Relationship Between Single Fibre Properties with Spinning Consistency Index, Sinking Time and Water Holding Capacity of Bleached Cotton

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Abstract
Cotton is a widely used raw material to prepare fabric from cotton yarn. Cotton fibre gives the properties of comfort, softness, strength, and washability into the fabric. Cotton breeder improves the quality of cotton fibre as per the yarn and fabric quality requirements through effective breeding programme. This study consists of one hundred and nine hybrid cotton varieties produced by cotton breeders at Tahsil – Saloo District - Wardha, Maharashtra. The main aim of this work is to study the relationship between single fibre properties with spinning consistency index, sinking time and water holding capacity of high micronaire cotton fibre samples. Statistical models can be used for regression analysis to investigate the relationship between different cotton fibre properties and responses such as spinning consistency index, sinking time and water holding capacity of cotton varieties suitable for medical textiles. It also helps to estimate their relative contribution in responses. Therefore, it is important to know the desirable characteristics of cotton fibre for Medical textile application through effective cotton breeding programme. These models also help in producing raw material for end use requirements and thereby reducing wastage, availability of raw material and improves the quality of the product. High micronaire cotton variety showed a positive relation between i) Len, Unf, Str, SFI, Elg, Moist, Rd, Plus B with spinning consistency index ii) Mic, Mat, Len, Unf, SFI, Moist with water holding capacity iii) Mic, Str, Rd & plus b with Sinking time of bleached cotton. Similarly, High micronaire cotton variety showed a negative relation between i) Mic, Mat with spinning consistency index ii) Str, Elg, Rd, Plus B with water holding capacity iii) Mat, len, Unf, SFI, Elg & Moist with Sinking time of bleached cotton.The cotton fibre strength has the strongest relationship with SCI; UNF has the second strongest relationship and Moist has the weakest relationship with SCI. The regression of the response ST on all the fiber properties shows little linear relationship. Similarly, the regression of the response WHC on the Mic, Elg & Moist shows a moderate relationship.
Keywords: *Cotton; Fibre; micronaire; Fineness; Strength; Elongation, spinning consistency index (SCI), Sinking time (ST), water holding capacity (WHC).*

I. INTRODUCTION

Cotton fibre is an important vegetable fibre of Gossypium plants. Cotton is a widely used raw material to prepare fabric from cotton yarn. Cotton fibre characteristics mainly affect the quality of yarn and quality of the resulting fabric. Cotton fibre gives the properties of comfort, softness, strength, and washability into the fabric. During the weaving process, yarns are subjected to stress and strain, yarn-to-yarn abrasion and high friction during shed formation leading to more warp end breakage rate and more weaving machine stops. Hence, it deteriorates the quality of woven fabric and reduces the loom shed productivity. Therefore, careful selection of cotton fibre for production of particular yarn and fabric is most important. Researchers are continuously trying to improve the quality of cotton fibre as per the yarn and fabric quality requirements through effective breeding programme. Statistical models can be used for regression analysis to investigate the relationship between different cotton fibre properties and responses such as spinning consistency index (SCI), sinking time (ST) and water holding capacity (WHC) of cotton varieties, and also to estimate their relative contribution in responses. Several researchers have developed regression models for spinnable fibres; there are no regression models developed for non-spinnable fibres [1]. This study therefore aimed at using multiple regression analyses and optimizes the combination of cotton fibre properties for medical textile end use. A statistical tool can be used to select the desired fibre properties for medical textile end use and improve the cotton varieties for medical textile by means of an effective cotton breeding program. Cotton breeder can inspect spinning consistency index of coarse cotton varieties and bleached cotton properties such as sinking time and water holding capacity. These models also help in producing raw material for end use requirements and thereby reducing wastage, increasing availability of raw material, and improving the quality of the product.

