Screening of Hybrid Cotton Varieties Suitable for Medical Textiles

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Abstract

The present research work was conducted to analyse the cotton fiber quality parameters of high micronaire value for the selection of surgical cotton .The hybrid cotton varieties were planted and grown at breeder farm saloowardha, 30 varieties were identified for the screening of bleached cotton properties. These cotton varieties are screened for fiber length, fiber maturity, fiber length, fiber strength and fiber elongation.

Among the 30 cotton varieties the CV% was 5.48%, 1.81%, and 7.30% for micronaire, maturity and fiber length, respectively .Highly significant positive correlation was identified between Fibermicronaire and fiber maturity (r=0.721), while highly significant negative correlation was found between the fibermicronaire and fiber length (r= - 0.657).Fiber Maturity with fiber length was negatively and significantly correlated (r= - 0.427). A principal component analysis is performed by using Minitab software on the fibermicronaire, fiber maturity, fiber length, fiber strength, and fiber elongation. Factor 1 has large positive loadings on Micronaire, Maturity and Elongation and small loading on length and strength. Factor 2 has a large positive loading on Len and Elg and small loadings on Micronaire, Maturity and Strength.

On the basis of screening, HICE, DEOR, CGC2, GAC4, GAC5, G3CM varieties with better sinking time and water holding capacities were identified. Variety ID DEOR, CERM, GAC5 , DHMC, GCCC, DEHY, GCC2 and GC45 are the most suitable cotton varieties for medical textiles with high micronaire value, less fiber length and low SCI. Cotton breeder can developed these varieties and encourage farmer and surgical manufacture to use these varieties for producing bleached cotton and which will boost the surgical cotton industry.

Keywords - *Surgical cotton, breeder, medical textile, spinning consistency index, sinking time ,water holding capacity, micronaire ,maturity.*

I. INTRODUCTION

Textile fibers and fabric are used for various applications in medical and healthcare sector [3]. Natural and synthetic fibers are being utilized for developing medical textile products as per their end use. Blending of natural and synthetic fibers is essential to get desired product property. The use of cotton fibers in medical textile has increased because of the good moisture absorbency, Comfortable Soft hand, comfortable to wear and Static electricity charges do not build up readily on the clothes. However, cotton is not suggested for use in base layer clothing because of its tendency to absorb and retain moisture.

The use of cotton in technical textiles segments such as Medical textiles is on the decline and cotton is replaced by manmade fiber and therefore it is essential that there is a greater focus on the development of high micronaire, short staple and high strength, cotton varieties [4]. Farmers doesn't grow short staple cotton varieties because of the cost of cultivation is high and government declares minimum support prizes for cotton fibers and hence there is shortage of availability of these varieties in India and therefore, it is essential to increase the production of the short staple cotton varieties which are suitable for surgical purpose through various cotton breeding trials.

The physical properties of cotton fiber determine its spin ability into yarn and contribute to textile application in various fields. The important properties of cotton fiber are Length, strength and micronaire [7]. Fiber quality priorities for the surgical cotton are high micronaire, short staple length and high maturity [1]. It is essential that the surgical cotton manufacturer purchase cotton varieties which are most suitable to process in bleaching equipment's and web forming machines to achieve the desired quality of the output product. For running surgical cotton units continuously the cotton varieties with fiber quality priorities mentioned above must be easily available throughout the year.The hybrid cotton varieties collected from the cotton breeder are screened on the basis of sinking time and water holding capacity of bleached cotton [5].

II. MATERIAL AND METHODS

The experiment was conducted at the experimental farm of cotton breeder at saloo, wardha district, Maharashtra during the season 2016-2017. Thirty hybrid cotton varieties are collected from the cotton breeder and ginned at the same place. Lint of these

cotton varieties were analysed by HVI system for fiber length, fiber fineness ,fiber strength , fiber elongation , fiber maturity ,short fiber index, fiber uniformity, Rd and Plus b [6]. The bleaching of selected varieties was carried out and the bleached cotton were analysed for sinking time in seconds and water holding capacity in gms. The observations are recorded and Minitab analysis of variance was applied for the analysis of data and interpretation of the results.

