Comparative analysis of 100% cotton Siro and single yarns

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ABSTRACT – REZUMAT

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The aim of this work is to carry out the comparative study to analyse the properties of Siro and single yarn with different linear densities. For this purpose Siro yarn and single yarn with the same linear densities were produced from cotton. Tensile strength and related properties such as evenness, imperfections and hairiness have very important role in weaving. In this comparative study Siro and single yarn with linear densities of 10 Nec, 14 Nec and 18 Nec were manufactured, tested and analysed. Two rovings were used for Siro and one roving was used for single yarn. Comparative study revealed that Siro yarn exhibit better tensile strength and related properties.

Keywords: *Siro and single yarn, tensile strength, evenness, hairiness and imperfections*

Analiza comparativă a firelor 100% bumbac Siro și a firelor simple

Scopul acestei lucrări este de a efectua un studiu comparativ pentru a analiza proprietățile firului Siro și ale firului simplu cu densități liniare diferite. În acest scop, au fost produse fire Siro și fire simple din bumbac cu aceleași densități liniare. Rezistența la tracțiune și proprietățile asociate, cum ar fi uniformitatea, imperfecțiunile și pilozitatea, au un rol foarte important în timpul țeserii. În acest studiu comparativ, firul Siro și firul simplu cu densități liniare de 10 Nec, 14 Nec și 18 Nec au fost fabricate, testate și analizate. Două semitorturi au fost folosite pentru Siro și un semitort a fost folosit pentru firul simplu. Studiul comparativ a arătat că firele Siro prezintă rezistență la tracțiune și proprietăți asociate superioare.

Cuvinte-cheie: *fir Siro și fir simplu, rezistența la tracțiune, uniformitate, pilozitate și imperfecțiuni*

INTRODUCTION

Ring spinning is the popular and oldest of present day spinning processes, it can be attributed mainly to flexibility, universal applicability and yarn quality. Ring spinning is the leading technique for producing quality yarn in spite of its limitations. Various efforts have been made to overcome limitation of ring spinning. Limitation for ring spinning are spinning triangle, balloon tension, traveller speed and spindle speed which lead to hairy structure and lower production of yarn [1–3]. Spinners are focused to overcome the limitations to get yarn with improved properties. In 1975 CSIRO developed a technology for woollen Siro spun yarn, later the development was commercialized in 1980 by group consist of the Melbourne engineering company Warren, Brown and Staff, IWS and CSIRO [4, 5]. In Siro spinning, two parallel rovings are drafted in the same drafting zone on ring machine, after they emerge from the nip of front top and bottom rollers, they come together to form a yarn by twisting [6]. Siro yarn has better physical and other mechanical properties such as high evenness, low CV%, less Imperfection and low hairiness, high tenacity, more extension, higher work of rupture and more breaking strength as compared to single ring spun yarn. Researchers are focused on Siro yarn properties and structure with properties of others yarns e.g., solo yarn, Siro solo, vortex yarn, OE yarn and/or ring spun yarn [7, 8]. The basic aim of the present work is to compare Siro yarn and single ring spun yarn with range of same linear densities

MATERIAL AND METHOD

The characteristics of the cotton fibres used for this study are shown in table 1. For opening cleaning and mixing of the cotton raw materials Rieter blow room was used. The Reiter blow room includes Mixing bale opener, Uniclean B11, Mixing opener followed by Uniflex for inter laminar flow for chute feed system. After opening cleaning and mixing the fibres, sliver was produced on card C51 with the linear density of 4 ktex. For more mixing and parallelization of sliver the carded sliver was processed on Rieter draw frame RSBD 35. 8 carded sliver were processed on draw frame to get 4 ktex slivers. For comparative analysis all the rovings of different densities were kept same. Other technological parameters were kept unchanged. After drawing the sliver 0.93 hanks roving is formed on simplex FA 415.Siro and single yarn samples were produced with linear densities 10 Nec, 14 Nec and 18 Nec on ring frame EJM 168 by keeping same Twist multiplier (TM). On ring frame EJM 168 two eyed roving guides were used for Siro yarn samples and one eyed roving guides for single yarn so that the roving can be guided to the drafting zone properly. Two rovings were fed to drafting zone for Siro yarn and one roving for single yarn with 0.93 hanks. Ring Frame Adjustments are shown in table 2. Uster tester-4 was used to determine evenness, thick thin places, mass variations and imperfection. Yarn strength and elongation were tested on Uster Tensorepid-4.