II. MATERIALS AND METHODS

One hundred and nine cotton varieties were grown in Wardha district, Maharashtra. The fibre properties micronaire, maturity index, upper half mean length, uniformity index, short fibre index, strength, elongation, Moist, Rd and plus b were measured by HVI instrument [2]. Statistical model was prepared to estimate the relationship between the independent variable and the dependent variable by using multiple regression analyses [3]. The linear relationship between the dependent & the independent variable can be tested by using scatter plot. Multi-collinearity can be checked by VIF values. VIF values below 5 indicate no multi-collinearity. In this study, linear multiple regression analysis method was used to establish a quantitative relationship between single fibre properties with spinning consistency index to develop cotton varieties, sinking time and water holding capacity of bleached cotton. The statistical model can be tested by using coefficient of multiple regression R-squared (R^2) and the alpha P-Significance value ($p<0.05$)[4]. R-squared value ranges from 0% to 100%; that means 100% R-square value shows that the model explains all the variability of the response data around its mean. The adjusted R-squared value indicates the percentage of variation explained by only those independent variables that in reality affect the dependent variable. The confidence interval used in Minitab statistical software is 95% [5].

III. RESULTS AND DISCUSSIONS

3.1 Relationship between single fibre properties with SCI, ST & WHC

Regression equations are used to determine the relationship between single fibre properties with SCI, ST and WHC. The direction of the relationship between single fibre properties and the response variable is described by the sign of the coefficient. If the sign of the coefficient is negative, as the single fibre properties increase, the mean value of the response (SCI/ST/WHC) decreases. If the coefficient sign is positive, as the single fibre properties increase, the mean value of the response (SCI/ST/WHC) increases. The SCI, ST & WHC can be predicted by using the regression model (Table 1, 2 & 3). The goodness-of-fit statistics in the model is determined by the R-sq value. The higher the R-sq value, better the model fits the data. R-sq increases by adding additional predictors to a model [6]. The single predictor models are given in Table 1, Table 2 & Table 3.

Table 1 Single fibre properties vs SCI

	Response variable SCI	
Predictor VARIABLE	**Regression equation**	**R sq**
MIC	SCI = 236.3 - 23.54 Mic	50.74%
MAT	SCI = 344.5 - 265.9 Mat	10.32%
LEN	SCI = - 122.6 + 9.382 Len	38.62%
UNF	SCI = - 965.3 + 12.92 Unf	68.55%
SFI	SCI = 228.2 - 14.17 SFI	59.88%
STR	SCI = - 70.36 + 5.702 Str	85.76%
ELG	SCI = 76.99 + 2.082 Elg	1.55%
MOIST	SCI = 130.2 - 5.624 Moist	5.26%
Rd	SCI = - 135.2 + 3.037 Rd	14.61%
Plus b	SCI = 90.64 - 0.298 Plus B	0.02%

As per the results in Table 1, the coefficient for the predictor variable Mic is (- 23.54), which indicates that the mean SCI decreases by approximately 23.54 for every unit increase in Mic. In these results, the micronaire value of cotton fibre explains 50.74% of the variation in the SCI value of raw cotton. The coefficient for the predictor Len is 9.382, which indicates that the mean SCI increases by approximately 9.382 for every unit increase in Len. In these results, the Length value of cotton fibre explains 38.62% of the variation in the SCI value of raw cotton. The coefficient for the predictor variable Unf is 12.92, which indicates that the mean SCI increases by approximately 12.92 for every unit increase in Unf. In these results, the Unf value of cotton fibre explains 68.55% of the variation in the SCI value of raw cotton. The coefficient for the predictor SFI is (-14.17), which indicates that the mean SCI decreases by approximately 14.17 for every unit increase in SFI. In these results, the SFI value of cotton fibre explains 59.88% of the variation in the SCI value of raw cotton. The coefficient for the predictor Str is 5.702, which indicates that the mean SCI increases by approximately 5.702 for every unit increase in Str. In these results, the Str value of cotton fibre explains 85.76% of the variation in the SCI value of raw cotton. The R sq value of Str model indicates that the model fits the data well.