The summary statistics for fiber properties are shown in Table 1. Correlations were also determined between each of fiber length, fibermicronaire and fiber maturity. ANOVA, CV and correlation analysis and principal component fiber analysis were performed with Minitab software.

III. RESULTS AND DISCUSSION

The analysis of variance of 30 cotton varieties was conducted for the fiber properties Mic, Mat and Length .The output results mentioned in Table 1.The observed CV% was 5.48%, 1.81%, and 7.30% for micronaire, maturity and fiber length, respectively. There are some variations but these differences were non-significant.

Table 1.Summary of Fiber characteristics of 30 cotton varieties

Variable	Min.	Max.	Mean	SE Mean	Std. dev	Coef Var
Mic	6.69	8.14	7.132	0.390	0.390	5.48
Mat	0.96	1.03	0.991	0.003	0.017	1.81
Len	18.75	25.88	21.94	0.293	1.603	7.30

The correlation coefficients among Micronaire, Maturity and fiber length of 30 cotton varieties are shown in Table 3. Between Fibermicronaire and fiber maturity the positive correlation (r=0.721) was observed and it is highly significant, while highly significant negative correlation was found between the fibermicronaire and fiber length (r= - 0.657).Fiber Maturity with fiber length was negatively and significantly correlated (r= - 0.427).

	Mic	Mat	Len
Mic	1		
Mat	0.721	1	
	0.000		
Len	-0.657	-0.427	1
	0.000	0.018	

Table 2. Correlations coefficients amongMic, Mat, Lenin 30 cotton varieties

Fiber characteristics for the selected hybrid cotton varieties for all the five fiber properties are listed in Table 3.Among the selected cotton varieties micronaire was ranged from 6.69 – 8.14 with a mean of 7.13.The highest value of micronaire was recorded in Variety ID CERM (8.14) while the lowest value was recorded in Variety ID GTUM (6.69). Micronaire is an indicator of both fiber maturity and fineness and it determines the spinning limit of cotton variety.Low micronaire values suggest fine and/or immature fibers; high micronaire values suggest coarse and/or mature fibers. All samples in Table 3 are very coarse cotton varieties

Maturity index ranged from 0.96 to 1.03 with a mean of 0.99133 The highest value for Maturity index was recorded in Variety ID GCCC , CERM (1.03), while lowest was recorded in Variety ID GCC2 (0.96). Maturity index is an important parameter in determining the thickness of the cell wall.

Fiber length UHML ranged from 18.75 to 25.88 mm with a mean of 21.945. The highest value for UHML was recorded in Variety ID DEHR (25.88), while lowest was recorded in Variety ID DEOR (18.75). Fiber length is an important parameter in determining evenness and strength of the yarn.

The fiber strength reveals wide variation which range from 17.6 to 31.6 g/tex with a mean of 24.957. The highest value for fiber strength was recorded in Variety ID DEHR (31.6), while lowest was recorded in Variety ID GCC2 (17.6). Fiber strength is an important parameter in determining yarn strength.

The fiber elongation reveals wide variation which range from 2.4 to 7.4 % with a mean of 4.23. The highest value for fiber elongation was recorded in Variety ID GC45 (7.4), while lowest was recorded in Variety ID GTCE (2.4).

The SCI reveals wide variation which range from 31 to 106 with a mean of 66.3. The highest value for SCI was recorded in Variety ID DEHR (106), while lowest was recorded in Variety ID DEOR (31).SCI is an important parameter in determining spinning limit of cotton fiber.

The sinking time in second's value was range from 2 to 5 sec with a mean of 3.167. The highest value for sinking time in seconds was recorded in Variety ID GAC5, DEOR (5), while lowest was recorded in Variety ID GCCC, CERM, DEHR, GT67, GTUM, GGGC (2).

The water holding capacity value was range from 22 to 32 gms with a mean of 25.167. The highest value for water holding capacity was recorded in Variety ID GAC6 (32), while lowest was recorded in Variety ID GAC4, GAC5 (22).

