a signify relaxation in the weft direction occurs.

Nirmala. V and G. Thilagavathib [1] revealed that finer yarn count in cotton/ core spun lycra fabric and silk/cotton core spun lycra fabric was shown to have higher smoothness and softness. Lewin [11] states that core-spun cotton/spandex was seen to have high resiliency property than 100% cotton yarns, due to its soft and rubbery isocyanide segments, which have a random coil structure, in the spandex yarn. Dunja. Š and Vili.B.[4] presents an investigation of fabric stretch behavior using elastane yarn., to study the stress-extension curve of fabrics with elastane yarn as well as the elastic and viscoelastic deformation after one hour of stretching the fabric to an extension of 25%, which is higher than the extension at the yield point. They observed that they have a wider field of viscoelastic deformation; by observing the behavior Elastic extension after one hour of keeping the fabric to the specified extension, which is higher than the yield point, is from 22.2% to 24.1 %. They observed that the percentage of elastane content in the yarn starts to influence the viscoelastic properties of the fabrics above the yield point

Senthilkumar Mani [21] in his paper present Figure (1) which indicate Loading and unloading behavior of the fabric is almost curvilinear, which is normally called as elastic deformation. Also, he compares the dynamic elastic behavior of cotton/spandex fabrics with 100% cotton fabrics for Knitted Fabrics, It is found that the cotton/spandex fabrics have higher dynamic work recovery and lower stress value than that of cotton fabrics for both wale wise and course wise directions., The cotton/spandex fabrics are preferable to cotton fabrics for dynamic elastic characteristics due to their quick work recovery which enhances the power of the performance of the sportsperson. This objective analysis of garment response is to help engineer a garment for sports activity.

The majority of the studies [4,8,15,20,14] reported in the literature have focused on the investigation of different physical and mechanical properties of stretchable for unidirectional stretch woven fabrics contain core stretch fibers and knitted fabrics. However, there is a paucity of literature on obtaining more stretch from 100% cotton fabrics without any spandex or lycra yarns. There is still a lack of information on this issue.

The theoretical relationships between fabric parameters enable the fabric designer to play with different fibers, yarn count, weave density, and mechanical machinery variants to vary texture, thickness fabric parameters properties., and so on .one of these relationships by calculate the limits to the stretch along warp or weft direction in the cloth and predict fabric dimensions, crimp and the changes in the fabric elongation. Predict crimp in a woven fabric; this has a marked impact on the fabric properties especially at stretch and recovery behavior. [3].

So that., The present study was therefore undertaken to produce more stretch fabrics with 100% Egyptian cotton from different spun yarns. This study; is part of a broader investigation for obtaining more stretch and recovery performance for cotton woven fabrics and stretchable therapy using different weaving parameters.

2.1. Materials and Methods:

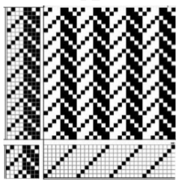
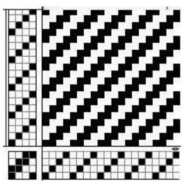
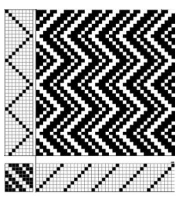
As shown in Table (1) the specification of used yarn. Table (2) shown the specification of specimens, **27** Egyptian cotton woven fabrics were used, with three twill Patterns (weave structure) as shown. Same warp yarn (40Ne Ring carded) was used, weft yarn which uses are three different spinning methods as following 40Ne (Ring Carded, Ring Compact, and Open-end).

This work is licensed under a Creative Commons Attribution 4.0 International License

Table 1. Weft yarn specification

Object/ Yarn	40/1 Ne Ring- Combed	40/1 Ne Ring- Carded	40/1 Ne Open End
Count average.	40.10	40.20	39/3
Twist Method.	26,35	26.65	32.15
Mesdan Tester 2531C.			
Twist (TPI) of single Yarn.			
B-force (g/f).	238.9	286.4	130.3
Strength Method / TensoRabid4	19.23	19.40	8.82
Breaking Length (RKM).			
Average Elongation %.	5.45	5.64	4.59
CV. %.	4.7	5.8	11.7
Thin places *1000 km (-50%).	1	7.5	80.0
Thick places *1000 km (+50%).	25	155	122.5
Neps *1000 km (+200%).	240	750	1265

Table2. Woven fabrics' specifications.

Sample code.	Pattern (weave structure)	Warp Yarn/ Density	Weft yarn 40Ne	Weft density/cm	Thickness (mm)	Weight (g/m^2)	Warp crimping	Weft crimping
A1	A 	40Ne Carded- 110/cm.	Ring Combed	90	46	164	10.73	13.90
A 2				110	54	185	10.63	15.30
A 3				130	60	192	10.63	17.36
A 4			Ring Carded	90	50	141	10.56	14.03
A 5				110	56	172	10.63	16.60
A 6				130	59	215	10.66	14.73
A 7			Open-end	90	38	148	10.63	14.10
A 8				110	46	151	10.63	15.00
A 9				130	55	160	10.66	13.83
B1	 B		Ring Combed	90	31	141	10.60	12.30
B 2				110	32	154	10.63	12.50
B 3				130	31	164	10.60	12.83
B 4			Ring Carded	90	31	140	10.60	12.10
B 5				110	33	147	10.56	12.43
B 6				130	32	164	10.60	12.16
B 7			Open end	90	33	135	10.60	11.69
B 8				110	34	148	10.56	12.30
B 9				130	36	161	10.60	12.50
C1	 C		Ring Combed	90	27	136	10.63	13.36
C 2				110	29	142	10.5	12.33
C 3				130	33	167	10.60	12.50
C 4			Ring Carded	90	28	130	10.66	12.10
C 5				110	30	148	10.63	12.36
C 6				130	34	155	10.53	12.43
C 7			Open end	90	28	136	10.56	12.4
C 8				110	30	145	10.63	12.23
C 9				130	35	158	10.56	12.46