Table 2 Single fibre properties vs ST

	Response variable ST	
Predictor VARIABLE	**Regression equation**	**R sq**
MIC	ST = 4.594 - 0.1876 Mic	1.83%
MAT	ST = 8.705 - 5.488 Mat	2.50%
LEN	ST = 6.522 - 0.1385 Len	4.80%
UNF	ST = 30.26 - 0.3292 Unf	25.36%
SFI	ST = 1.878 + 0.1553 SFI	4.09%
STR	ST = 3.115 + 0.01074 Str	0.17%
ELG	ST = 2.357 + 0.1994 Elg	8.08%
MOIST	ST = 5.309 - 0.2528 Moist	6.06%
Rd	ST = 5.459 - 0.02785 Rd	0.70%
Plus b	ST = 2.224 + 0.1348 Plus B	2.21%

As per the results in Table 2, the coefficient for the predictor Mic is (-0.1876), which indicates that the mean ST decreases by approximately 0.1876 for every unit increase in Mic. The coefficient for the predictor Len is (-0.1385), which indicates that the mean ST decreases by approximately 0.1385 for every unit increase in Len. The coefficient for the predictor Unf is (-0.3292), which indicates that the mean ST decreases by approximately 0.3292 for every unit increase in Unf. The coefficient for the predictor SFI is 0.1553, which indicates that the mean ST decreases by approximately 0.1553 for every unit increase in SFI. The coefficient for the predictor Str is 0.01074, which indicates that the mean ST increases by approximately 0.01074 for every unit increase in Str.

Table 3 Single fibre properties vs WHC

	Response variable WHC	
Predictor VARIABLE	**Regression equation**	**R sq**
MIC	WHC = 11.99 + 1.818 Mic	25.95%
MAT	WHC = - 6.231 + 30.77 Mat	11.85%
LEN	WHC = 14.51 + 0.3978 Len	5.96%
UNF	WHC = 60.97 - 0.4603 Unf	7.47%
SFI	WHC = 19.97 + 0.3508 SFI	3.15%
STR	WHC = 31.31 - 0.2834 Str	18.17%
ELG	WHC = 29.32 - 1.110 Elg	37.71%
MOIST	WHC = 12.77 + 1.423 Moist	28.91%
Rd	WHC = 34.43 - 0.1496 Rd	3.04%
Plus b	WHC = 29.17 - 0.6497 Plus B	7.72%

As per the results in Table 3, the coefficient for the predictor Mic is 1.818, which indicates that the mean WHC increases by approximately 1.818 for every unit increase in Mic. The coefficient for the predictor Len is 0.3978, which indicates that the mean WHC increases by approximately 0.3978 for every unit increase in Len. The coefficient for the predictor Unf is (-0.4603), which indicates that the mean WHC decreases by approximately 0.4603 for every unit increase in Unf. The coefficient for the predictor SFI is 0.3508, which indicates that the mean WHC increases by approximately 0.3508 for every unit increase in SFI. The coefficient for the predictor Str is (-0.2834), which indicates that the mean WHC decreases by approximately 0.2834 for every unit increase in Str.

