# Genetic studies of correlation and path coefficient analysis for yield and fibre quality traits in cotton (*Gossypium hirsutum* L.)

**K. Keerthivarman[1*], N. Meenakshi ganesan[2], N. Premalatha[3], N. Manikanda Boopathi[4], K. Senguttuvan[5] , A. Manivannan[6] and S. Subhashini[7]**

[1]*Department of Genetics and Plant Breeding,* Tamil Nadu Agricultural University, Coimbatore
[2]*Department of Genetics and Plant Breeding,* Tamil Nadu Agricultural University, Coimbatore
[3]*Department of Cotton,* Tamil Nadu Agricultural University, Coimbatore
[4]*Department of Biotechnology,* Tamil Nadu Agricultural University, Coimbatore
[5]*Department of Agricultural Entomology,* Tamil Nadu Agricultural University, Coimbatore
[6]*Central Institute for Cotton Research,* Regional Station, Coimbatore
[7]*Department of Genetics and Plant Breeding,* Tamil Nadu Agricultural University, Coimbatore

***E.mail :** *varmankrishnankeerthi@gmail.com*

## Abstract

Sixteen Line × Tester hybrids were studied to better understand yield component relationships. The number of bolls per plant and boll weight had a substantial positive correlation and a high direct influence on seed cotton yield per plant, according to both association and route analysis analyses. Finally, selecting some features, such as number of bolls per plant and boll weight, directly impacts seed cotton yield per plant. Furthermore, number of bolls per plant had a substantially favourable indirect influence on number of sympodial branches per plant, micronaire value, and lint index through number of sympodial branches per plant, micronaire value, and lint index. The lint index had a significant indirect impact on the seed index. Selection based on these qualities indirectly increases seed cotton output per plant by a large margin. As a result, the yield and yield potential have improved.

**Key words**: Path analysis, Cotton, Correlation co-efficient and *Gossypium hirsutum* L.

## Introduction

Cotton is the king of fibre crops, accounting for more than 70% of lint used in the textile industry. It is grown in over 80 countries throughout the world with an annual production of over 20 million tonnes, contributing to commerce and investment as well as increasing GDP (Saeed *et al.* 2014). According to Isong *et al.* 2017, hybrids account for 45 percent of total acreage and 55 percent of total cotton output in India. The goal of optimizing yield in interspecific cotton crosses has yet to be realized to maximize reported production potential (Isong *et al.* 2017 and Thiyagu *et al.* 2010). The correlation coefficient is well-known for determining the relationship between components required for selection, but as more traits are included and also with indirect relationships between traits, the complexity of the relationship between them increases. Path coefficient analysis has been proven to be a favorable trait, revealing the connection between characters, which is important for selecting complex features in cotton (Isong *et al.* 2017; Liaqat *et al*. 2015 and Iqbal *et al*. 2006). When using path analysis to create a better trait selection, understanding the origin of the trait's

negative influence is essential. As a result, the current research was designed to assess correlation coefficient and path analysis for variety of the yields and yield contributing traits (Gururajan and Sunder, 2004 and Gite *et al.* 2006). Such data could be useful in developing an effective selection programme for the creation and development of novel cotton genotypes with higher yields and other desirable features.

## Materials and Method

During the summer of 2021, the current research was carried out at the experimental field of the Department of Cotton, Centre for Plant Breeding and Genetics (CPBG), Tamil Nadu Agricultural University (TNAU), Coimbatore. Four *Gossypium hirsutum* L. genotypes *viz.*, MCU 5, MCU 7, CO 14 and CO 17 were selected as lines (high yield) and four *Gossypium hirsutum* L. genotypes *viz.*, KC 2, KC 3, NDLH 1755 and NDLH 1938 were used as testers (donor parents for jassid resistance and good quality for lint) during the summer of 2021. Sixteen $F_1$'s hybrids were arranged in ten rows, with the line and testers separated into four rows. The separation for each adjacent plant was 90 x 45 cm in order to measure their genotypic correlation coefficient and path analysis. A randomized block design with two replications was used for the experiment in the field. Many agronomic procedures were used under well-fertilized and irrigated circumstances to prove a superior crop set. The observations were made for a total of 17 characters, namely, days to first flowering, plant height (cm), number of monopodial branches, number of sympodial branches, number of bolls per plant, boll weight (g), number of locules per boll, number of seeds per boll, seed index (g), lint index (g), upper half mean length(mm), uniformity ratio (%), Bundle strength (g/tex), elongation percent (%), micronaire value (µg/inch), ginning outturn (%) and seed cotton yield per plant (g). The genotypic correlation coefficients and path analysis were estimated using statistical analysis of the data.