Table 3 Fiber characteristics of selected cotton varieties

Variety no.	Variety ID	Mic	Mat	Len	Str	Elg	SINKING TIME IN SECONDS	WATER HOLDING CAPACITY IN	SCI

								GMS	
1	HICE	7.04	1.00	22.12	27.2	2.7	4	23	77
2	CGCC	7.05	1.00	20.83	23.6	3.1	4	26	56
3	GTCE	7.20	0.99	22.14	23.5	2.4	4	24	62
4	GTCM	7.23	0.99	22.57	24.8	2.8	3	26	72
5	GACE	7.53	1.01	20.46	24.9	3.4	3	25	58
6	GAC6	7.51	0.99	23.73	21.4	3.1	3	32	46
7	GTCR	6.79	0.97	23.05	25.6	2.7	3	26	76
8	GAC5	7.30	0.98	19.49	20.8	4.4	5	24	34
9	GTCU	7.05	0.98	22.12	24.0	3.3	4	25	59
10	GCCC	7.97	1.03	20.72	22.6	3.3	2	28	49
11	DEOR	7.95	1.02	18.75	21.9	4.1	4	23	31
12	CERM	8.14	1.03	19.58	22.6	4.1	3	25	36
13	DEHY	7.37	1	19.94	23.4	4.8	3	24	51
14	DHMC	7.59	1.02	19.37	23	4.9	3	24	37
15	DEHR	6.79	0.99	25.88	31.6	2.6	2	28	106
16	GT67	7.13	0.99	23.57	24.7	3.7	2	27	71
17	10Y1	6.72	1.01	24.75	30.6	3.5	2	26	103
18	GTUM	6.69	0.97	22.62	26.3	3.7	2	25	83
19	GAUM	6.83	0.98	22.63	25.5	3.6	3	25	75
20	GTEM	7.03	0.98	23.25	25.1	2.8	3	27	69
21	GAEM	6.87	0.98	22.1	25.4	3.6	3	25	69
22	GTRM	7.02	0.99	23.08	26.9	3.2	3	27	78
23	CGC2	6.90	1.00	21.62	29.7	6.6	4	23	88
24	GAC4	6.73	0.99	21.49	28.0	6.5	3	22	85
25	GAC5	7.02	0.99	22.03	29.8	5.8	4	22	88
26	GGGC	6.77	0.98	22.61	26.5	5.8	2	24	90
27	GG3C	6.76	0.97	22.80	25.8	6.5	4	24	76
28	G3CM	6.81	0.98	21.93	25.8	6.3	3	23	77
29	GCC2	7.2	0.96	21.09	17.6	6.2	3	26	42
30	GC45	6.99	0.97	22.02	20.1	7.4	4	26	45

Mic-Fibermicronaire Mat – Fiber Maturity Len-UHML Str - Fiberstrength Elg - Fiber Elongation

Variations in three fiber characteristics Mic, Mat, Len were observed among 30 cotton varieties (Fig. 1). Cotton varieties (DEOR, CERM, DHMC, GACE and GCCC) were screened for high micronaire value, high maturity index and low UHML values. Some of the varieties are also grouped with high micronaire, high maturity and short fiber length. Cotton breeder must develop these varieties to fulfil the certain standards and requirement of surgical cotton manufacturer.

Micronaire, Maturity and fiber strength were closely and significantly correlated, it helps cotton breeder to grow varieties with higher micronaire, higher maturity and less fiber length value. The results of this screening further shows that , cotton varieties having high micronaire value were with lower fiber length and high maturity index. Correlations between different fiber characteristics helps cotton breeder in selecting criteria for successful breeding programme.

