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RESPONSE OF EGYPTIAN COTTON YARNS TO DIFFERENT MERCERIZATION TREATMENTS

[12]

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ABSTRACT

Yarns spun at 60's count and 3.6 twist multiplier representing six Egyptian cotton cultivars, namely; Giza 45, Giza 70 and Giza 77 (Extra-long staple) and Giza 86, Giza 89 and Giza 83 (Long staple) were subjected to mercerization treatments in 20% (w/w) NaOH. Yarns were mercerized under three mercerization treatments, i.e. slack, at constant length and under tension. Yarns tensile properties including: single yarn strength (g/tex), elongation % and luster degree were measured. Single thread was measured, and strength and elongation were also corrected for changes in linear density at point of break and shrinkage, respectively. Slack mercerization reduced actual yarn tensile strength, increased yarn elongation and increased luster degree. Mercerization at constant length leads to increasing in each of strength and luster degree whereas it reduced elongation. Mercerization under tension had the same effect as mercerization at constant length but with more effect. Different cotton varieties revealed variations in their magnitude of response due to varying mercerization treatments.

Key words: Cotton, Mercerization, Yarn, Strength, Elongation, Luster

INTRODUCTION

The popular use of cotton as the prime textile material is by no means entirely due to its cheapness and abundance, but rather to its desirable properties such as strength durability and absorbency of moisture. Mercerization is one of the oldest and most successful chemical treatments of cotton and had extensive and continuous study. However, there is still some uncertainty remains about its effect on certain physical properties of cotton fibers and yarns, as well as about differential response of Egyptian cotton varieties. In the present investigation a study was made on the effect of mercerization under specified conditions and on the yarn quality.

Slack mercerization decreased yarn tenacity, while yarn elongation increased (**De Boer 1973, Abdel-Salam *et al* 1985**

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and Ismail *et al* 1990) while (Nelson *et al* 1976) found that the slack mercerization of skeins did not change tenacity.

Mercerization of yarns at a constant length slightly increased yarn tenacity (De Boer, 1973). Whereas mercerization at normal length increased tenacity by 37 – 39% (Nelson *et al* 1976). Strength of yarns mercerized at normal length may depend to a small extent on tenacity of the unperceived cotton, and to a large extent on other changes in cotton (Nomeir *et al* 1985).

Mercerization under tension nearly doubled the increase resulting from mercerization at a constant length (Kamal *et al* 1989 and Ismail *et al* 1990). The increases in strength due to mercerizing treatments could be attributed to straightening and realignment of the internal structure of yarns mercerized under tension (Nomeir *et al* 1985).

Slack mercerization caused a marked increase in yarn elongation, on the other hand, both mercerization at a constant length and under tension decreased yarn elongation. The rate of increase in elongation of the slack mercerized yarns, may be due to the effect of pre-load device on reducing crimp and straightening yarn specimens before testing procedure. Yarns mercerized at normal length gave breaking loads as high as or higher than those of yarns mercerized slack, therefore, they were stronger than the slack mercerized yarns. Mercerization at normal length gave also yarns with elongations slightly lower than the untreated control yarns. Mercerization under tension gave the highest yarn strength and the lowest yarn elongation at break (McDonald *et al* 1957, Nelson *et al* 1976, Al-Ashwat *et al* 1983, Nomeir *et al* 1985 and Abdel-Aziz 1998).

The slack mercerization has little effect on the luster of yarn. the maximum luster was obtained when the cotton fibers were parallel to the axis of the folded yarn. The more regular the yarn, the better is the luster. Mercerization under tension could improve the luster of cotton yarns more than slack mercerization (Fourt and Stricher 1953 and Fourt *et al* 1954). The high luster produced by mercerization with tension is still one of the main purposes of the treatment (Orr *et al* 1959).