## Result and Discussion

## Genotypic correlation

From table 1, the days to first flowering showed a negative significant correlation for the traits, namely, number of locules per boll (-0.420) and upper half mean length (-0.435). The number of sympodial braches per plant exhibited a positive highly significant correlation with the number of bolls per plant (0.612) as reported by Bhatti *et al.*(2020) and negative significant correlation with traits namely, boll weight (-0.426) and bundle strength (-0.523). The number of locules per boll revealed positive significant correlation traits, *viz*., number of seeds per boll (0.436) and bundle strength (0.505). Ginning outturn was observed to have a highly negative significant correlation for seed index (-0.667) and a highly positive significant correlation for lint index (0.523). The seed cotton yield of the plant was found to be positively highly significant for the trait number of bolls per plant (0.624), number of seeds per boll (0.518) same as suggested by Farooq *et al.* (2018), Rathinavel *et al.* (2018) and Nisar *et al.* (2022) and highly significant negative correlation with the traits number of monopodial branches per plant (-0.520) as observed by Yaqoob *et al.* (2016) and Alkuddsi *et al.* (2013). The boll weight (0.514) was also observed to have positive significant correlation with seed cotton yield per plant same as suggested by Nisar *et al.*(2022); Zhu *et al.* (2021) and Salahuddin *et al.* (2010).

## Path analysis

## Direct effect

From table 2, a very high direct effect was observed in the traits of number of bolls per plant (1.0235), seed index (1.2249) and ginning outturn (1.4416). Same result for number of bolls per plant was observed by Dahiphale *et al.* (2018) and Nikhil *et al.* (2018). The trait boll weight (0.601) was observed to have a high direct effect on seed cotton yield per plant same as observed by Shaheen *et al.* (2021) and Nikhil *et al.* (2018), followed by the trait number of locules per boll (0.3535).

A very high direct negative effect on seed cotton yield per plant was contributed by the trait lint index (-1.0935). The number of sympodial branches per plant (-0.3055) showed a highly negative direct effect on the trait seed cotton yield per plant as reported by Mudhalvan *et al.* (2021).

## Indirect effect

An indirect positive effect was contributed by the trait number of bolls per plant through the traits number of sympodial branches per plant (0.6261), lint index (0.3002) and micronaire value (0.3725) for seed cotton yield per plant. Similar result was reported for the trait number of bolls per plant by Nikhil *et al.* (2018). The trait seed index per plant showed a positive high indirect effect through the trait lint index with a value of 0.3482 with seed cotton yield per plant Kumar *et al.* (2021). Jangid *et al.* (2019) also reported positive indirect effect for seed index and the further traits, namely number of locules per boll (-0.3738), number of seeds per boll (-0.3525) and the trait ginning outturn (-0.8168) showed a negative highly indirect effect with seed cotton yield per plant. The trait lint index contributed to a negative high indirect effect as reported by Parre *et al.* (2021), channelized through the traits number of bolls per plant (-0.3207), seed index (-0.3108), micronaire value (-0.3986) and ginning outturn (-0.5724). The trait ginning outturn contributed positive high indirect effect as suggested by Kumar *et al.* (2019) funneling through the traits namely, number of seeds per boll (0.5396) and lint index (0.7547) as well as a negative high indirect effect through seed index (-0.9613) with seed cotton yield per plant.

The number of bolls per plant has a moderate indirect positive effect through the traits of upper half mean length (0.2952) and a moderate indirect negative effect through the trait of number of locules per boll (-0.2137). The trait boll weight had a moderate negative indirect effect through the trait number of sympodial branches per plant (-0.2562) and uniformity ratio (-0.2076). Moderate positive indirect effect was contributed by the traits seed index for seed cotton yield per plant through the traits namely, number of monopodial branches per plant (0.2281) and micronaire value (0.2258). Uniformity ratio (-0.2327) contributed to a moderately negative indirect effect linked through the trait seed index. The trait elongation percentage (0.2142) had a moderate positive effect on seed cotton yield per plant, contributing through the traits lint index. The number of locules per boll (0.2962), uniformity ratio (0.2502) and number of bolls per plant (0.2798) had moderate positive effects through the trait ginning outturn contributing to seed cotton yield per plant.