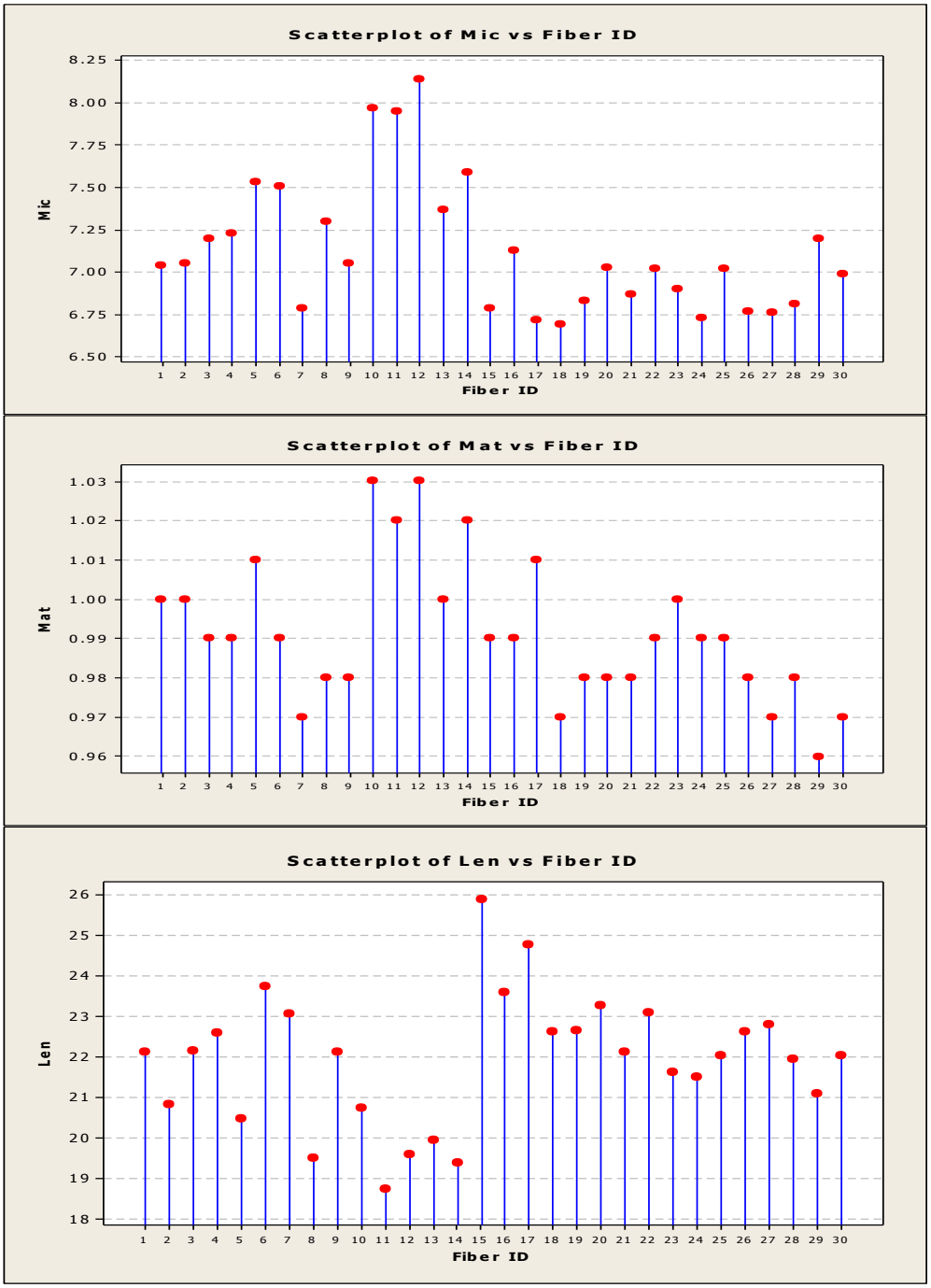

Fig 1. Variations in three fiber characteristics Mic, Mat and Len

A principal component analysis is performed by using Minitab software on the fibermicronaire, fiber maturity, fiber length, fiber strength, and fiber elongation. The Unrotated Factor Loadings and rotated Factor Loadings and Communality for all five variables are given Table 4. A Loading Plot of two rotated factors generated from the principal component factor analysis is shown in Fig. 2. The points 1–5 in Fig.2 represents to fibermicronaire, fiber maturity, fiber length, fiber strength, and fiber elongation respectively. The measuring steps of the first component include variables Mic,Mat and Str and the second component includes variable Len and Elg.

