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Yarn quality analysis in non-cellulosic and metal contents of cotton fibre of various locations

Abstract

The fibre physical properties can be influenced by non-cellulosic and metal contents present in it which ultimately may impact the quality and spinning performance of resultant yarn. The concentration of these materials largely depends upon cotton variety, growing area and atmospheric conditions. In this back drop the present research study was planned to investigate the impact of various varieties and locations on non-cellulosic and metal contents of raw cotton and their eventual effects on subsequent yarn quality. So four varieties of single-season upland cottons from four different cotton-growing locations in Pakistan were selected for the study. The collected cotton samples were subjected to chemical and physical testing to know the concentrations of non-cellulosic and metal contents present in them along with other physical parameters. Then they were subjected to yarn manufacturing by conventional ring spinning method. At the end the yarn quality testing was carried out in respect of its tensile and imperfections characteristics. The results disclosed significant impacts of selected variables on yarn quality. The reduction in non-cellulosic contents and metal contents put negative impact on Count Lea Strength Product (CLSP), yarn lea strength, single yarn strength, breaking length, evenness, thin spots, and neps count of resultant yarn.

Keywords: cotton fibre, yarn quality, non cellulosic contents, metal contents, cotton varieties

Volume 8 Issue 1 - 2022

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Received: February 12, 2022 | **Published:** February 21, 2022

Introduction

Non-cellulosic materials on raw cottons may impact yarn processing efficiency and product quality. Concentrations are influenced by factors such as growing area, genetics of the particular variety, atmospheric changes, maturity of the fibre, length of growth period, growing and yield support chemical treatments, any pest aphid present, and contamination encountered in during cotton picking, ginning, and baling processes. Several preceding research looked examined the effects of dissimilar amounts of natural, insect, and man-made components on ginned cottons and how they might impact on yarn quality.[1]

Cotton contains non-cellulosic materials such as plant waxes, changeable amounts of ionic species and metals that are present throughout yarn spinning.[2] Cotton alcohol extractable (which include wax, small amounts of certain metals, and other non-fibrous materials) may vary from 10 to over 20g/kg (1.0% to 2.0%) of the weight of the fibre. Extracted wax concentrations generally differ from 2 to 10g/kg (0.2% to 1.0%) and concentrations of the most abundant metals (e.g. potassium, calcium, and magnesium) may vary from 2 to 7g/kg (0.2% to 0.7%). Concentrations of total solvent extractable materials and residual metals are heavily dependent upon the growing area, variety, length of growing season, weathering record, and fibre maturity. These materials are considered to be "surface related" and their collective concentrations may represent up to 30 g/kg (3.0%) of the weight of the fibre, wax, metals, and other surface related materials can directly influence the fibre performance in textile processing.[3]

Metal cat-ions are present as salts, or complex, either on the cotton fibre surface or enclosed within the chemical matrices of the variety of structural components of the fibre, including the primary and secondary walls of the cell. These cat-ions can contribute to a number of issues connected with processing of yarn, fabric production, bleaching and dyeing process. The presence of salts on the outer surface of the fibre and in the lumen have been linked with a possible beneficial effect to quality of yarn and processing efficiency owing to their anti-static properties.[4]

The most abundant metals on cotton fibre are potassium, calcium, magnesium, and sodium. Other metals observed at a much lesser relative concentration are iron, copper, manganese, zinc, nickel, silicon, cobalt, and aluminum.[5] The cotton fibre is composed of concentric layers. The cuticle layer on the fibre itself is divisible from the fibre and consists of wax and pectin material. The primary wall is composed of cellulose crystalline fibrils. The secondary wall of cotton fibre consists of three distinct layers. The entire three layers of the secondary wall include very much packed parallel fibrils with spiral twisting of 25-35° and represent the mass of cellulose within the fibre. Most commonly the contents are broken down into the components of 80-90% cellulose, 6-8% water, 0.5-1% waxes and fats, 0-1.5% proteins, 4-6% hemicellulose and pectins, 1-1.8% ash.[6]

Quality of cotton can be apparent in the course of seed or fibre properties, but is most often linked with fibre properties that affect processing into yarn and textile products. Cotton fibre quality can be enhanced through genetics, crop managing, and postharvest handing out. Awareness of the effect of fibre properties on processing and their inheritance, interaction, and environmental influences is essential to originate improvement strategies. In the light of these facts the present study endeavors to assess the impacts of these specific non-fibrous elements present in cotton in varying quantity with respect to different varieties and location on the quality of the final yarn.