Table 1

COTTON FIBRE PROPERTIES	
Cotton type	**Pakistani (MNH 83)**
50% span length (inch)	0.6032
2.5% span length (inch)	1.0756
Fibre fineness (MIC)	4.2
Fibre strength – Pressley value (cN/tex)	27.3

Table 2

RING FRAME ADJUSTMENTS						
Parameters	**Siro**			**Single**		
	10 Nec	**14 Nec**	**18 Nec**	**10 Nec**	**14 Nec**	**18 Nec**
Hank roving	0.465 Nec			0.93 Nec		
Break draft	1.45	1.45	1.45	1.45	1.45	1.45
Total draft	21.50	30.10	38.70	10.752	15.053	19.354
TM	4.2	4.2	4.2	4.2	4.2	4.2
TPI	13.28	15.72	17.80	13.28	15.72	17.80

Table 3

YARN PROPERTIES						
Parameters	**Siro**			**Single**		
	10 Nec	**14 Nec**	**18 Nec**	**10 Nec**	**14 Nec**	**18 Nec**
Evenness CV (%)	2.9	3.7	5.7	5	6.5	9.1
Thick places (+50 %)	38	144	272	40	212	310
Thin places (–40 %)	26	130	278	28	308	494
Hairiness (%)	8.95	7.58	6.76	10.72	7.84	7.17
Elongation (%)	5.3	4.25	3.75	5.18	4.19	3.7
Tenacity (cN/tex)	1978	1751	1671	1681	1632	1606

RESULT AND DISCUSSION

Comparison of irregularities in yarns

Yarn irregularity is the variation in weight per unit length of the yarn or standard deviation of irregularity CV %. UT-4 was used for the testing of CV % of a yarn. UT-4 is based on capacitive sensor which measures the capacitance between two separated conductive plates. Yarn is passed between two conductive plates which are separated by an air gap and the yarn acts as dielectric [7]. The Siro yarn with linear density of 18 Nec, 14 Nec and 10 Nec exhibits improved CV%. The mean values of C.V of single yarns (18, 14 and 10 counts) are 9.1%, 6.5% and 5%, while the mean C.V% values of Siro yarns were 5.7%, 3.7% and 2.9% shown in figure 1. The C.V% values shows that, the Siro yarns had lower C.V% than the single yarn by 3.89 %, 6.80% and 15.2 % with yarn linear density of 18, 14 and 10 Nec respectively. Yarn irregularity and coefficient of variation of irregularity in Siro yarn have improved due to the structure. Siro yarn structure has more consistent and smoother as compared to ring single yarn [9–11].

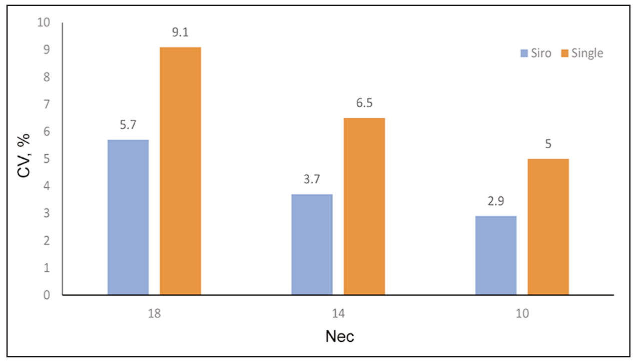

Fig. 1. Comparisons of yarn CV%

Comparison of IPI

IPI stands for imperfection index which shows the thick places, thin places and neps. Occurrences of yarn mass 50% more than the yarn mean value per kilo meter shows thick places. Similarly occurrences of 50% thinner places in yarn are called thin places. Entanglement of fibres having mass 200% to the yarn mean mass per kilo meter is called nep. The mean +50 thick places values of single yarns are 312, 212 and 40 while the mean +50% thick places values of Siro yarns are 272, 144 and 38 respectively. The +50% thick places values shows that the Siro yarns had less thick places than the single yarn by 22.9%, 32.1%and 5% with the same linear density of 18, 14 and 10 Nec respectively (figure 2).