The low luster of slack mercerization yarns probably arised from combination of the following factors; (a) the improvement in cross-sectional shape was not as great as with tension mercerized treatment. (b) the removal of kinks along the length of the cotton fiber was expected to be less in slack mercerization. (c) the spiral angle was less decreased by slack mercerization, and the lumen was more prominent, hence less transparent. (d) the fibers were less slinger and packed in slack than tension mercerized yarns. When the cotton is in yarn form, four factors must be considered: the twist of the yarn, the irregularity and evenness of the yarn structure, the smoothness of the yarn surface (together with the presence or absence of loose ends), and the fineness of the yarn. (Warwicker *et al* 1966).

The present investigation was designed to estimate the effect of three mercerization treatments on yarn strength, elongation, luster in six Egyptian cotton cultivars.

MATERIAL AND METHODS

Lint of six Egyptian cottons, namely; Giza 45, Giza 70 and Giza 77 as extra-long staple cultivars and Giza 86, Giza 89

and Giza 83 as long staple cultivars were used in this study. Four bulk samples were taken from each variety of commercial cotton crop of 1999 season, then carefully hand blended. Each sample was spun at 60's count and 3.6 twist multiplier. The spun yarns were mercerized under three various mercerization treatments (slack, constant length and under tension).

The mercerization process was carried out in a bath containing a solution of 20 % [w/w] sodium hydroxide, and 1 % mercerol as a wetting agent at room temperature [20°c ± 1.1°c].

Yarn was kept in the mercerizing solution for 10 minutes to ensure complete penetration of the liquor into the yarn. Yarn was then washed in running water for 10 minutes, treated for 10 minutes with 1 % acetic acid solution for neutralizing excess alkali, and thoroughly in running water to remove traces of acid solution. The mercerized yarn was then dried in the oven at 50°c for 4 hours and left overnight at room temperature. After drying the yarn was re-wound again on a bobbin, conditioned at [65% ± 2%] relative humidity and [20°c ± 1.1°c] temperature, and tested for physical and mechanical yarn properties.

On the slack mercerization, yarn was mercerized at its original length in the slack form using no tension. Yarn was allowed to contract freely in the mercerization solution, the yarn was mercerized at a constant length without stretching. In the meantime, it was not allowed to contract during mercerization practice. While on the mercerization under tension the yarn leas were stretched to 3 % more than their original lengths before being mercerized. To prepare the leas, the yarn was mounted on the necklized iron frames then the leas were gently removed out of the frame.

Single yarn strength (g/tex) and elongation (%) were measured, before and after mercerization, on the Uster Automatic Yarn Strength Tester according to the **ASTM D-2256-66T (1982)** by taking 120 breaks for each test specimen.

Luster degree of yarn was measured before and after mercerization by Glossmeter which was used to measure light reflection on yarn. The test was done in Cotton Textile Consolidation Fund at Alexandria.

The data were statistically analyzed according to Completely Randomized Design in factorial system of treatments to analyze the effect of cotton varieties and mercerization treatments and their interactions on yarn properties with four replicates as outlined by **Snedecor and Cochran (1976)**. The L.S.D. at 0.05 level of probability was used to obtain the significance for differences between treatments.

RESULTS AND DISCUSSION

1- Effect of cotton varieties on yarn properties

a) Single yarn strength

It could be shown from Table (1) and Fig. (1) that single yarn strength of all varieties significantly affected by mercerization treatments (slack, constant length and under tension). The results indicated that the highest value of single yarn strength was noticed for the Giza 45 while the lowest value was obtained for the Giza 83.