Materials and methods

The present study was set in the Department of Fibre and Textile Technology, University of Agriculture, Faisalabad. The chemical tests were carried out in the National Institute of Agriculture and Biology (NIAB) Faisalabad and Spinning of samples were performed at Central Cotton Research Institute (CCRI) Multan, Pakistan. The details of experimental process regarding the materials and methods are given here under.

Materials

The lint cotton samples of different varieties and different micronaire values were collected from various cotton research stations of Pakistan (Table 1).

Table 1 Variables selected for the study

Location (L)	Cotton variety (V)	Micronaire value (M)
L1= Multan	V1= CIM-473	M1= 4.4
L2= Bahawalpur	V2= CIM-496	M2= 4.6
L3= Rahim Yar Khan	V3= NIAB-111	M3= 4.8
L4= Faisalabad	V4= NIAB-999	M4= 5.0

Methods

All the selected cotton varieties were tested for their physical properties, non-cellulosic contents and metal contents adopting standard procedures. Physical characteristics of cotton fibres i.e. staple length, length uniformity index, fibre strength, fibre fineness and fibre elongation (%) were estimated by High Volume Instrument (HVI-900A), a fibre testing system manufactured by M/S Zellweger Uster Ltd. (Switzerland). HVI system is designed to measure the larger quantity of cotton samples with in a minimum time frame. The span length and uniformity index are measured with fibrograph-910 module using optical technique. The determination of fibre strength takes place simultaneously along with fibre length measurement. The maximum tensile force is measured as fibre tuft held between two clamps. Micronaire value is estimated on Micronaire-920 module by measuring the escape of airflow through a plug of weighted cotton sample. The total fibre surface determines the resistance to airflow. The instrument is calibrated according to the method laid down in its instructional manual supplied by M/S Zellweger Ltd adopting the ASTM standard methods.[7] The results are tabulated below (Table 2).

Table 2 Physical characteristics, non- cellulosic and metal contents of cotton fibre under selected variables

Fibre properties	Location (L)				Variety (V)				Micronaire value (M)			
	L1	L2	L3	L4	V1	V2	V3	V4	M1	M2	M3	M4
Span length (mm)	28.44	27.91	28.69	27.31	26.13	27.61	29.07	25.1	28.59	28.2	27.07	26.05
Length Uniformity Index (UI %)	81.8	82.08	82.86	82.64	80.21	82.9	82.42	81.36	81	82.13	82.48	82.77
Fibre Strength (g/tex)	27	28.25	26.11	29.44	29.23	26.9	25.83	28.18	25.83	27.34	28.57	29.94
Fibre Elongation (%)	5.5	5.2	5.83	4.85	4.82	6	6.28	4.5	5.75	5.51	5.25	5.03
Non cellulosic contents												
Wax contents (%)	0.51	0.55	0.57	0.46	0.5	0.55	0.61	0.45	0.55	0.5	0.52	0.48
Alcohol extractable (%)	1.99	1.87	1.25	1.37	1.63	1.55	1.42	1.72	1.69	1.52	1.6	1.44
Residual sugar (%)	0.46	0.56	0.31	0.49	0.43	0.45	0.48	0.41	0.41	0.44	0.47	0.49
Ash content (%)	1.62	1,69	1.2	1.44	1.48	1.4	1.33	1.56	1.52	1.45	1.38	1.31
Metal contents												
Magnesium (ppm)	675	644	455	577	537	566	509	597	608	592	582	570
Potassium (ppm)	5258.6	6084.3	3862.4	4216.2	4890.6	4562.8	3985.5	5253.5	5412.6	4168.9	4875	4564.9
Calcium (ppm)	1488	525	655	913	893	893	902	893	873	921	826	780
Sodium (ppm)	186	141	106	100	139	131	119	125	161	138	125	112

Metal contents

Metal contents of cotton fibres were tested[8] using the following methods.