2.2. Laboratory Testing:

On the rapier weaving machine (Vamatex silver HS 2010)., In the warp direction, tension is applied by the warp beam at standard tension at (4.8) KN, which allows weaving stability. In the filling direction, tension is applied by the loom temples and it is this tension that prevents the filling yarn from crimping. A bleaching process was performed on the raw cloth (on the straightened) on the Morthon machine, and the degree of bleaching was measured at 57 degrees.

All tests were carried out in the *weft direction* after conditioning specimens in a standard atmosphere (temperature 20 ± 2 °C, 65 ± 2% relative humidity)., which related to the purpose of current research by using the commercial term (*1-way stretch fabric*) (weft stretch).

Tensile strength measurements of the fabric samples were carried out on (Tinius Olsen – H5kt) tester in accordance with ASTM 5035.

The standard test method Ltd. 06 ;(05/27/10) Elastic, Load, Elongation &Recovery) was used to test the Elasticity (%) and Resilience (%) of all woven fabrics' specimens. This test was performed also on Tensile Strength (Tinius Olsen – H5kt) tester. Fabric samples were cut according to the standard method. Three samples were used for each test and their average values were taken.

After placing the sample in the jaws of the universal tensile strength tester, the jaws were moved at a constant rate of load range (100Ibf). Samples were held at four automatic loads for 10 inches/Min., to give maximum stretch% at 3.3 g load, and then machine jaws were allowed to return to their starting point. Samples were kept under extension in the jaws for (20-40-60-80) % loads extension and then fabric Resilience (%) was measured. The percentage of the produced samples in extension load at (3.3Ibf) and immediate recovery (%) was calculated.

3.Results and Discussion

Since the stretch in the weft direction, assessments of the produced fabrics for physical and stretch properties were carried out in the weft direction.

All the test results are given in Table 3 and their interpretations are given in the following sections.

Table 3. Tests result for woven specimens.

	Spun Method	Weave density/cm	Pattern A	Pattern B	Pattern C
Breaking strength (Kg/F)	Ring combed	90	20.31	34.00	42.60
		110	25.40	46.60	55.50
		130	51.60	61.60	61.20
	Ring carded	90	29.40	36.90	38.00
		110	36.30	49.70	54.40
		130	51.20	58.60	46.90
	Open end	90	26.50	22.40	24.30
		110	32.60	32.60	33.30
		130	28.30	42.80	39.30
Elongation (%)	Ring combed	90	55.20	25.00	27.60
		110	53.80	27.00	28.20
		130	44.90	26.90	27.60
	Ring carded	90	48.50	26.70	26.60
		110	53.20	26.60	27.70
		130	54.60	27.30	26.90
	Open end	90	32.80	24.80	25.00
		110	39.50	26.00	26.40
		130	47.00	25.00	26.00
Elasticity (%)	Ring combed	90	20.25	12.10	7.58
		110	21.25	9.58	6.88
		130	25.88	8.30	10.48
	Ring carded	90	23.19	7.45	8.55
		110	21.05	8.98	9.73
		130	17.00	8.68	8.13
	Open end	90	21.25	7.18	7.08
		110	9.60	9.68	10.68
		130	14.60	8.28	8.43
Resilience (%)	Ring combed	90	63.50	87.40	91.70
		110	62.40	95.80	91.30
		130	61.50	91.90	89.70

This work is licensed under a Creative Commons Attribution 4.0 International License

	Ring carded	90	64.80	98.30	88.60
		110	71.20	88.90	90.20
		130	73.40	91.60	93.50
	Open end	90	62.40	88.90	91.50
		110	89.30	85.30	74.70
		130	73.30	92.10	84.60

All test results related to physical and stretch properties of the woven fabrics were evaluated in this study for significant differences in means using one-way ANOVA variance analysis through SPSS statistical package. In order to deduce whether the type of spinning method also which pattern in the woven fabric samples has a significant effect on fabric stretch properties, the values of the significance level, i.e., p-value, should be examined. P-value must be less than or equal to 0.05.

3.1. Fabric crimping:

Changes in fabric weaving structure due to extension in the warp or weft direction are useful in achieving the desired crimp and also in making fabrics that are difficult to produce on weaving machines [(13)].

This section demonstrates the relationship between *crimps phoneme* in samples by manipulating length changes in different *Patterns* (weave structure) which uses. This phoneme causes A stretch in the samples because, it is equivalent to stretching in weft direction accompanied by contraction in the vice versa direction.

Owing to the crimp in the weft direction because of the different in weave density, a component of the tension exists in the filling direction. This force generally brings the ends closer to set, causing the width of the fabric to compress. After removing the fabrics from the loom, this contraction will be greater and will be more apparent in the case of stretchable fabrics. This contraction had a turn impact of the physical and mechanical properties of woven samples., as indicates in a table (3), by increasing the number of weft per cm, makes the fabrics have more thickness and become stiffer with more weight (g/m^2).