The unrotated factors explain 69.6% of the data variability but variable Elongation is well represented by these two factors (communalities are 0.0.063 for Elg, 0.534-1.0 for other variables). The percent of total variability interpreted by the factors does not change with rotation, but after rotating, these factors are more evenly balanced in the percent of variability that they represent, being 40.3 % and 29.30%, respectively (Table 4).Factor 1 has large positive loadings on Mic (0.764), Mat and Elg and small loading on len and str. Factor 2 has a large positive loading on Len and Elg and small loadings on Mic, Mat and Str (Fig2).

Table 4 Unroated and rotated factor loadings obtained with principal component method

Variables	Unrotated Factor Loadings			Rotated Factor Loadings		
	Factor 1	Factor 2	Communality	Factor 1	Factor 2	Communality
Mic	-0.936	-0.103	0.886	0.764	-0.549	0.886
Mat	-0.832	0.555	1.000	0.247	-0.969	1.000
Len	0.684	0.255	0.534	-0.680	0.268	0.534
Str	0.508	0.861	1.000	-0.954	-0.300	1.000
Elg	0.159	-0.193	0.063	0.011	0.250	0.063

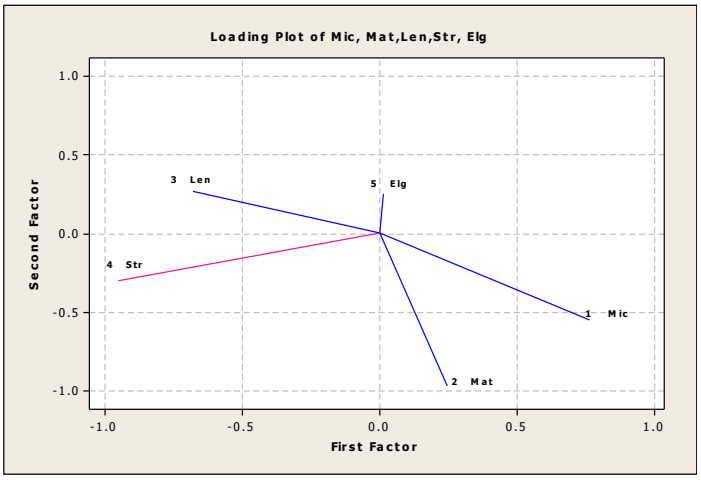

Fig 2 Loading plot of Mic, Mat, Len, Str and Elg

IV. CONCLUSION

With the rise in demand of bleached cotton for preoperative and post-operative medical procedure, the selected raw cotton fiber quality parameters must shows much more significance with sinking time and water holding capacity of bleached cotton.

From the results of the all studied parameters, it was concluded that Variety ID DEOR, CERM, GAC5 , DHMC, GCCC, DEHY, GCC2 and GC45 are the most suitable cotton varieties for medical textiles with high micronaire value, less fiber length and low SCI. These cotton varieties can be utilized in future by surgical cotton manufacture and cotton breeder in breeding programme for further improvement. There is a need to developed high micronaire, short staple, and medium Unf, SFI and strength cotton varieties for medical textile purpose. Cotton breeder must understand the fiber quality priorities requirements for bleached cotton and hence extra efforts required from breeder for improving the fiber quality. Correlations between cotton fiber characteristics would be exercised as deciding factor for the development of the coarse cotton varieties and which will be helpful to the cotton breeder.

Based on analysis for various cotton varieties, HICE, DEOR, CGC2, GAC4, GAC5, G3CM varieties with better sinking time and water holding capacities were identified. Fromm the results it was also concluded that in most of the high micronaire value variety, the fiber elongation is very low (less than 5%), that indicates when fiber elongation is less micronaire often increases and produces coarse shorter fibers.

A principal component factor analysis of five cotton fiber properties explains 69.6% data variability for unrotated factors but after rotating, these factors are more evenly balanced in the percent of variability that they represent, being 40.3 % and 29.30% for factor 1 and factor 2 respectively. The measuring steps of the first component include variables Mic, Mat and Str and the second component includes variable Len and Elg.

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