Table 1. Effect of cotton varieties on yarn properties under mercerization treatments

Cotton variety	Single yarn strength g/tex	Elongation %	Luster degree
Giza 45	17.78	6.30	4.80
Giza 70	17.45	5.87	4.95
Giza 77	17.02	6.02	4.87
Giza 86	16.28	5.76	4.76
Giza 89	15.32	5.55	5.03
Giza 83	15.04	5.54	4.63
L.S.D. at 0.05 level	0.26	0.15	0.17

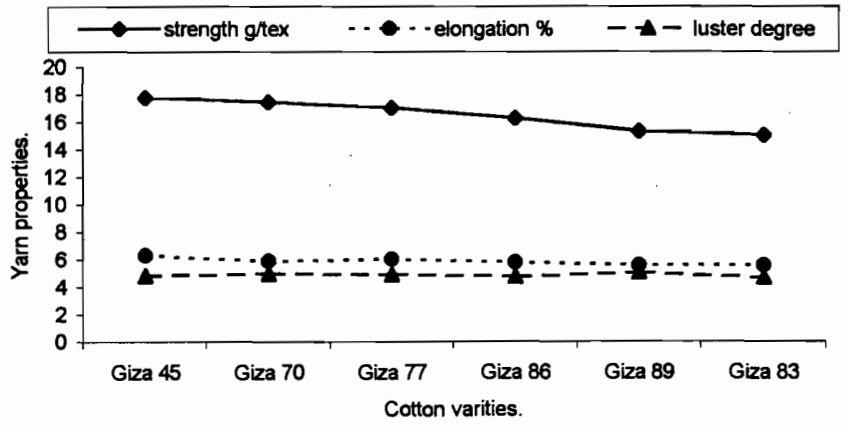

Fig. 1. Effect of cotton varieties on yarn properties under mercerization treatments

b) Yarn elongation %

Significance differences were found between the values of yarn elongation % of the varieties under study, with an exception of between the values of Giza 70 and Giza 86 as will as between Giza 89 and Giza 83. (Table 1 and Fig. 1)

c) Luster degree

Inspecting the results in Table (1) and Fig. (1) it could be shown that cotton varieties varied in their luster degree. Giza 89 had the highest luster degree (5.03) and the lowest value was recorded by Giza 83 (4.63). The table showed that significant differences existed between Giza 89 and Giza 83 and all the other varieties whereas there was no significant differences between Giza 45, Giza 70, Giza 77 and Giza 86.

2- Effect of mercerization treatments on yarn properties

a) Single yarn strength

Data recorded in Table (2) and Fig. (2) showed that, the effect of mercerization process on single yarn strength varied according to adopted degree of tension. In case of slack mercerization yarn strength tend to decrease. On the other hand, both mercerization at constant length and mercerization under tension increased yarn strength.

The decrease in single yarn strength resulted after slack mercerization was attributed to many factors concerning lint structure and yarn construction. (i) the decrease of crystallinity and increase of the disordered regions, **Warwicker *et al* (1966)** (ii) the increase of the spiral angle due to swelling of the lints **(DeBoer, 1973)** (iii) the decrease in the inter-lint friction resulting from the more circular cross-section of the mercerized lints **(DuBois, 1959)** and (iv) the increase in twist of the yarn due to its shrinkage and swelling of the slack mercerized lints. Thus resulting in decreased yarn strength.

However, the increase in yarn strength caused by mercerization at a constant length and under tension was reported by several workers: **Grant (1956) and McDonald *et al* (1957)**. This increase might be also attributed to factors concerning lint structure and yarn constriction. (i) gradual increase in fibrillar orientation and lint strength with increasing the stretch during mercerization **(Orr *et al* 1959)**. (ii) decrease in spiral angle of lint, so, its strength increased **(DeBoer, 1973)**. (iii) higher moisture regain compared with the unperceived yarn. Thus increased the strength. However, the increase in yarn strength is probably a combination of an increase in lint strength and increase in the "co-operative action" of lints in the yarn. **Al-Ashwat *et al* (1983)**.

b) Yarn elongation %

It could be shown from Table (2) and Fig. (2) that the achieved increase or decrease in yarn elongation as a result of adopted mercerization treatments were calculated as percentages of the control then tabulated. It is obvious that slack mercerized yarn recorded a pronounced increase in elongation. On the other hand, obvious decrease associated with both mercerization treatments at constant length and under tension.