Flame photometer for potassium and sodium quantification

Chemical examination of fibrous materials was performed when the fibrous material was physiologically mature. The fibrous raw material was dried for 24 hours at 70 degrees Celsius. Sulphuric acid and hydrogen peroxide were used to digest the dry material (0.5g) according to Wolf's procedure.[9] One milliliter of potassium extract was diluted to 100 milli liters and evaluated on a flame photometer model Jenway PFP 7. Individual potassium levels were compared to a standard curve, and total amounts were computed. On a flame photometer, sodium (Na) was also measured following the guidelines provided in its instruction manual.

Titration with EDTA to determine calcium and magnesium (versenate)

The detection of calcium (Ca) and magnesium (Mg) was done using the technique given by the US salinity staff.[10]

Yarn characteristics

The physical qualities of 30s count yarn materials were evaluated using the following established procedures.

Yarn count

The yarn count was assessed using the "skein method" with the assistance of the Uster Auto Sorter-III, a direct reading device, in accordance with ASTM regulations.[11]

Yarn lea strength

The lea strength of the yarn was estimated using ASTM criteria in pounds.[11]

Count lea strength product (CLSP)

Multiplying the exact count value by the yarn's appropriate lea strength value as stated by British Standards yielded the count lea strength product value.[12]

CLSP= yarn count ×Lea strength

Yarn tensile characteristics

Tensile characteristics such as elongation, single yarn strength, and rupture per kilometer were calculated using the Uster Tensojet, working under the principle of constant rate of extension (CRE) as per ASTM standards.[11]

Yarn evenness, imperfections and hairiness

The Uster Evenness Tester-4 (UT-4) was employed, which uses an ASTM standard approach to analyze yarn hairiness, evenness (U percent), and faults such as thin places, thick places, and neps per kilo meter of yarn.[11]

Atmospheric conditions

The tests were conducted under typical laboratory circumstances, which included a relative humidity of 65±2 percent and a temperature of 20±2 degrees Celsius.

Results and discussions

Yarn lea strength (lbs)

The influence of Location (L), Variety (V), and Micronaire value (M) on yarn lea strength was found to be very significant. The mean values of yarn lea strength for L_1, L_2, L_3, and L_4 were 113.48, 109.49, 118.81, and 103.75 pounds, respectively, according to Duncan's Multiple Range Test (DMRT) and the individual treatment differentiation of averages for various locations provided in Table-3. The results discovered that the yarn lea strength levels at various locations varied substantially. The results showed that L_3 had the highest value for yarn lea strength, followed by L_1, L_2, and L_4 in that order.

Yarn lea strength average values for V_1, V_2, V_3, and V_4 were 100.24, 112.02, 119.41, and 106.47 pounds, respectively, according to DMRT and individual treatment averages differentiation for four cotton varieties provided in Table 3. The studies discovered that the yarn lea strength values for all varieties varied greatly. The greatest figure for yarn lea strength was reported for V_3, which was followed by V_2, V_4, and V_1 in that order.

The mean value of yarn lea strength for M_1, M_2, M_3, and M_4 was 119.71, 113.99, 108.58, and 102.24 pounds, respectively, according to DMRT and the differentiation of individual treatment averages for various Micronaire values provided in Table-3. The results indicated that the yarn lea strength values for various Micronaire levels varied substantially. The yarn lea strength ranged from 102.24 to 119.71 pounds for the specified micronaire values. The results showed that M_1 had the highest yarn lea strength, followed by M_2, M_3, and M_4.