The Importance of the crimping parameter in this paper is manifested by showing the percentage of elongation of yarns inside the fabrics, which in turn helps to increase the percentage of elongation of the fabrics and the extent of their resilience. Fig (2) indicates the percentage of crimping in the weft direction.

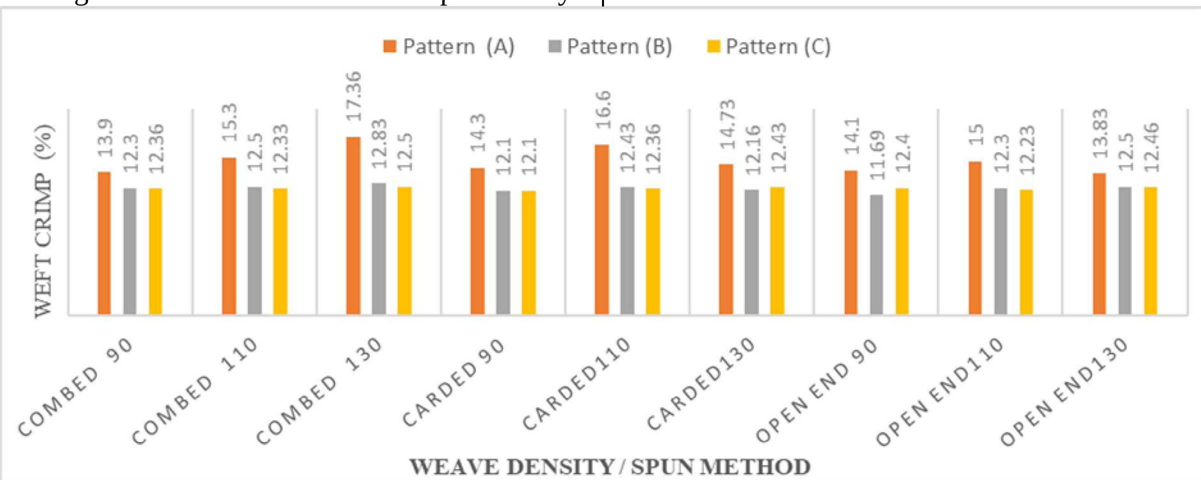


Figure 2. percentage of crimping on weft direction.

Fig.2 Clarify the percentage of crimping of filling yarns for woven samples., It can see that samples code (A6) at table 1 – using *Pattern* (A) at 130 pick /cm when using (ring combed spinning method) has the largest crimp percentage at (17.36) %. Using the same *Pattern, A* of twill structure using 110/cm., ring carded sample has the next largest crimp percentage at (16.60) %.

By analyzing the percentage of crimping for three *Patterns* (weave structures):

- *Pattern (A)* has the largest rates of crimping for woven sample, by calculating the average float of *Pattern (A)* it is equal (0.625), whilst *Pattern (B)* and *(C)* have the same average float at (0.5625).
- The researcher suggest that more *crimp phoneme* occurs due to (the zigzag line in *Pattern* A at table 2) a strong effect on the rate of crimp as a result of interlacing between threads and filling yarns.

Summarizing the results in crimp section., It can say that the maximum fabric extension will be limited to the following two options:

First option., when the crimp in the wanted direction being pulled becomes nearest zero [2,9], the threads will be pulled straight and the changes in other direction will not cause interference.

Second option., the maximum wanted stretch direction will be limited to jamming in the anther direction. *And this is what occurred at the case of the samples under this study.*

3.2. Fabric tensile strength:

Not only testing breaking strength for samples highlights the signifying rates for research samples and its mechanical properties., but also it should indicate the correlation rates of woven samples for assessing the main objectives for the research., Therefore the researcher using tensile strength for specimens to study the significance level of its mechanical properties with its Elongation, Elasticity and Resilience properties as shown in next section (3.3).

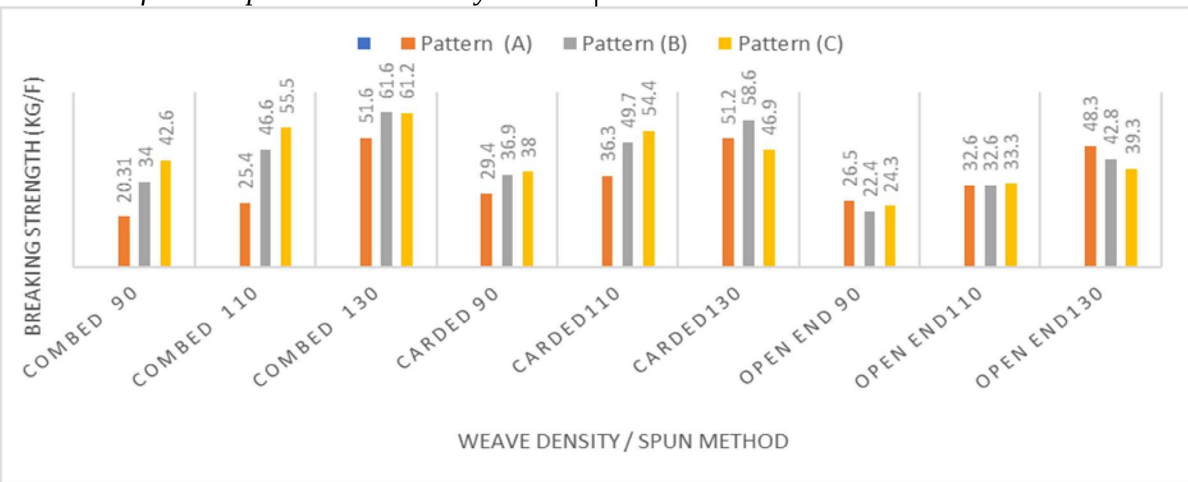


Figure3. Fabric tensile strength at different weave structure, density and different spun yarn.