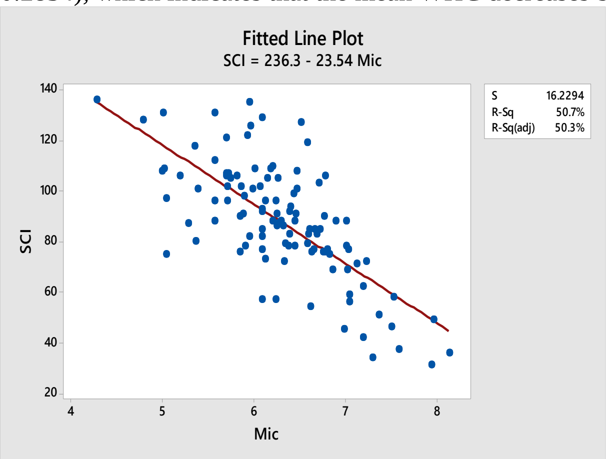

Fig 1. Fitted line plot SCI vs Mic

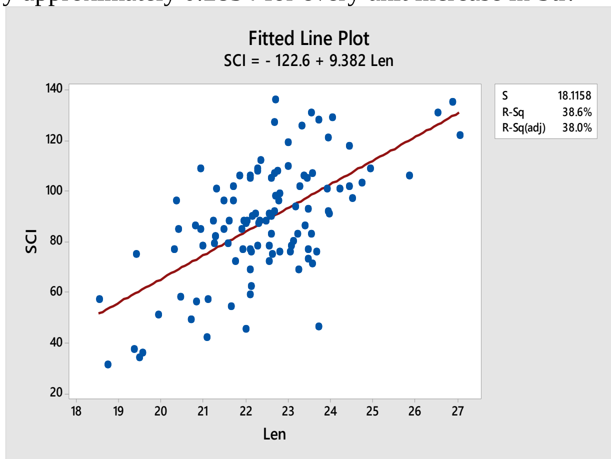

Fig 2. Fitted line plot SCI vs Len

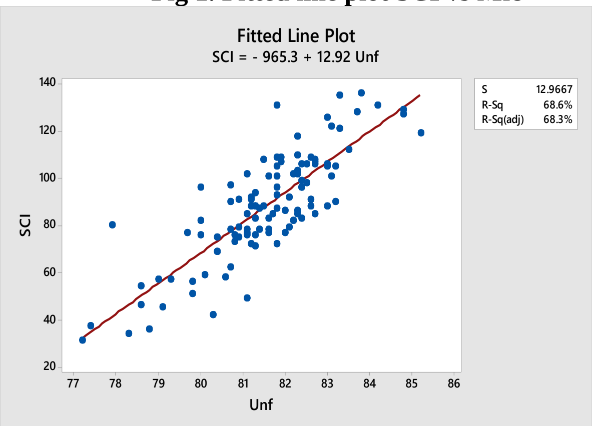

Fig 3. Fitted line plot SCI vs Unf

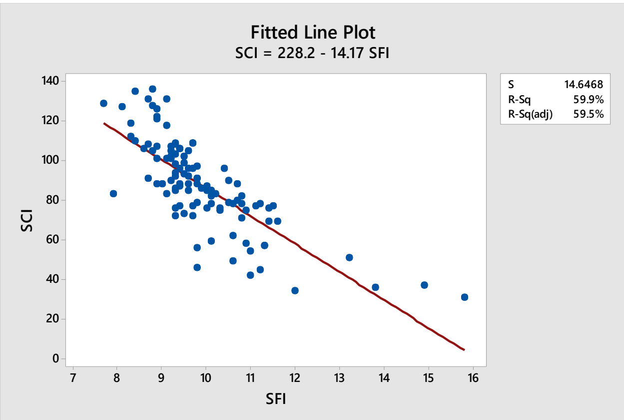

Fig 4. Fitted line plot SCI vs SFI

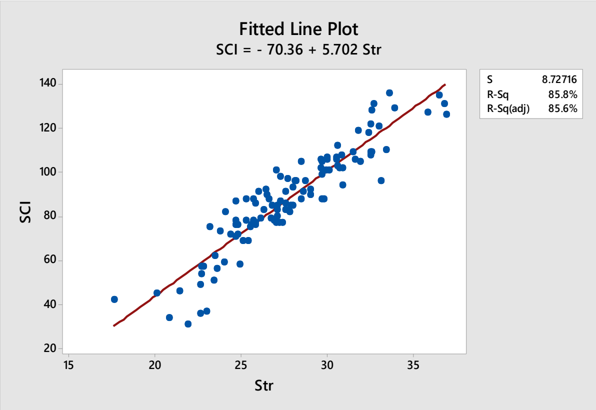

Fig 5. Fitted line plot SCI vs Str

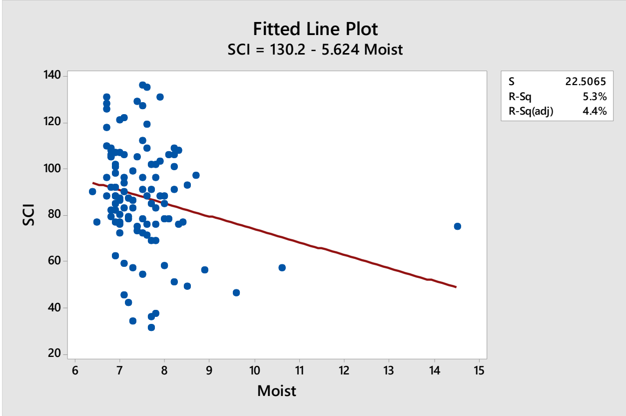

Fig 6. Fitted line plot SCI vs Moist

A fitted line plot between the cotton fibre single properties and spinning consistency index display a scatter plot with a regression line and equation [8]. It examines the relationship between spinning consistency index and the single cotton fibre properties used in bleached cotton manufacturing process (Fig 1 to 6). It also shows the variation around the predicted regression line. The plot (Fig 1,4 & 6) indicate that there is decreasing relationship between the SCI with Mic, SFI and Moist. The plot (Fig 2, 3 & 5) indicates that there is an increasing relationship between the SCI with Len, UNF and Str.