Table 3 A differentiation of individual yarn lea strength means

Location (L)	Variety (V)	Micronaire value (M)
L1=113.48b	V1=100.24d	M1=119.71a
L2=109.49c	V2=112.02b	M2=113.99b
L3=118.81a	V3=119.41a	M3=108.58c
L4=103.75d	V4=106.47c	M4=102.24d

Mean scores with dissimilar letters vary significantly at the 0.05 probability level

Where L_1 = Multan, L_2 = Bahawalpur, L_3 = Rahim Yar Khan and L_4 = Faisalabad. And V_1 = CIM-473, V_2 = CIM-496, V_3 = NIAB-111 and V_4 = NIAB-999. And M_1 = 4.4, M_2 = 4.6, M_3 = 4.8 and M_4 = 5.0

Count lea strength product (CLSP) (Hanks)

The influence of the L, V, and M on count lea strength product was found to be very significant. The average values of CLSP for L_1, L_2, L_3, and L_4 were 2296.9, 2206.0, 2332.9, and 2128.3 hanks, respectively, according to DMRT test and the differentiation of individual treatment averages for various locations provided in Table 4. The results concluded that the count lea strength product values for four cotton growing areas varied greatly. According to the results, L_3 had the highest count lea strong product, followed by L_1, L_2, and L_4 in that order. These results are in line with the findings that the physical properties of cotton, such as fibre length, fineness strength, and maturity, largely affected the CLSP of the yarn.[13]

Table 4 Individual CLSP mean values are compared

Location (L)	Variety (V)	Micronaire value (M)
L1=2296.9b	V1=2014.3d	M1=2316.5a
L2=2206.0c	V2=2246.6b	M2=2276.9b
L3=2332.9a	V3=2348.4a	M3=2225.9c
L4=2128.3d	V4=2132.9c	M4=2144.9d

Mean scores with dissimilar letters vary significantly at the 0.05 probability level

The average values of CLSP for V_1, V_2, V_3, and V_4 were 2014.3, 2246.6, 2348.4, and 2132.9 hanks, respectively, according to DMRT and differentiation of individual treatment averages for four cotton varieties provided in Table-4. The results showed the CLSP values for all varieties varied greatly. The largest value for CLSP was reported for V_3, which was followed by V_2, V_4, and V_1 in that order.

The average values of CLSP for M_1, M_2, M_3, and M_4 were 2316.5, 2276.9, 2225.9, and 2144.9 hanks, respectively, according to DMRT and differentiation of individual treatment means for various micronaire values provided in Table 4. The results indicated that the CLSP for all micronaire levels varied substantially. The CLSP ranged from 2144.9 to 2316.5 hanks for variant micronaire. The results showed that M_1 had the highest count lea strong product, followed by M_2, M_3, and M_4. The matches with the findings that the CLSP value of the yarn was mostly determined by the physical features of cotton, such as fibre strength, length, maturity and fineness.[14,15]

Single yarn strength (SYS) (grams)

All the selected variables put significant impact on SYS. The mean values of SYS for L_1, L_2, L_3, and L_4 were 427.75, 405.17, 448.94, and 382.20 grams, respectively, according to DMRT and the differentiation of individual treatment averages for various locations provided in Table-5. The results concluded that SYS ratings for various sites are considerably variable. According to the results, L_3 had the highest SYS followed by L_1, L_2, and L_4, in that order.

The mean values of single yarn strength for V_1, V_2, V_3, and V_4 were 401.96, 422.50, 444.08, and 380.52 grams respectively, according to DMRT and the differentiation of individual treatment means for four varieties provided in Table 5. The results revealed that SYS ratings for all varieties varied greatly from one another. According to the results, V_3 had the highest SYS followed by V_2, V_1, and V_4, in that order.

Table 5 SES individual averages differentiation

Location (L)	Variety (V)	Micronaire value (M)
L1=427.75b	V1=401.96c	M1=449.46a
L2=405.17c	V2=422.50b	M2=427.12b
L3=448.94a	V3=444.08a	M3=406.74c
L4=382.20d	V4=380.52d	M4=385.74d

Mean scores with dissimilar letters vary significantly at the 0.05 probability level

The mean values of SYS for M_1, M_2, M_3, and M_4 were 449.46, 427.12, 406.74, and 385.74 grammes, respectively, according to DMRT and differentiation of individual treatment means for four micronaire values provided in Table 5. SYS ratings for various Micronaire levels are considerably variable, according to the results. For the specified micronaire values, the SYS ranged from 449.46 to 385.74 grammes. According to the results, M_1 had the highest single yarn strength, followed by M_2, M_3, and M_4, in that order.