Table 2. Effect of mercerization treatments on yarn properties under all the varieties

Mercerization treatments	Single yarn strength g/tex	Elongation %	Luster degree
Control	13.43	5.56	3.56
Slack mercerization	11.32	9.77	4.02
Mercerization at constant length	20.31	4.04	5.78
Mercerization under tension	20.88	4.00	6.00
L.S.D. at 0.05 level	0.22	0.12	0.14

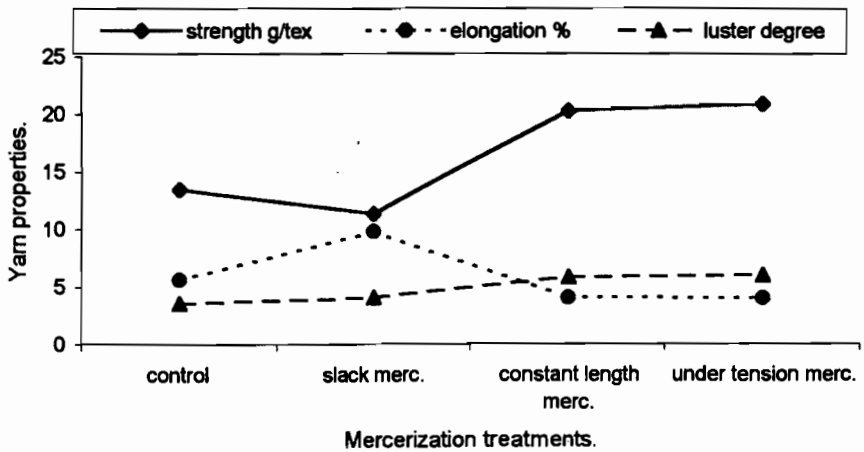

Fig. 2. Effect of mercerization treatments on yarn properties under all the varieties

However, this increase or decrease in yarn elongation % due to mercerization treatments could be explained on the same basis previously discussed in case of yarn strength, taking in account that the factors decreasing yarn strength, generally, increase yarn elongation and vice versa.

c) Luster degree

The data presented in Table (2) and Fig. (2) indicated that after mercerization treatments, cotton varieties showed a similar trend. The mercerization under tension improved the luster degree of cotton yarn more than slack mercerization and mercerization at constant length. These results are in harmony with those obtained by **(Fourt and Stricher 1953).**

3- Effect of the interaction between cotton varieties and mercerization treatments on yarn properties

The interactions between varieties and mercerization treatments on yarn properties, i.e. yarn strength, yarn elongation and luster degree are presented in Table (3). The analysis of variance for the three yarn properties revealed that the interaction between both variables were significant for the three properties, indicating differential response of the studied varieties to varying mercerization treatments concerning yarn strength, elongation and luster.

a) Single yarn strength

Data in Table (3) show the values of single yarn strength (g/tex) as affected by the interaction between the two variables studied. The effect of mercerization process on single yarn strength varied according to adopted degree of tension.

In case of slack mercerization, single yarn strength tended to decrease, the lowest decrease percentage ranged from (-5.0%) for Giza 77 to (-15.8 %) for Giza 45, while Giza 86, Giza 89, Giza 83 showed higher decrease (ranged from -19.7% to -22.3 %). In this respect **Abdel-Salam *et al* (1985)** reported that the actual tensile strength of slack mercerized yarns were significantly lower than that of untreated yarns.