Hence, both association and path analysis studies conclude that the number of bolls per plant and boll weight had a significant positive correlation and a high direct effect on seed cotton yield per plant. Finally the results revealed that the selection of these traits, viz.,

number of bolls per plant and boll weight, directly contributes towards the seed cotton yield per plant. Moreover, the trait number of bolls per plant had a high positive indirect effect through the traits *viz.*, number of sympodial branches per plant, micronaire value and lint index. Similar result was observed by Kumar *et al.* (2019). The seed index also contributed to a highly positive indirect effect through the lint index. Selection based on these traits shows a high indirect positive effect and also indirectly increases the seed cotton yield per plant. Therefore, the yield and yield-attributing traits will be enhanced in future breeding programmes.

## Financial support

Financial support was rendered by the Department of Cotton, Tamil Nadu Agricultural University, Coimbatore -03.

## Conflicts of Interest

Conflicts of interest are none

## Ethical Standards

Not applicable

## Author contribution

KK is the corresponding author of this manuscript and SS helped in writing the manuscript. RS and PN had corrected the article; KT, MMS and JP had supervised the overall work.

## Reference:

Alkuddsi, Y., Rao, M. G., Patil, S. S., Joshi, M., & Gowda, T. H. (2013). Correlation and path coefficient analysis between seed cotton yield and its attributing characters in intra hirsutum cotton hybrids. *Molecular Plant Breeding*, *4*: 214-219.

Bhatti, M. H., Yousaf, M. I., Ghani, A., Arshad, M., Shehzad, A., Mumtaz, A., & Shah, S. A. S. (2020). Assessment of genetic variability and traits association in upland cotton (*Gossypium hirsutum* L.). *Int J Bot Studies*, *5*(2), 148-51.

Dahiphale, K. D., & Deshmukh, J. D. (2018). Genetic variability, correlation and path coefficient analysis for yield and its attributing traits in cotton (*Gossypium hirsutum* L.). *Journal of Cotton Research and Development*, *32*(1), 38-46.

Farooq, J., Rizwan, M., Saleem, S., Sharif, I., Chohan, S. M., Riaz, M., & Kainth, R. A. (2018). Determination of genetic variation for earliness, yield and fiber traits in advance lines of cotton (*Gossypium hirsutum* L.). *Advances in Agricultural Sciences*, *6*(2), 59-74.

Gite, V. K., Misal, M. B., & Kalpande, H. V. (2006). Correlation and path analysis in cotton (Gossypium hirsutum L.). *Journal of Cotton Research and Development*, 20(1): 51-54.

Gururajan, K. N., & Sundar, S. (2004). Yield component analysis in American cotton. International Symposium. on "Strategies for Sustainable Cotton Production–A Global

Vision" held at University of Agricultural Sciences, Dharwad., 23rd –25th November, 2004.

Iqbal, M., Hayat, K., Khan, R. S. A., & Sadiq, A. (2006). Correlation and path coefficient analysis for earliness and yield traits in cotton (*G. hirsutum* L.). *Asian journal of plant sciences*.5:341-345

Isong, A., Balu, P. A., & Ramakrishnan, P. (2017). Association and principal component analysis of yield and its components in cultivated cotton. *Electronic Journal of Plant Breeding*, 8(3): 857-864.

Jangid, K. (2019). Genetic parameters, correlation and path analysis of agro-morphological traits in elite genotypes of upland cotton (*Gossypium hirsutum* L.). *International Journal of Chemical Studies*, 7(5), 1885-1889.

Kumar, C. P. S., Prasad, V., Rajan, R. E. B., Joshi, J. L., & Thirugnanakumar, S. (2019). Studies on correlation and path-coefficient analysis for seed cotton yield and its contributing traits in cotton (*Gossypium hirsutum* L.). *Plant Arch*, 19, 683-686.

Mudhalvan, S., Rajeswari, S., Mahalingam, L., Jeyakumar, P., Muthuswami, M., & Premalatha, N. (2021). Causation studies for Kapas yield, yield components and lint quality traits in Mexican cotton (*Gossypium hirsutum* L.). *Environment Conservation Journal*, *22*(3), 357-363.

Nikhil, P. G., Nidagundi, J. M., & Anusha, H. A. (2018). Correlation and path analysis studies of yield and fibre quality traits in cotton (*Gossypium hirsutum* L.). *Journal of Pharmacognosy and Phytochemistry*, *7*(5), 2596-2599.

Nisar, S., Khan, T. M., Iqbal, M. A., Ullah, R., Bhutta, M. A., Ahmad, S. & Ishaq, M. Z. (2022). Assessment of Yield Contributing Quantitative Traits in Upland Cotton (*Gossypium hirsutum* L.). *Sarhad Journal of Agriculture*, 38(1). 353-359.

Parre, S., & Patil, R. S. (2021). Correlation studies and path coefficient analysis of yield attributing traits among selected F2 populations of intra-hirsutum cotton hybrids under rain-fed situation. *The Pharma Innovation Journal*, 10(3): 942-950.