Yarn evenness (U %)

The mean values of U % for L_1, L_2, L_3, and L_4 were 11.60, 12.90, 13.60, and 12.21 percent, respectively, according to DMRT and the differentiation of individual treatment averages for four locations provided in Table 6. The results revealed that the U % values for all locations are considerably varied. According to the results, L_3 had the highest U % value, followed by L_2, L_4, and L_1, in that order.

Table 6 U % treatment means differentiation

Location (L)	Variety (V)	Micronaire value (M)
L1=11.60d	V1=13.21b	M1=13.00b
L2=12.90b	V2=12.74c	M2=13.74a
L3=13.60a	V3=12.01d	M3=12.25c
L4=12.21c	V4=14.01a	M4=11.65d

Mean scores with dissimilar letters vary significantly at the 0.05 probability level

The mean values of U % for V_1, V_2, V_3, and V_4 were 13.21, 12.90, 13.60, and 12.21 percent, respectively, according to DMRT and differentiation of individual treatment averages for four cotton varieties provided in Table 6. The results disclosed that the U % for all varieties varied greatly from one another. According to the results, V_3 had the highest U % value, followed by V_1, V_2, and V_4 in that order.

The mean values of U % for M_1, M_2, M_3, and M_4 were 13.00, 13.74, 12.25, and 11.65 percent, respectively, according to DMRT and differentiation of individual treatment means for four micronaire values provided in Table 6. The results indicated that the U % values for all micronaire levels are considerably varied. The U % range for the chosen micronaire values was determined to be between 11.65 and 13.74 percent. According to the results, M_2 had the highest U percent value, followed by M_1, M_3, and M_4, in that order.

Breaking length (RKM) (g/tex)

The influence of the L, V, and M on RKM was found significant on Breaking length of the yarn, The mean values of RKM for L_1, L_2, L_3, and L_4 were 14.52, 13.89, 15.24, and 13.00g/tex, respectively, according to DMRT and the differentiation of individual treatment averages for four locations provided in Table 7. RKM levels for all locations are considerably diverse, according to the results. The results showed that L_3 had the highest RKM value, followed by L_1, L_2, and L_4, in that order.

Table 7 RKM individual means differentiation

Location (L)	Variety (V)	Micronaire value (M)
L1=14.52b	V1=13.59c	M1=15.04a
L2=13.89c	V2=14.51b	M2=14.65b
L3=15.24a	V3=15.40a	M3=14.01c
L4=13.00d	V4=13.01d	M4=13.66d

Mean scores with dissimilar letters vary significantly at the 0.05 probability level

The mean values of RKM for V_1, V_2, V_3, and V_4 were 13.59, 14.51, 15.40, and 13.01g/tex, respectively, according to DMRT and differentiation of individual treatment averages for four cotton varieties provided in Table 7. The results revealed that the RKM values for all varieties differed substantially. The results showed that V_3 had the highest RKM value, followed by V_2, V_1, and V_4, in that order.

The mean values of RKM for M_1, M_2, M_3, and M_4 were 15.04, 14.65, 14.01, and 13.66g/tex, respectively, according to DMRT and the differentiation of individual treatment averages for four micronaire values provided in Table 7. RKM values for all micronaire levels are considerably varied, according to the results. For the specified Micronaire values, the RKM ranged from 13.66 to 15.04g/tex. The results showed that M_1 had the highest RKM value, followed by M_2, M_3, and M_4, in that order.