The mean (–40%) thin places values of single yarns are 494, 308 and 28 while the mean (–40%) thin places values of Siro yarns are 278, 130 and 26 respectively. The (–40%) thin places values showing that, the Siro yarns had less thin places than the single yarns by 44%, 57.8% and 7.15% with the same linear density of 18, 14 and 10 Nec respectively (figure 3). However, the overall IPI improved in Siro yarn as compare to single yarns because of fibres are almost completely bound in the body that produces smoother surface and as a result yarn fault were reduced [9–11].

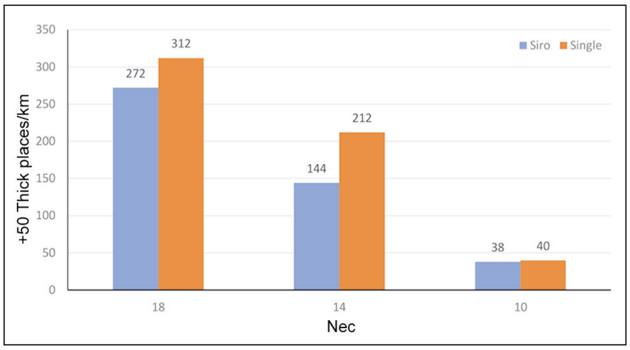

Fig. 2. Comparisons of +50 Thick places/km

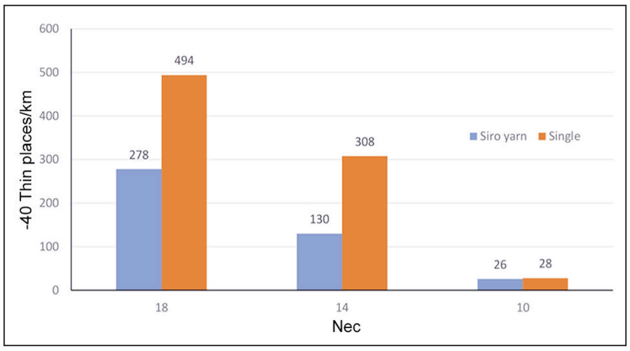

Fig. 3. Comparisons of (–40%) Thin places/km

Comparison of yarn hairiness

In UT-4, hairiness is the ratio of the total length of protruding fibres (in centimetres) per centimetre of yarn [13, 14]. The hairiness of Siro yarns and single yarns of all linear densities are compared which is shown in figure 4. The mean hairiness values of single yarns are 7.17, 7.84 and 10.72 while the mean hairiness values of Siro yarns are 6.768, 7.58 and 8.95. The hairiness means values showing that, the Siro yarns had less hairiness than the single yarn by 5.72%, 3.42% and 6.6%, with yarn linear density of 18, 14 and 10 Nec respectively. Lower hairiness is indicating about the more consolidated structure. It is showing that fibres are highly integrated in the body of Siro yarn as compare to ring single yarn [11, 12].