The regression of the response SCI on the Mic (Fig 1) shows that there is a moderately strong linear relationship (*R-sq* = 50.7%) between SCI and Mic. The regression of the response SCI on the Len (Fig 2) shows that there is a moderate linear relationship (*R-sq* = 38.2%) between SCI and Len. The regression of the response SCI on the UNF (Fig 3) shows that there is a moderately strong linear relationship (*R-sq* = 68.6%) between SCI and UNF. The regression of the response SCI on the SFI (Fig 4) shows that there is a moderately strong linear relationship (*R-sq* = 59.9%) between SCI and SFI. The regression of the response SCI on the Str (Fig 5) shows that there is the strongest linear relationship (*R-sq* = 85.8%) between SCI and Str. The regression of the response SCI on the Moist (Fig 6) shows that there is little linear relationship (*R-sq* = 5.3%) between SCI and Moist. It is noticeable that the fibre strength has the strongest relationship with SCI, UNF has the second strongest relationship and Moist has the weakest relationship. The plot between SCI & other fibre characteristics show no pattern, suggesting that there is no relationship between the SCI & other fibre characteristics. The regression of the response ST on the ten predictor variables shows little linear relationship. Similarly, the regression of the response WHC on the Mic, Elg & Moist shows moderate relationship.

3.2 Examine the relationship between HVI cotton fibre properties with SCI, ST & WHC

The Minitab software used to develop the model and the Coefficient of variables values in Table 4 indicates that the model coefficients are nonzero. The model included all the independent variables that have been identified and are useful in predicting the Spinning consistency index of coarse cotton varieties [7]. The results of the statistical analysis are shown in Table 5. The results of R-sq and R-sq (adj) show that there is a high correlation between the Spinning consistency index and other input variables [10]. This also indicates a very good relationship between dependent and independent variables.

The following statistical tests on "R" value were conducted for SCI model, where $R^2 = 0.9998$, N = 109

1) Probable Error (P.E.) in "R" value

$$P.E = 0.6745 * \left\{ \frac{(1 - R^{2})}{\sqrt{N}} \right\} = 0.6745 * \frac{0.0002}{10.44} = 0.00001292$$

Therefore R is 0.9998 $\pm$ 0.00001292

The probable error is small as compared with R, correlation directly exists where R > 0.5 and hence, the correlation of the studied SCI equation is existing.

2) Standard Error (S.E.) in "R" value

$$S.E = \left\{ \frac{(1 + R^{2})}{\sqrt{N}} \right\} = \frac{1.9998}{10.44} = 0.1915$$

Hence, the correlation is accepted for R = 0.9998, and 109 observations.

3) Test of significance indicates that the correlation may be accepted when R > 0.22 (for 100 observations). Again, the correlation is accepted for R = 0.9998, and 109 observations.

4) A simple method of testing whether "R" differs significantly from "zero" taking null hypothesis that there is no correlation between the two variables, provided "N" is large:

$$\frac{3}{\sqrt{N}} = \frac{3}{\sqrt{109}} = \frac{3}{10.44} = 0.287 < 0.9998$$

The value arrived at by this test is smaller than the observed value of correlation coefficient and hence, coefficient of correlation can be taken as significant.