As shown In Fig.3:

- We can encode that the samples which has largest (pick / cm) which equal 130 pick/cm ,at ring combed and carded spinning method only ., This samples have the largest breaking strength rates, and it can be said exactly the opposite.
- Combed spinning method in woven samples have the largest breaking strength rates as plotted in Fig.3 regardless of weave structure and number of weave density., for example: *Pattern (C)* Samples at 90,110 pick/per cm and *Pattern (B)* samples at 130 pick per cm, have the largest rates of breaking strength comparing with their parallel from carded or open-end spinning method.

3.3.1 Breaking Elongation:

The most important output of a tensile test is *a load–elongation curve* which can be converted into a stress–strain curve. The stress–strain curve relates the application of stress to the resulting strain [6]. Each specimen has its own unique stress–strain curve., the researcher encodes this behavior as shown in Fig.3, in numerical values.

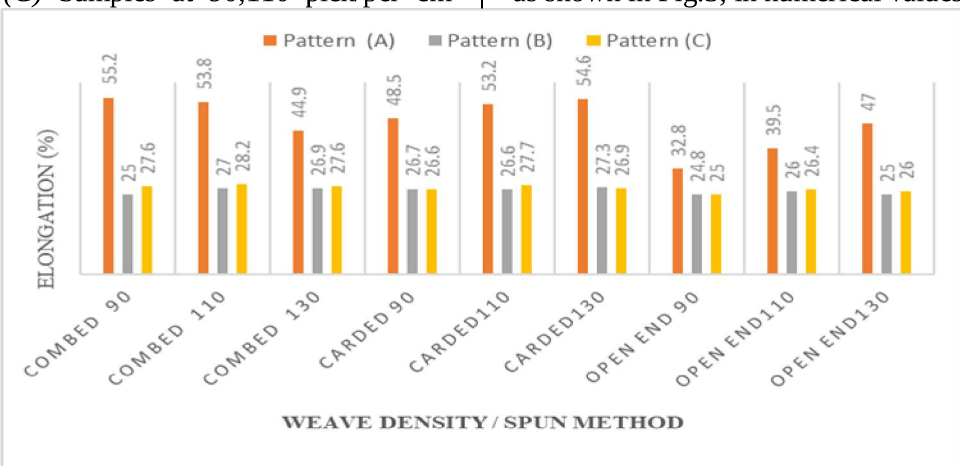


Figure4. Fabric elongation at different weave structures, density, and different spun yarn.

As shown In FIG.4:

By analyzing the percentage of elongation of woven fabric:

- *Pattern (A)* has the largest elongation rates

This work is licensed under a Creative Commons Attribution 4.0 International License

when using difference spun methods.

- The highest elongation occurred when using *Pattern (A)* with the carded spinning method at 130 pick/cm.

3.3.2 Elasticity.

The standard test method Ltd. 06 ;(05/27/10) was used to determine the modulus of elasticity, during stretching, stress is applied to a textile material and causes it to stretch (extension). It is a proportional function due to further stretching while testing, the extension begins to increase more rapidly than the stress. Consequently, the relation between stress and extension is no longer linear, and the first viscoelastic extension starts. [(17)]

As an explanation of *elasticity phoneme* in textile materials, both viscous and elastic properties coexist. The viscous property behaves in accordance with Newton´s liquids, while the elastic property means that which behaves in accordance with Hooke`s solids. Under the lower extension, the behavior of most textile materials is linearly elastic [(17)]. When the extension becomes higher than the (limit extension), which is at the yield point, the response of the textile material is no longer elastic and reaches the viscoelastic extension, which is recoverable with a definite time component.

Upon the previous explanation., the Elasticity properties of woven samples were depicted in Fig. 5.and then commentary.

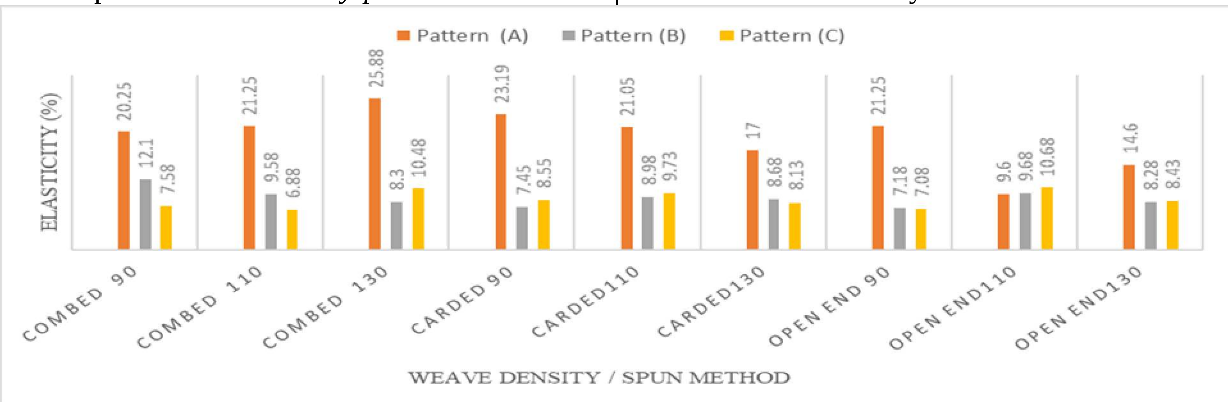


Figure 5. Elasticity properties of woven samples.