On the other hand both mercerization at a constant length and mercerization under tension increased single yarn strength. The results showed that Giza 70 exhibited the highest response for mercerization at constant length followed by Giza 77 while Giza 83 ranked third. The percentages ranged from (+57.8%), (+54.4 %) to (+54.1%), respectively. While in the case of under tension mercerization the response was high for all varieties. The percentages ranged from (+59.4 %) for Giza 77, (+50.2 %) for Giza 45 to (+59.1 %) for Giza 83. These results indicated that Giza 77 showed the highest response to mercerization treatments.

b) Yarn elongation %

Mean values of yarn elongation % as affected by the interactions between cotton varieties and mercerization treatments are listed in Table (3). The results indicated that there were significant differences in yarn elongation% due to the two factors under study. It's previously shown that the slack mercerization increased yarn elongation% in all varieties. The increase in yarn elongation was (+94.2 %) for Giza 45

Table 3. Effect of the interction between cotton varieties and mercerization treatments on yarn properties

Cotton variety	Mercerization treatments	Single yarn strength g/tex	Elongation %	Luster degree
Giza 45	Control	14.71	5.58	3.55
	Slack	12.38 (-15.8%)*	10.84 (+94.2%)*	4.00 (+12.7%)*
	Constant length	21.95 (+49.2%)	4.60 (-17.6%)	5.85 (+64.8%)
	Under tension	22.10 (+50.2%)	4.20 (-24.7%)	5.80 (+63.4%)
Giza 70	Control	13.92	5.45	3.65
	Slack	12.42 (-10.8%)	10.03 (+84.0%)	4.05 (+10.9%)
	Constant length	21.96 (+57.8%)	3.98 (-26.9%)	5.95 (+63.0%)
	Under tension	21.52 (+54.6%)	4.03 (-26.0%)	6.20 (+69.8%)
Giza 77	Control	13.38	5.76	3.40
	Slack	12.71 (-5.0%)	9.28 (+61.1%)	3.95 (+16.2%)
	Constant length	20.66 (+54.4%)	4.27 (-25.8%)	6.00 (+76.5%)
	Under tension	21.33 (+59.4%)	4.78 (-17.0%)	6.15 (+80.8%)
Giza 86	Control	13.71	5.51	3.55
	Slack	11.00 (-19.7%)	9.83 (+78.5%)	3.95 (+11.3%)
	Constant length	19.39 (+41.4%)	3.87 (-29.7%)	5.45 (+53.5%)
	Under tension	21.04 (+53.5%)	3.83 (-30.4%)	6.10 (+71.8%)
Giza 89	Control	12.59	5.32	3.80
	Slack	9.89 (-21.4%)	9.52 (+78.5%)	4.30 (+13.1%)
	Constant length	19.02 (+51.1%)	3.74 (-27.9%)	5.90 (+55.3%)
	Under tension	19.79 (+57.2%)	3.65 (-31.4%)	6.15 (+61.8%)
Giza 83	Control	12.26	5.76	3.40
	Slack	9.52 (-22.3%)	9.15 (+58.8%)	3.90 (+14.7%)
	Constant length	18.90 (+54.1%)	3.77 (-34.5%)	5.60 (+64.7%)
	Under tension	19.50 (+59.1%)	3.51 (-39.1%)	5.65 (+66.2%)
L.S.D. at 0.05 level		0.52	0.31	0.33

* Percentages between parenthesis are the percent increases or decreases relative to the control value of each variety

followed by (+84.0%) for Giza 70 then (+78.5 %) for Giza 86 and 89.

In contrast both mercerization at constant length and under tension mercerization decreased yarn elongation relative to the control. The decrease of elongation was different as a result of mercerization at constant length. Giza 45 showed the least decrease (-17.6%) while Giza 83 showed the greatest decrease (-34.5%) among the six varieties.

It can be noticed that extra-long staple indicated lower decrease than long staple as a result of under tension mercerization. The decreased percentage ranged from (-17.0%) to (-24.7 %) in extra-long staple, while the decreased percentage ranged from (-30.4%) to (-39.1 %) in long staple.

However the mercerization treatments which caused increasing in single yarn strength generally decreased yarn elongation and vice versa. In this respect, **Al-Ashwat *et al* (1983)** reported that the decrease in yarn elongation in case of under tension mercerization, could be probably ascribed to the decrease in spiral angle of the fiber and the decrease in yarn twist as a result of swelling.

c) Luster degree

Data in Table (3) showed the values of luster degree as affected by the interaction between the two variables studied. Data revealed that the effect of the interaction between these variables was significant on luster degree. The effect of mercerization process on luster degree varied according to adopted degree of tension. Both slack mercerization, mercerization at a constant length and mercerization under tension increased luster degree.