Table 4. Regression coefficients, SE coefficient, t-values and significance level of variables of linear regression model for SCI

Term	SCI (Single Step Regression Approach)					SCI (Step wise Regression Approach)				
	Coef	SE Coef	T-Value	P-Value	VIF	Coef	SE Coef	T-Value	P-Value	VIF
Constant	-412.28	4.68	-88.18	0		-413.72	2.45	-168.89	0	
Mic	-9.168	0.218	-41.98	0	24.01	-9.3308	0.0541	-172.62	0	1.51
Mat	-3.63	4.77	-0.76	0.449	18.29	-	-	-	-	-
Len	1.9094	0.0373	51.21	0	3.35	1.9085	0.0255	74.92	0	1.6
Unf	4.7318	0.0398	119	0	3.57	4.7269	0.0292	161.87	0	1.97
SFI	0.011	0.0547	0.2	0.841	4.91	-	-	-	-	-
Str	2.939	0.0234	125.68	0	7.93	2.9242	0.0132	221.98	0	2.58
Elg	0.0016	0.0436	0.04	0.971	3.73	-	-	-	-	-
Moist	0.1006	0.038	2.64	0.01	1.32	0.099	0.0342	2.9	0.005	1.09
Rd	0.6394	0.0126	50.76	0	1.38	0.6386	0.0117	54.78	0	1.21
Plus B	0.3833	0.0399	9.6	0	1.87	0.3823	0.0312	12.24	0	1.17

Table 5 Model summary of SCI

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)
0.322550	99.98%	99.98%	12.4541	99.98%

Table 4 shows regression coefficients of variables, SE Coef, t-values and significance level of each variable. The positive & negative signs of regression coefficients of variables indicate the direction of increased or reduced output parameter [9]. We found very high negative coefficient between Micronaire value and SCI. This means that higher the micronaire value, the lower the SCI value. In addition, we also found positive coefficient for Len, Unf, Str, Moist, Rd, Plus B, with spinning consistency index of coarse cotton variety. The positive signs indicate increase in these parameters will increase spinning consistency index and decrease in these parameters will reduce the spinning consistency index. The developed SCI model P –value is 0.000, which is less than 0.05 ($P<0.05$), the standard error of estimate (S) is small 0.322550 and the VIF values for Len, UNF, SFI, Elg Moist, Rd and Plus B were below 5 which shows no multicollinearity and all these input parameters are independent of each other. Hence, the model was significant with a good fit and may be used to predict the SCI values of coarse cotton variety.

The results of R-sq and R-sq (adj) show that there is a high correlation between the sinking time (ST) in seconds of bleached cotton fibre and other input variables. This also indicates a very good relationship between dependent and independent variables (Table 6).

The following statistical tests on "R" value were conducted for ST model, where $R^2 = 0.8169$, N = 109

1. Probable Error (P.E.) in "R" value

$$P.E. = 0.6745 * \left\{ \frac{(1- R^2)}{\sqrt{N}} \right\} = 0.6745 * \frac{0.1831}{10.44} = 0.01182$$

Therefore R is 0.9038 $\pm$ 0.01182

The probable error is small as compared with R, correlation directly exists where $R > 0.5$ and hence, the correlation of the studied ST equation is existing.

2. Standard Error (S.E.) in "R" value

$$S.E. = \left\{ \frac{(1+ R^2)}{\sqrt{N}} \right\} = \frac{1.8169}{10.44} = 0.1740$$

Hence, the correlation is accepted for R = 0.9038 and 109 observations.
3. Test of significance indicates that the correlation may be accepted when R > 0.22 (for 100 observations). Again, the correlation is accepted for R = 0.9038, and 109 observations.
4. A simple method of testing whether "R" differs significantly from "zero" taking null hypothesis that there is no correlation between the two variables, provided "N" is large:

$$\frac{3}{\sqrt{N}} = \frac{3}{\sqrt{109}} = \frac{3}{10.44} = 0.287 < 0.9038$$

The value arrived at by this test is smaller than the observed value of correlation coefficient and hence, coefficient of correlation can be taken as significant.

Table 6 Regression coefficients, SE coefficient, t-values and significance level of variables of our linear regression model for ST