As Shown in Fig.5:

- It certifies that using *Pattern (A)* which has a zigzag life gives the highest level of Elasticity for woven samples comparing with others (*Pattern B and C*).
- Combed spinning yarn method has the highest rate of Elasticity for all woven samples when using (130 picks/cm) with *Pattern (A)*.
- Numerical values for the Elasticity property when using (carded and open-end) spinning method considered relatively few comparing with the combed spinning method, and it clarifies when tightened by hand.

3.3.3 Resilience:

The ratio of energy recovered to energy used to extend the fabric at a low-stress level known as resilience *phoneme*. Resilience is declared at two important performance standards in a textile: User Comfort, Extensibility, and wear performance.

This *Resilience phoneme* expresses the extent of recovery from the extension is a property that is dependent on the type of each species used in this paper as shown in Fig.6.

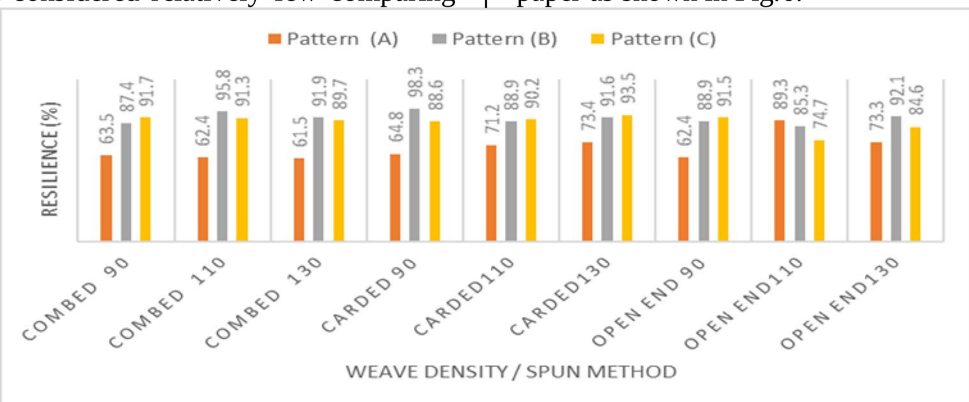


Figure 6. Resilience behavior of woven samples.

It can be noted in Figure 6 that the fabric recovery after stretch will be greater for the shortest weave float for Patterns B and C. The explanation is that there will be less growth in fabric due to short weave float, so yarns will find less constraints to return to their initial positions due to less number of interlacements; thus, fabric will have more recovery.

3.3.4. Correlation rates of woven samples:

This section is clarifying the Correlation rates of physics parameters analyses of tests for woven specimens. Following by tables in **Appendix tables (A&B).**

Table 4. Correlation rates of woven samples

Pattern	Property	Correlation Coefficient (R)	P-value
A	Crimp □ Elasticity	-0.10	0.002
	Elasticity □□Resilience	-0.91	**0.001**
	Elongation □ Elasticity	0.17	0.004
	Elongation □ Resilience	-0.17	0.666
B	Crimp □ Elasticity	0.10	0.807
	Elasticity □□Resilience	-0.44	0.231
	Elongation □ Elasticity	-0.14	0.711
	Elongation □ Resilience	0.48	0.197
C	Crimp □ Elasticity	-0.04	0.926
	Elasticity □□Resilience	-0.61	0.084
	Elongation □ Elasticity	0.11	0.769
	Elongation □ Resilience	0.28	0.47
All	**Crimp □ Elasticity**	**0.73**	**0.001**
	Elasticity □□Resilience	**-0.94**	**0.001**
	Elongation □ Elasticity	**0.83**	**0.001**
	Elongation □ Resilience	**-0.79**	**0.001**

In Table (4) the most important relation illustrates the existence of an inverse correlation between the Elasticity and Resilience property for Pattern A, while the presence of relations between the properties concerning all patterns used, where there is a positive relationship between Crimp Elasticity, an inverse relationship between Elasticity Resilience, and a positive relationship between Elongation Elasticity, as well as an inverse relationship between Elongation Resilience.

The below figures from (6-10) indicate Graphic representations for the Correlation coefficient between different parameters measurement.

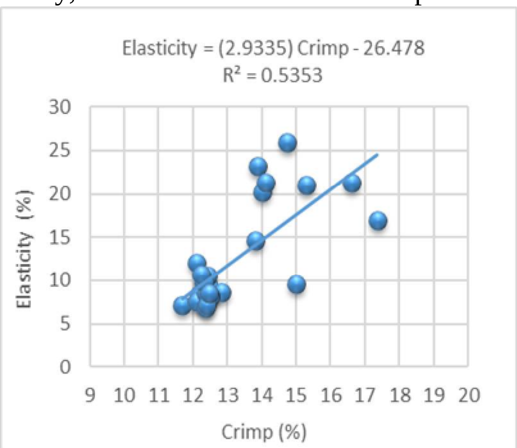


Fig 7. Effect of Crimp-on Elasticity.