Rathinavel, K. (2018). Principal component analysis with quantitative traits in extant cotton varieties (*Gossypium hirsutum* L.) and parental lines for diversity. *Current Agriculture Research Journal*, *6*(1), 54- 64.

Saeed, F., Farooq, J., Mahmood, A., Riaz, M., Hussain, T., & Majeed, A. (2014). Assessment of genetic diversity for Cotton leaf curl virus (CLCuD), fiber quality and some morphological traits using different statistical procedures in *Gossypium hirsutum* L. *Australian Journal of Crop Science*, 8(3), 442-447.

Salahuddin, S., Abro, S., Rehman, A., & Iqbal, K. (2010). Correlation analysis of seed cotton yield with some quantitative traits in upland cotton (*Gossypium hirsutum* L.). *Pakisthan Journal of Botany*, *42*(6), 3799-3805.

Shaheen, M., Abdul Rauf, H., Taj, M. A., Yousaf Ali, M., Bashir, M. A., Atta, S., & Alamri, S. (2021). Path analysis based on genetic association of yield components and insects pest in upland cotton varieties. *PloS one*, *16*(12), e0260971.

Thiyagu, K., Nadarajan, N., Rajarathinam, S., Sudhakar, D., & Rajendran, K. (2010). Association and path analysis for seed cotton yield improvement in interspecific crosses of cotton (*Gossypium* spp). *Electronic Journal of Plant Breeding*, 1(4), 1001-1005.

Yaqoob, M., Fiaz, S., & Ijaz, B. (2016). Correlation analysis for yield and fiber quality traits in upland cotton. *Communication of Plant Science*, *6*(3/4), 55-60.

Zhu, G., Hou, S., Song, X., Wang, X., Wang, W., Chen, Q., & Guo, W. (2021). Genome-wide association analysis reveals quantitative trait loci and candidate genes involved in yield components under multiple field environments in cotton (Gossypium hirsutum). *BMC Plant Biology*, *21*(1), 1-11.

**Table 1, Genotypic correlation coefficients between single plant yield with yield components and fibre quality traits for 16 $F_1$'s in *Gossypium hirsutum* L.**

| Characters | DFF | PH (cm) | MB | SB | NB | BW (g) | NLB | NSB | SI (g) | LI (g) | UHML (mm) | UR (%) | STR (g/tex) | EL (%) | MIC (µg/inch) | GOT (%) | SCYPP (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DFF** | 1 | | | | | | | | | | | | | | | | |
| **PH** | -0.131 | 1 | | | | | | | | | | | | | | | |
| **MB** | 0.342 | 0.016 | 1 | | | | | | | | | | | | | | |
| **SB** | 0.023 | 0.096 | 0.108 | 1 | | | | | | | | | | | | | |
| **NB** | 0.004 | 0.177 | -0.18 | .612** | 1 | | | | | | | | | | | | |
| **BW** | -0.167 | 0.098 | -0.26 | -.426* | -0.12 | 1 | | | | | | | | | | | |
| **NLB** | -.420* | 0.119 | -0.279 | -0.36 | -0.209 | 0.234 | 1 | | | | | | | | | | |
| **NSB** | -0.213 | -0.023 | -0.161 | -0.178 | 0.192 | 0.288 | .436* | 1 | | | | | | | | | |
| **SI** | 0.029 | 0.013 | 0.186 | -0.057 | 0.023 | 0.111 | -0.305 | -0.288 | 1 | | | | | | | | |
| **LI** | 0.062 | -0.119 | 0.124 | -0.018 | 0.293 | 0.054 | -0.104 | 0.129 | 0.284 | 1 | | | | | | | |
| **UHML** | -.435* | 0.108 | -0.389 | 0.378 | 0.288 | 0.061 | 0.163 | 0.308 | -0.082 | 0.016 | 1 | | | | | | |
| **UR** | -0.109 | 0.303 | -0.048 | 0.127 | 0.039 | -0.345 | 0.046 | -0.117 | -0.19 | 0.008 | -0.378 | 1 | | | | | |
| **STR** | -0.294 | 0.235 | -0.062 | -.523** | -0.185 | 0.262 | .505* | 0.316 | 0.116 | 0.054 | -0.002 | 0.055 | 1 | | | | |
| **ELP** | -0.117 | -0.171 | 0.178 | 0.165 | -0.128 | -0.188 | -0.246 | 0.064 | -0.145 | -0.196 | -0.138 | 0.305 | -0.108 | 1 | | | |
| **MIC** | -0.082 | 0.297 | -0.029 | 0.163 | 0.364 | 0.218 | 0.043 | -0.11 | 0.184 | 0.365 | 0.093 | -0.096 | -0.047 | -0.096 | 1 | | |
| **GOT** | 0.017 | -0.093 | -0.065 | 0.022 | 0.194 | -0.049 | 0.205 | 0.374 | -.667** | .523** | 0.095 | 0.174 | -0.051 | -0.026 | 0.123 | 1 | |
| **SPY** | -0.398 | 0.105 | -.520** | 0.11 | .624** | .514* | 0.294 | .518** | -0.115 | 0.195 | 0.399 | -0.063 | 0.147 | -0.068 | 0.315 | 0.253 | 1 |