In slack mercerization the increase in luster was low compared to the other ways of mercerization. The increased percentage ranged from (+10.9 %) for Giza 70 to (+16.2 %) for Giza 77. The increase was high in both mercerization at constant length and under tension mercerization. The increased percentage ranged from (+53.5 %) for Giza 86 to (+76.5 %) for Giza 77 in mercerization at constant length. While the increase percentage ranged from (+61.8 %) for Giza 89 to (+80.8%) for Giza 77 in mercerization under tension, indicating that stretch mercerization is the best treatment in increasing the luster degree of the spun yarns. In this respect, **(Fourt and Stricher, 1953 and Fourt *et al* 1954)** reported that mercerization under tension improved the luster of cotton yarns more than slack mercerization, which agree with our results.

REFERNCES

Abdel-Aziz, M.A. (1998). Response of carded and combed yarns of Egyptian Extra-long staple cottons to mercerization under tension. ***Agric. Res. Rev., Egypt. 76 (4) :1595-1605.***

Abdel-Salam, M.S.; A.M. Samra; A.M. Ismail and A.A. Nomeir (1985). Response of Egyptian cotton yarns to slack mercerization under various conditions of caustic concentration and treatment period. ***Agric. Res. Rev., Egypt. 63 (6) : 233-242.***

Al-Ashwat, A.A.; A.M. Zaher and M.M. Kamal (1983). Effect of mercerization on fiber and yarn mechanical properties of different grades and blends in some Egyptian cotton cultivars. ***Agric. Res. Rev., Egypt. 16 : 1-19.***

Standards, A.S.T.M. (1982). American Society for Testing and Materials, Part 32 and 33. ***Philadelphia, Pa., U.S.A.***

De Boer, J.J. (1973). The spiral angle and orientation of swollen and stretched single cotton fiber and their relation to fiber tenacity. ***Text. Res. J., 43: 141- 145.***

Du Bois, W.F. (1959). Frictional measurements on fibrous materials. ***Text. Res. J. 29: 451- 466.***

Grant, J.W. (1956). Certain physical properties of selected samples of chemically modified cottons. ***Text. Res. J. 26: 74 - 80.***

Fourt, L and P. Stricher (1953). Improvement of luster of cotton. Part II : Decrystallizing and mercerizing influence on luster. ***Text. Res. J. 23 :23-31.***

Fourt, L; R.M. Howorth; M.B. Rutheriord and P. Stricher (1954). Improvement of luster of cotton. Part V : Fiber shape in relation to luster. ***Text. Res. J., 24: 156 – 163.***

Ismail, A.M.; A.Y. Ashour and M.A. Abdel-Mohsen (1990). Effect of twist multiplier and yarn count on mechanical properties of untreated and mercerized yarns of Giza (75) cotton cultivar. ***Agric. Res. Rev., Egypt. 68(6) : 1309-1319.***

Kamal, M.M.; Nafisa, T., Ahamed and A.N. El-Sabbagh (1989). Alteration of the mechanical properties mercerized cotton yarns in accordance with the condition of treatment and the concentration of mercerizing solution. ***Annals. Agric. Sci., Ain-Shams. Univ., Egypt. 34 (1) : 125-140.***

McDonald, A.W.; R.S. Orr; G.C. Humphreys and J.N. Grant (1957). Physical properties of chemically modified cottons. Part 3 : Effect of mercerization. ***Text. Res. J. 27 : 641-648.***

Nelson, M.L.; G.B. Hassenboehler; F.R. Andrews and A.R. Markezish (1976). Mechanical properties of cotton yarns mercerized in liquid ammonia and sodium hydroxide. ***Text. Res. J. 46 : 872-879.***