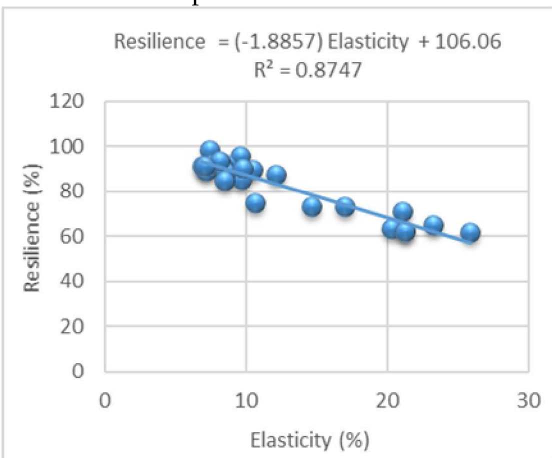


Fig 8. Effect of Elasticity on Resilience.

This work is licensed under a Creative Commons Attribution 4.0 International License

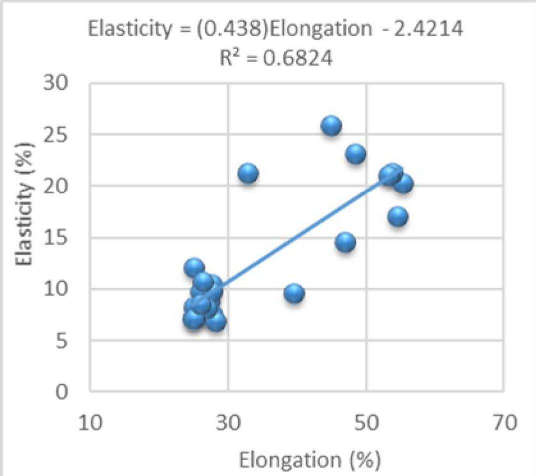


Fig 9. Effect of Elongation on Elasticity.

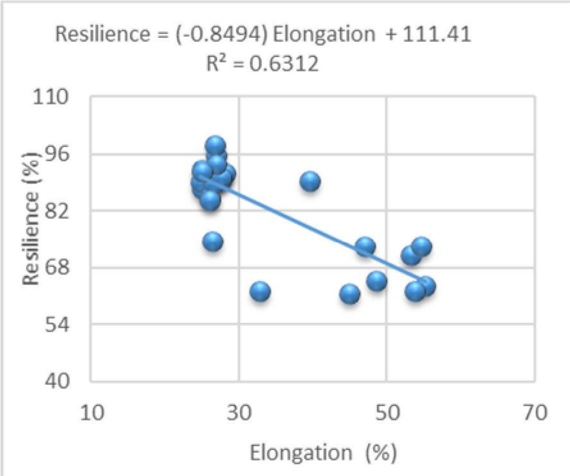


Fig10. Effect of Elongation on Resilience.

According to ANOVA results, spinning methods has a significant. effects on (elongation, elasticity, resilience, and crimp) properties especially when using (ring combed and carded). (p=0.001<0.05). Besides, according to multiple comparison test results for weft density, each weft density value (90, 110, 130 pick/cm) has statistically different effects on (90&130) pick on elasticity and relicense, in the high confidence interval. On the other hand, test analysis ratios of open-end in different weave densities have no statistical effect on parameter Measured, Except crimping ratios.

The largest ratio of elastics (25.88%) with breaking elongation (44.9%) values at when using (ring combed spinning method) 130 pick /cm., using pattern (A) .at recovery ratio (61.5%).

This benefits of considering this value above of speciesism code (A3); Considered respect partially values for research filed to obtain more stretch and recovery proprieties from 100% Egyptian cotton fabric.

4. Conclusion:

The fabrics can be woven in any conventional weave structure; however, it will be understood that the type of weave -(T*will*)- will be factored into the mechanics of this research to determine the proper fabric to optimize stretch for a given fabric

According to the paper presented, the selective density distribution of the filling yarns can be engineered to create the optical condition for stretch.

The stretch and recovery proprieties are achieved through the combination of particular fabric construction, spun component, selective density, distribution, and processing steps to impart a cumulative weave balance, in particular, the fabric is engineered to achieve stretchability(elasticity) and resilience with weft density factor, a stretch of about (20-25) or greater in combination with the resilience of about (80-93) %can be achieved through this paper from (100%) cotton yarns.

Relation between thread spacing and crimp height study by using algorithm involving equations will provide us more and more verity of biaxial or uniaxial stretchability in cotton woven fabrics. It is possible to predict fabric parameters and their effect on the fabric properties by soft computing. It should make more trials; this information is helpful in deciding specific needs...

Recruiting the woven specimens in this paper results in finding a method for evaluating the instantaneous response of woven fabrics by calculating dynamic motion recovery and stress value at different extension levels for many specific applications as a field of electronic non-wearable textile volume or several medical purposes. The woven samples presented in this paper share three common design goals: low cost, stretchability, and long-running by comparing with their peers.