Term	ST (Single Step Regression Approach)					ST (Step wise Regression Approach)				
	Coef	SE Coef	T-Value	P-Value	VIF	Coef	SE Coef	T-Value	P-Value	VIF
Constant	93.32	6.28	14.86	0		87.99	4.68	18.8	0	
Mic	0.393	0.293	1.34	0.183	24.01	-	-	-	-	-
Mat	-15.08	6.41	-2.35	0.021	18.29	-6.39	1.58	-4.03	0	1.14
Len	-0.2759	0.0501	-5.51	0	3.35	-0.255	0.0358	-7.12	0	1.75
Unf	-0.8738	0.0534	-16.36	0	3.57	-0.8718	0.0506	-17.23	0	3.27
SFI	-0.4016	0.0735	-5.46	0	4.91	-0.393	0.0628	-6.26	0	3.65
Str	0.227	0.0314	7.23	0	7.93	0.1909	0.0162	11.75	0	2.16
Elg	-0.0279	0.0586	-0.48	0.635	3.73	-	-	-	-	-
Moist	-0.4116	0.0511	-8.06	0	1.32	-0.4035	0.0461	-8.76	0	1.1
Rd	0.0058	0.0169	0.35	0.73	1.38	-	-	-	-	-
Plus B	0.0075	0.0536	0.14	0.888	1.87	-	-	-	-	-

Table 7 Model summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)
0.433215	81.69%	79.82%	24.3299	75.77%

Table 6 shows regression coefficients of variables, SE Coef, t-values and significance level of each variable. The positive & negative signs of regression coefficients of variables indicate the direction of increased or reduced output parameter. We found very high negative coefficient between Mat value and ST. This means that higher the Mat value, the lower the ST value. In addition, we found negative coefficient for Len, Unf, SFI and Moist; these are the other important parameters for sinking time in seconds of coarse cotton variety. Sinking time in seconds are important bleached cotton parameters since it affects the absorbency of bleached cotton fibre. The ST model test values of R^2, Adjusted R^2, P-value, F-value, standard error of estimate (S), and variance Inflation Factor (VIF) / multi-collinearity tests are shown in Table 6. The predictor variables Mic, Elg, Rd and Plus B with high P values were removed from the model and hence, giving new regression equation and all the factors in equation have significant influence on ST values of coarse cotton variety. The adjusted R^2 value is 79.82% (Table 7); this indicates 79.82% variation in ST and can be described by adjusted number of terms in the model. The developed ST model P –value is 0.000, which is less than 0.05 ($P<0.05$), the standard error of estimate (S) is small 0.433215 and the VIF values for Mat, Len, UNF, SFI, Str and Moist were below 5 which shows no multicollinearity. Hence, the model was significant with a good fit and may be used to predict the ST values of coarse cotton variety.
The results of R-sq and R-sq (adj) show that there is a high correlation between the water holding capacity in grams of bleached cotton fibre and other input variables. This also indicates a very good relationship between dependent and independent variables (Table 8). The model included all the independent variables that have been identified and are useful in predicting the water holding capacity in grams of bleached cotton fibre of coarse cotton varieties.
The following statistical test on "R" value were conducted for WHC model, where $R^2 = 0.9376$, N = 109.

1. Probable Error (P.E.) in "R" value

$$P.E = 0.6745 * \left\{ \frac{(1-R^2)}{\sqrt{N}} \right\} = 0.6745 * \frac{0.0624}{10.44} = 0.00403$$

Therefore R is 0.9682 $\pm$ 0.00403

The probable error is small as compared with R, correlation directly exists where R > 0.5 and hence, the correlation of the studied WHC equation is existing.

2. Standard Error (S.E.) in "R" value

$$S.E = \left\{ \frac{(1+R^2)}{\sqrt{N}} \right\} = \frac{1.9376}{10.44} = 0.1855$$

Hence, the correlation is accepted for R = 0.9682 and 109 observations.

3. Test of significance indicates that the correlation may be accepted when R > 0.22 (for 100 observations). Again, the correlation is accepted for R = 0.9682, and 109 observations.

4. A simple method of testing whether "R" differs significantly from "zero" taking null hypothesis that there is no correlation between the two variables, provided "N" is large:

$$\frac{3}{\sqrt{N}} = \frac{3}{\sqrt{109}} = \frac{3}{10.44} = 0.287 < 0.9682$$

The value arrived at by this test is smaller than the observed value of correlation coefficient and hence, coefficient of correlation can be taken as significant.