Yarn imperfections

Thin places per kilometer

The results revealed substantial influence of the L, V, and M on yarn thin places per kilometer. The mean values of thin places per kilometer for L_1, L_2, L_3, and L_4 were 88.25, 80.75, 75.68, and 70.04 per thousand meters, respectively, according to DMRT and differentiation of individual treatment averages for four locations provided in Table 8. The results disclosed that the values for thin spots per kilometer for all locations varies greatly. The data showed that L_1 had the highest number of thin spots per kilometer, followed by L_2, L_3, and L_4, in that order. These results get support from the observations that as total ethyl alcohol surface extractables on the fibre increased, the thin places in the yarn decreased.[16] Increased levels of total alcohol extractable components were also connected to greater yarn corrected skein break factor and SYS testing.

The mean values of thin spots per kilometer for V_1, V_2, V_3, and V_4 were 91.06, 64.37, 77.06, and 82.06 per thousand metres, respectively, according to DMRT and differentiation of individual treatment averages for four cotton varieties provided in Table 8. The studies revealed that the numbers for thin spots per kilometer for all varieties varies greatly. The data showed that V_1 had the highest number of thin spots per kilometer, followed by V_4, V_3, and V_2 in that order. These results are backed up by findings that evenness, neps, and thick and thin patches in the ring and open end spun yarn increased as total surface extractable, total light metal content and wax increased, while vortex spinning increased.[17]

Table 8 Yarn thin places per kilometer individual treatment means differentiation

Location (L)	Variety (V)	Micronaire value (M)
L1=88.25a	V1=91.06a	M1=90.00a
L2=80.75b	V2=64.37d	M2=82.19b
L3=75.68c	V3=77.06c	M3=76.31c
L4=70.04d	V4=82.06b	M4=70.06d

The mean values of thin spots per kilometer for M_1, M_2, M_3, and M_4 were 90.00, 82.19, 76.31, and 70.06 per thousand meters, respectively, according to DMRT and differentiation of individual treatment means for various micronaire values provided in Table 8. The results indicated that the values for thin locations per kilometer for all micronaire levels varied substantially. For the given micronaire value, the range of thin spots per kilometer was determined to be between 70.06 and 90.00 per thousand meters. The data showed that M_1 had the highest number of thin spots per kilometer, followed by M_2, M_3, and M_4 in that order. The similar results were noted in a previous study[17] that when total ethyl alcohol surface extractables on the fibre grew, Classimat yarn long thin place measurements dropped. Increases in yarn adjusted skein break factor and single strand strength tests were likewise linked to higher amounts of total alcohol extractable components.

Thick places per kilometer

The mean values of thick spots per kilometer for L_1, L_2, L_3, and L_4 were 360.44, 398.69, 379.63, and 345.81 per thousand meters, respectively, according to DMRT and the differentiation of individual treatment averages for four cotton growing areas provided in Table 9. The results indicated that the thick places per kilometer for all locations fluctuate greatly. The data showed that L_2 had the highest density of thick spots per kilometer, followed by L_3, L_1, and $_{L4}$ in that order.

Table 9 Yarn thick places per kilometer individual treatment means

Location (L)	Variety (V)	Micronaire value (M)
L1=360.44c	V1=549.38a	M1=359.50c
L2=398.69a	V2=297.62c	M2=345.69d
L3=379.63b	V3=460.88b	M3=375.13b
L4=345.81d	V4=265.69d	M4=398.25a

Mean scores with dissimilar letters vary significantly at the 0.05 probability level

The mean values of thick spots per kilometer for V_1, V_2, V_3, and V_4 were 549.38, 297.62, 460.88, and 265.69 per thousand meters, respectively, according to DMRT and differentiation of individual treatment averages for four cotton varieties provided in Table-9. The results revealed that the thick spots per kilometer values for all varieties vary greatly. The data showed that V_1 had the highest density of thick spots per kilometer, followed by V_3, V_2, and V_4 in that order. The variation in thick places is due to the variation of metal contents of different varieties that correlate with the outcomes that Evenness, neps, and thick and thin spots in the ring and open end increased as total surface extractable, wax, and total light metal content grew, while vortex spinning increased.[17]