The researcher aspirant is supposed that obtained and developed a generalized theory applicable for predicting more A stretch behavior from 100% cotton yarns. The model can be used to characterize and predict the stretchability of fabrics with different trails as: weaving floats, including combinations of weaving machine parameters with focusing a tension rates, involving different yams and different degrees of twill structures'.

Reference:

1. A.P. Singh Sawheny (1947). The Effect of Fabric Structure on the Properties of Two-Way Stretch Fabrics Made from Elastic Core-Spun Yarns of Cotton and Wool Blend. Textile Research journal .44(7).
2. B K Behera & P K Hari (2010). *Woven textile structure Theory and applications.* 1st Edition Woodhead publishing series in textile, Cambridge, England.
3. Batra. S. K. (1974). A generalized model for

crimp analysis of multi-component fibers. Part II: An illustrative example, Textile Research Journal. *44*(5).
4. Dunja Šajn Gorjanc, Vili Bukošek (2008). The Behavior of Fabric with Elastane Yarn During Stretching: FIBRES & TEXTILES in Eastern Europe. 16(3).
5. E.-H. Ng, C. W. Smith, E. Hequet, S. Hague, and J. Dever (2015). Generation Means Analysis for Fiber Elongation in Upland Cotton. Crop Science Society of America (54). August.
6. Fanging Sun, Abdelfattah M. Seyam and B.S. Gupta (1997). A Generalized model for Prediction Load-Extension proprieties of woven fabric. Textile Research journal .67(12).
7. Greer, James Tantillo, Blalock, john, and l. Love Franklin, S. (2004). Woven stretch fabrics and methods of making same. Invention, No. (W0 2004/104384). International Application Published Under the Patent Cooperation Treaty (PCT). World Intellectual Property Organization.
8. H.I. Celik and H.k. kayanak (2017). An Investigation on the effect of elastance draw ratio on the air permeability of denim bi-stretch fabrics 17th world textile conference Autex. Iop Publishing
9. Haque MM. (2009). Effect of weft parameters on weaving performance and fabric properties. J Science & Technology.4(2).
10. Md. Mahbubul Haque (2009). Effect of weft parameters on weaving performance and fabric properties. Journal of science and technology .4(2).
11. Menachem Lewin, Jack Preston (1985). *High Technology Fibers Handbook of Fiber Science and Technology*, Volume 2, High Technology Fibers: Part B.CRC Publisher.
12. Mourad, M (2012). Physical and stretch properties of woven cotton fabrics containing different rates of spandex. Journal of American Science, 8, 567–572.
13. Muhammad Maqsood, Yasir Nawab, Jawairia Umar, Muhammad Umair & Khubab Shaker (2017). Comparison of compression properties of stretchable knitted fabrics and bi-stretch woven fabrics for compression garments. The Journal of The Textile Institute. 108. (3).
14. Muhammad Maqsood., Tanveer Hussain., Mumtaz Hasan Malik & Yasir Nawab (2016). Modeling the effect of elastane linear density, fabric thread density, and weave float on the stretch, recovery, and compression properties of bi-stretch woven fabrics for compression garments. The Journal of The Textile Institute.107(3).
15. Nilgün Özdil (2008). Stretch and Bagging Properties of Denim Fabrics Containing Different Rates of Elastane. FIBRES & TEXTILES in Eastern Europe .16(1):66.
16. Nirmala Varghesea and G. Thilagavathib (2015). Development of woven stretch fabrics and analysis on handle, stretch, and pressure comfort, The Journal of The Textile Institute, 106(3).
17. Oloffson, B. (1967). Study of inelastic deformations of textile fabrics, The Journal of the Textile Institute, 58(6).
18. Peirce, F. T. (1947). Geometrical principles applicable to the design of functional fabrics, Textile Research Journal, (17) 123.
19. S. El-Ghezal∗, A. Babay, S. Dhouib and M. Cheikhrouhou (2009). Study of the impact of elastane's ratio and finishing process on the mechanical properties of stretch denim. The Journal of The Textile Institute.100(3).
20. S. Noyan Ogulata, Cenk Sahin, R. Tugrul Ogulata and Onur Balci (2006). The Prediction of Elongation and Recovery of Woven Bi-Stretch Fabric Using Artificial Neural Network and Linear Regression Models. FIBRES & TEXTILES in Eastern Europe .14(2):56.
21. Senthilkumar Mani, Anbumani N. (2014). Dynamic Elastic Behavior of Cotton and Cotton / Spandex Knitted Fabrics. Journal of Engineered Fibers and Fabrics.9(1).
22. Sinha SK, Bansal P, Maity S. (2017) Tensile and elastic performance of cotton / lycra core spun denim yarn. Journal of The Institution of Engineers (India): Series E. 89(1).
23. Taslima Ahmed Tamanna, Mohammad Abul Hasan, Bivuti Vusan Mondal and Palash Kumar Saha (2017). Investigation of Stretch and Recovery Property of Weft Knitted Regular Rib Fabric. European Scientific Journal September.13(27).
24. **V Kumar1, Guluma Sorsa1 and C Prakash. (**2018). Investigation on Geometric and Dimensional Properties of Cotton Sheath Elastomeric Core Spun Yarn Single Jersey and Popcorn Jersey Fabric Structures. **Latest Trends in Textile and Fashion Designing Journal .2(1).**

This work is licensed under a Creative Commons Attribution 4.0 International License

Appendix.