Table 8 Regression coefficients, SE coefficient, t-values and significance level of variables of our linear regression model for WHC

Term	WHC (Single Step Regression Approach)					WHC (Step wise Regression Approach)				
	Coif	SE Coef	T-Value	P-Value	VIF	Coif	SE Coif	T-Value	P-Value	VIF
Constant	-23	9.44	-2.44	0.017		-12.69	2.22	-5.72	0	
Mic	0.89	0.441	2.02	0.046	24.01	1.432	0.123	11.67	0	1.9
Mat	12.71	9.64	1.32	0.191	18.29	-	-	-	-	-
Len	1.1733	0.0753	15.58	0	3.35	1.1542	0.0584	19.77	0	2.06
Unf	0.0477	0.0803	0.59	0.554	3.57	-	-	-	-	-
SFI	0.014	0.111	0.13	0.897	4.91	-	-	-	-	-
Str	-0.3686	0.0472	-7.8	0	7.93	-0.3115	0.0226	-13.79	0	1.86
Elg	-0.1388	0.0881	-1.58	0.118	3.73	-0.1906	0.0606	-3.15	0.002	1.81
Moist	1.4653	0.0768	19.08	0	1.32	1.4479	0.0722	20.05	0	1.2
Rd	-0.0165	0.0254	-0.65	0.517	1.38	-	-	-	-	-
Plus B	-0.0667	0.0806	-0.83	0.41	1.87	-	-	-	-	-

Table 9 Model summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)
0.651368	93.76%	93.13%	56.9893	91.45%

Table 8 shows regression coefficients of variables, SE Coef, t-values and significance level of each variable. The positive & negative signs of regression coefficients of variables indicate the direction of increased or reduced output parameters. We found negative coefficient between STR, Elg, Rd and Plus B value and WHC. This means that increase in these values, lower the WHC value. We also found positive coefficient for Mic, Mat, Len, Unf, SFI, Moist with water holding capacity in grams of coarse cotton variety. Water holding capacity in grams is an important bleached cotton parameter since it affects the absorbency of bleached cotton fibre. During WHC model development test values of R^2, Adjusted R^2, P-value, F-value, standard error of estimate (S), and variance Inflation Factor (VIF) / multi-collinearity tests are shown in Table 9. The predictor variables Mat, UNF, SFI, Rd and Plus B with high P values were removed from the model and hence, giving new regression equation, and all the factors in equation have significant influence on WHC values of coarse cotton variety. The adjusted R^2 value is 93.13%; this indicates 93.13% variation in WHC and can be described by adjusted number of terms in the model. The developed WHC model P –value is 0.000, which is less than 0.05 ($P<0.05$), the standard error of estimate (S) is small 0.651368 and the VIF values for Mic, Len, Str, Elg and Moist were below 5 which shows no multi-collinearity. Hence, the model was significant with a good fit and may be used to predict the WHC values of coarse cotton variety.

IV. CONCLUSION

This research work predicts different cotton fibre characteristics by using multiple regression method for the analysis of spinning consistency index of different cotton varieties, sinking time and water holding capacity of bleached cotton. Spinning consistency index, sinking time and water holding capacity regression equation is developed in MINITAB statistical software to study the effect of single fibre characteristics with spinning consistency index of different cotton varieties, sinking time and water holding capacity of bleached cotton. The results show negative coefficient between Micronaire value and SCI. This means that higher the micronaire value, lower the SCI value. The result also shows positive coefficient for Len, Unf, STR, Moist, Rd, and Plus B with spinning consistency index of coarse cotton variety. The result between Str, Elg, Rd, Plus B value and WHC give negative coefficient. This means that increase in these values, lower the WHC value. In addition, there is positive coefficient for Mic, Mat, Len, Unf, SFI, and Moist with water holding capacity in grams of coarse cotton variety. There is a very high negative coefficient between Mat value and ST. This means that higher the Mat value, lower the ST value. In addition, there was a negative coefficient for Len, Unf, SFI Moist with ST. Sinking time (ST) and water holding capacity (WHC) are the important bleached cotton parameters that affect the absorbency value of medical textile. The cotton fibre strength has the strongest relationship with SCI, UNF has the second strongest relationship and Moist has the weakest relationship with SCI. The regression of the response ST on the ten predictor variables shows little linear relationship. Similarly, the regression of the response WHC on the Mic, Elg & Moist shows moderate relationship.

V. REFERENCES

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