The mean values of thick spots per kilometer for M_1, M_2, M_3, and M_4 were 359.50, 345.69, 375.13, and 398.25 per thousand meters, respectively, according to DMRT and differentiation of individual treatment means for four micronaire values provided in Table 9. The results indicated that the thick spots per kilometer values for all micronaire levels varied substantially. For the given micronaire value, the range of thick spots per kilometer was determined to be between 345.69 and 398.25 per kilometers. The data showed that M_4 had the highest density of thick spots per kilometer, followed by M_3, M_1, and M_2. These observations are in line with the results that ring yarn neps increased when alcohol extractions, wax levels, potassium and magnesium content, and fibre to metal friction increased, but rotor yarn neps decreased.[18]

Neps per kilometer

The mean values of neps per kilometer for L_1, L_2, L_3, and L_4 were 147.13, 153.75, 169.00, and 161.16 per kilometers, respectively, according to DMRT and the differentiation of individual treatment averages for four locations provided in Table 10. The results reflected that the neps per kilometer values for all locations varied greatly. The data showed that L_3 had the highest number of neps per kilometer, followed by L_4, L_2, and L_1, in that order.

Table 10 Differentiation of individual mean values for Yarn Neps

Location (L)	Variety (V)	Micronaire value (M)
L1=147.13d	V1=151.56c	M1=164.84a
L2=153.75c	V2=184.34a	M2=156.38b
L3=169.00a	V3=170.31b	M3=147.25c
L4=161.16b	V4=141.81d	M4=139.56d

Mean scores with dissimilar letters vary significantly at the 0.05 probability level

The mean values of neps per kilometer for V_1, V_2, V_3, and V_4 were 151.56, 184.34, 170.31, and 141.81 per thousand meters, respectively, according to DMRT and the differentiation of individual treatment averages for four cotton varieties provided in Table-10. It is depicted from the results that the neps per kilometer values for all varieties varies greatly. The data showed that V_2 had the highest number of neps per kilometer, followed by V_3, V_1, and V_4, in that order.

The mean values of neps per kilometer for M_1, M_2, M_3, and M_4 were 164.84, 156.38, 147.25, and 139.56 per thousand meters, respectively, according to DMRT and differentiation of individual treatment averages for four micronaire values provided in Table 10. The results indicated that the neps per kilometer values for all micronaire levels varied substantially. For the given micronaire value, the range of neps per kilometer was determined to be between 139.56 and 164.84 per kilometers. The data showed that M_1 had the highest number of neps per kilometer, followed by M_2, M_3, and M_4, in that order.

Conclusion

The purpose of this experiment was to investigate the impact of location on the non-cellulosic constituents of raw cotton and its subsequent impact on yarn properties. Cotton from four growing areas (Multan, Bahawalpur, Rahim Yar Khan, and Faisalabad), four cotton varieties (CIM-473, CIM-496, NIAB-111, and NIAB-999), and four micronaire values (4.4, 4.6, 4.8, and 5.0) were analyzed for alcohol extractables, wax, residual sugars, fibre ash content, light metal content, and yarn properties. The calculated values were then compared to spinning performance data. Non-cellulosic elements such as wax content, alcohol extractables, residual sugars, ash, and metal content showed very significant variances. With an increase in micronaire value, alcohol extractables, wax, fibre ash content, and light metal content reduced for all cottons from four distinct locales, whereas residual sugars increased. This is because the non-cellulosic elements are dependent on the thickness of the cotton fibre secondary cell wall. The secondary cell wall thickness decreased as micronaire rose. With the reduction in wax, alcohol extractables, and ash content, CLSP, yarn lea strength, SYS, breaking length, evenness, thin spots, and neps reduced. The decrease in metal content linked to decreased CLSP, yarn lea strength, SYS, breaking strength, evenness, thin spots, and neps. Hence it is established from the study that varieties of cotton from various places, as well as micronaire values, have a substantial impact on non-cellulosic components and metal content, which are linked to yarn quality criteria.

Acknowledgments

None.

Funding

None.

Conflicts of interest

Authors declare that there is no conflict of interest.

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