Table (A). ANOVA analysis table for **(spun methods) .**

Spun method	Laboratory Test	Source	Sum of Squares	df	Mean Square	F	Sig.
Ring Combed	Breaking strength (Kg/F)	Between Groups	683.365	2	341.682	1.819	.241
		Within Groups	1127.264	6	187.877		
		Total	1810.629	8			
	Elongation (%)	Between Groups	1179.500	2	589.750	54.271	**.000**
		Within Groups	65.200	6	10.867		
		Total	1244.700	8			
	Elasticity (%)	Between Groups	358.368	2	179.184	32.770	**.001**
		Within Groups	32.808	6	5.468		
		Total	391.176	8			
	Resilience (%)	Between Groups	1663.682	2	831.841	126.079	**.000**
		Within Groups	39.587	6	6.598		
		Total	1703.269	8			
	Crimp (%)	Between Groups	16.328	2	8.164	13.410	**.006**
		Within Groups	3.653	6	.609		
		Total	19.981	8			
Ring Carded	Breaking strength (Kg/F)	Between Groups	148.607	2	74.303	0.718	.525
		Within Groups	621.073	6	103.512		
		Total	769.680	8			
	Elongation (%)	Between Groups	1263.429	2	631.714	177.503	**.000**
		Within Groups	21.353	6	3.559		
		Total	1284.782	8			
	Elasticity (%)	Between Groups	280.022	2	140.011	37.408	**.000**
		Within Groups	22.457	6	3.743		
		Total	302.479	8			
	Resilience (%)	Between Groups	979.447	2	489.723	29.604	**.001**
		Within Groups	99.253	6	16.542		
		Total	1078.700	8			
	Crimp (%)	Between Groups	18.637	2	9.319	8.992	**.016**
		Within Groups	6.218	6	1.036		
		Total	24.855	8			
Open end	Breaking strength (Kg/F)	Between Groups	22.136	2	11.068	0.194	.828
		Within Groups	341.727	6	56.954		
		Total	363.862	8			
	Elongation (%)	Between Groups	405.602	2	202.801	11.837	**.008**
		Within Groups	102.793	6	17.132		
		Total	508.396	8			

	Elasticity (%)	Between Groups	87.172	2	43.586	3.350	.105
		Within Groups	78.070	6	13.012		
		Total	165.242	8			
	Resilience (%)	Between Groups	290.176	2	145.088	1.637	.271
		Within Groups	531.907	6	88.651		
		Total	822.082	8			
	Crimp (%)	Between Groups	8.438	2	4.219	22.300	**.002**
		Within Groups	1.135	6	.189		
		Total	9.573	8			

Table (B): ANOVA analysis table for (weave **density /cm**).

Weave density	Laboratory Test	Source	Sum of Squares	df	Mean Square	F	Sig.
90 pick /cm	Breaking strength (Kg/F)	Between Groups	138.860	2	69.430	1.218	.360
		Within Groups	342.105	6	57.017		
		Total	480.965	8			
	Elongation (%)	Between Groups	765.620	2	382.810	8.507	**.018**
		Within Groups	270.000	6	45.000		
		Total	1035.620	8			
	Elasticity (%)	Between Groups	352.660	2	176.330	50.653	**.000**
		Within Groups	20.887	6	3.481		
		Total	373.547	8			
	Resilience (%)	Between Groups	1513.807	2	756.903	57.696	**.000**
		Within Groups	78.713	6	13.119		
		Total	1592.520	8			
	Crimp (%)	Between Groups	6.956	2	3.478	78.140	**.000**
		Within Groups	0.267	6	.045		
		Total	7.223	8			
110 pick /cm	Breaking strength (Kg/F)	Between Groups	421.429	2	210.714	2.339	.177
		Within Groups	540.540	6	90.090		
		Total	961.969	8			
	Elongation (%)	Between Groups	956.060	2	478.030	21.552	**.002**
		Within Groups	133.080	6	22.180		
		Total	1089.140	8			
	Elasticity (%)	Between Groups	129.594	2	64.797	4.005	.079
		Within Groups	97.063	6	16.177		
		Total	226.658	8			

This work is licensed under a Creative Commons Attribution 4.0 International License

	Resilience (%)	Between Groups	390.860	2	195.430	1.937	.224
		Within Groups	605.500	6	100.917		
		Total	996.360	8			
	Crimp (%)	Between Groups	21.467	2	10.734	43.617	**.000**
		Within Groups	1.477	6	.246		
		Total	22.944	8			
130 pick /cm	Breaking strength (Kg/F)	Between Groups	169.629	2	84.814	0.630	.564
		Within Groups	807.133	6	134.522		
		Total	976.762	8			
	Elongation (%)	Between Groups	987.442	2	493.721	52.530	**.000**
		Within Groups	56.393	6	9.399		
		Total	1043.836	8			
	Elasticity (%)	Between Groups	218.654	2	109.327	8.865	**.016**
		Within Groups	73.991	6	12.332		
		Total	292.645	8			
	Resilience (%)	Between Groups	906.196	2	453.098	20.344	**.002**
		Within Groups	133.633	6	22.272		
		Total	1039.829	8			
	Crimp (%)	Between Groups	15.982	2	7.991	6.892	**.028**
		Within Groups	6.956	6	1.159		
		Total	22.938	8			