Nomeir, A.A.; Nafisa, T. Ahamed and A.M. Ismail (1985). Mechanical properties of some untreated and mercerized cotton yarns. ***Agric. Res. Rev., Egypt. 63 (6) : 223-332.***

Orr, R.S.; A.W. Burgis; F.R. Andrews and J.N. Grant (1959). Physical properties of mercerized and decrystallized cottons. Part I : Effect of swelling solutions on fibers and yarns. ***Text. Res. J. 29: 349 – 355.***

Snedecor, G.W. and W.G. Cochran (1976). ***Statistical Methods.*** 6th. Edition, Iowa. State Univ. Press, Ames, Iowa, U.S.A.

Warwicker, J.O.; R. Jeffries; R.L. Colbran and R.N. Robinson (1966). A Review of the Literature on the Effect of Caustic Soda and Other Swelling Agents on the Fine Structure of Cotton. ***Shirley Institute, Didsbury, Manchester. Pamphlet, No. 93, pp. 1-247.***

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استجابة خيوط غزل الأقطان المصرية لطرق المرسرة المختلفة

[١٢]

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عوملت خيوط غزل لستة أصناف قطن مصرية مغزولة على نمرة غزل ٦٠ مسرح ومعامل برم ٣,٦ بثلاث طرق للمرسرة هى (المرسرة بدون شد , المرسرة بطول ثابت , المرسرة تحت شد) تمت المرسرة باستعمال محلول هيدروكسيد الصوديوم تحت الظروف القياسية من تركيز المحلول ٢٠% ودرجة الحرارة ومدة المعاملة ثم اختبرت صفات خيوط الغزل المفردة , وهى المتانة , الاستطالة , واللمعان وذلك قبل وبعد عملية المرسرة .

وجد أن المرسرة بدون شد تقلل متانة الخيوط , ولكنها فى نفس الوقت تزيد من استطالتها زيادة كبيرة . ويحدث العكس عند المرسرة بطول ثابت او تحت شد حيث تزيد المتانة وتقل الاستطالة وتزيد المتانة بدرجة اكبر عند المرسرة تحت شد .

ووجد أيضا ان جميع طرق المرسرة تزيد من درجة اللمعان للخيوط الممرسرة ولكن الزيادة فى المرسرة بدون شد كانت زيادة طفيفة إذا ما قورنت بالزيادة الناتجة عن المرسرة بطول ثابت او تحت شد .

أوضح تحليل التفاعل بين الأصناف ومعاملات المرسرة تباين الأصناف فى استجابتها لطرق المرسرة المختلفة بالنسبة للصفات الثلاث المدروسة. حيث تراوح الانخفاض فى المتانة بين (- ٥ %) فى صنف جيزة ٧٧ إلى (- ٢٢,٣ %) فى صنف جيزة ٨٣ عند المرسرة بدون شد , بينما تراوحت الزيادة فى متانة الغزل فى حالة المرسرة بطول ثابت وتحت شد بين (+٤١,٤%) فى صنف جيزة ٨٦ إلى (+ ٥٩,٤ %) فى صنف جيزة ٧٧ مما يدل على ان صنف جيزة ٧٧ هو أعلى الأصناف استجابة لعملية المرسرة , أما بالنسبة للاستطالة فتراوحت قيم الزيادة فى الاستطالة نتيجة المرسرة بدون شد بين (+٩٤,٢ %) فى صنف جيزة ٤٥ وهو

اكثر الأصناف استجابة للمرسرة إلى (+ ٥٨,٨ %) فى صنف جيزة ٨٣ . كما تباينت الأصناف فى استجابتها لطرق المرسرة المختلفة بالنسبة لقيم درجة اللمعان وكان اكثر الأصناف زيادة فى قيم درجة اللمعان صنف جيزة ٧٧ (+٨٠,٨ %) واقل الأصناف فى الزيادة جيزة ٨٩ (+٥٥,٣ %).

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