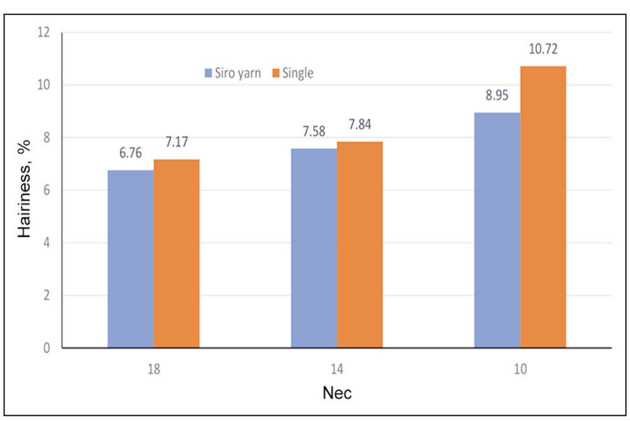

Fig. 4. Comparisons of yarn hairiness

Comparison of tensile properties of yarn

UTR-4 is used to determine the tensile properties of yarn such as breaking force, elongation, and toughness properties of the yarn. Siro and single ring spun yarns with the same linear density of 18, 14 and 10 Nec were tested. The mean elongation % values of single yarns are 3.7%, 4.19% and 5.18% while the mean elongation % values of Siro yarns are 3.75%, 4.25% and 5.3% respectively. The values showing that, the Siro yarns had greater elongation than the single yarn by 1.34%, 1.42% and 2.23% (figure 5). The elongation % of Siro yarns ascribed to the fact that in the core fibres of Siro yarn did not straighten due to two drafted strands special twisting (self-twisting) with each other. In this way, due to self-twisting of strand to each other, the fibre may get crimp and thus tensile force applied on Siro yarn initially open the crimp. Therefore fibres in Siro yarn exhibits elongation greater than single ring spun yarns.

The mean CLSP values of single yarns are 1606 cN/tex, 1632 cN/tex and 1681 cN/tex while the mean CLSP values of Siro yarns are 1978 cN/tex, 1751 cN/tex and 1606 cN/tex respectively (figure 6). The tenacity values shows that, the Siro yarns were considerably stronger than the single yarn by 3.89%, 6.80% and 15.2% with yarn linear density of 18, 14 and 10 Ne respectively. The tenacity of Siro yarn is greater than single yarn due the particular yarn structure, in Siro yarn structure the fibres are firmly bound within the yarn structure. Two twisted strands drafted fibres caused some surface fibres to be trapped into

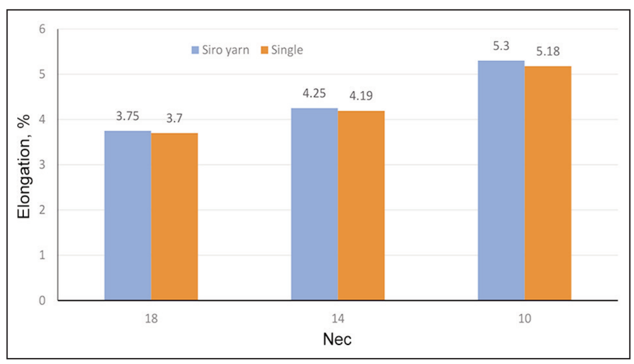

Fig. 5. Comparison of Elongation %

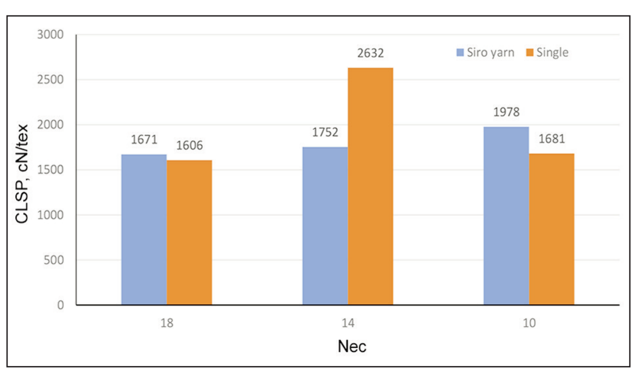

Fig. 6. Comparisons of yarn CLSPs

Siro yarn so as to increase the inter-fibre cohesion in the yarn which can withstand higher breaking force [11, 12].

CONCLUSION

The different counts 18, 14 and 10 of Siro and single yarns were spun in order to analyse the mechanical and physical properties. Both types of yarns were manufactured by 100% cotton fibre. Both types of spun yarns were analysed by mechanical and physical testing. Due to the special twisting and particular yarn structure of Siro Spinning system, Siro yarn had batter yarn characteristics then single yarns such as tenacity, elongation, thick and thin places, C.V% and hairiness.

It was observed that the tenacity values of Siro yarns were significantly stronger than the single yarn and greater elongation than the single yarn. +50% thick places, the Siro yarns had less thick places than the single yarns.

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