*. Correlation is significant at the 0.05 level **. Correlation is significant at the 0.01 level

**DFF**: Days to first flowering **PH**: Plant height (cm) **MB**: Number of monopodial branches **SB**: Number of sympodial branches **NB**: Number of bolls per plant
**BW**: Boll Weight (g) **NLB**: Number of locules per boll **NSB**: Number of seeds per boll **SI** : Seed index (g) **LI**: Lint Index (g)
**UHML**: Upper Half Mean Length (mm) **UR**: Uniformity ratio (%) **STR**: Bundle strength **(g/tex)** **EL**: Elongation percent (%) **MIC**: Micronaire value (µg/inch)
**GOT**: Ginning outturn (%) **SCYPP**: Seed Cotton yield per plant (g)

**Table 2, Direct effects (diagonal) and indirect effects (off diagonal) of various traits on seed cotton yield at genotypic level in 16 $F_1$'s in *Gossypium hirsutum* L.**

| Characters | DFF | PH (cm) | MB | SB | NB | BW (g) | NLB | NSB | SI (g) | LI (g) | UHML (mm) | UR (%) | STR (g/tex) | EL (%) | MIC (µg/inch) | GOT (%) | SCYPP (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DFF** | **-0.0852** | 0.0176 | -0.0019 | -0.0071 | 0.0039 | -0.1006 | -0.1484 | 0.0404 | 0.0358 | -0.0675 | -0.1021 | -0.0137 | 0.0258 | -0.0311 | 0.0111 | 0.0249 | -0.3982 |
| **PH** | 0.0112 | **-0.1335** | -0.0001 | -0.0293 | 0.1813 | 0.059 | 0.0419 | 0.0043 | 0.0165 | 0.1303 | 0.0254 | 0.038 | -0.0206 | -0.0455 | -0.0403 | -0.1337 | 0.105 |
| **MB** | -0.0291 | -0.0022 | **-0.0055** | -0.0331 | -0.1838 | -0.1562 | -0.0985 | 0.0306 | 0.2281 | -0.1359 | -0.0912 | -0.006 | 0.0054 | 0.0473 | 0.0039 | -0.0941 | -0.5204 |
| **SB** | -0.002 | -0.0128 | -0.0006 | **-0.3055** | 0.6261 | -0.2562 | -0.1272 | 0.0338 | -0.0695 | 0.0199 | 0.0887 | 0.0159 | 0.0459 | 0.044 | -0.0221 | 0.0311 | 0.1095 |
| **NB** | -0.0003 | -0.0237 | 0.001 | -0.1868 | **1.0235** | -0.0722 | -0.0738 | -0.0364 | 0.028 | -0.3207 | 0.0676 | 0.0049 | 0.0162 | -0.0342 | -0.0493 | 0.2798 | 0.6236 |
| **BW** | 0.0143 | -0.0131 | 0.0014 | 0.1302 | -0.1229 | **0.601** | 0.0827 | -0.0546 | 0.1359 | -0.0591 | 0.0144 | -0.0434 | -0.023 | -0.0501 | -0.0295 | -0.0703 | 0.514 |
| **NLB** | 0.0358 | -0.0158 | 0.0015 | 0.1099 | -0.2137 | 0.1407 | **0.3535** | -0.0828 | -0.3738 | 0.1137 | 0.0383 | 0.0058 | -0.0443 | -0.0654 | -0.0058 | 0.2962 | 0.2936 |
| **NSB** | 0.0181 | 0.0031 | 0.0009 | 0.0544 | 0.1961 | 0.173 | 0.1542 | **-0.1898** | -0.3524 | -0.1408 | 0.0722 | -0.0148 | -0.0278 | 0.0171 | 0.0149 | 0.5396 | 0.5181 |
| **SI** | -0.0025 | -0.0018 | -0.001 | 0.0173 | 0.0234 | 0.0667 | -0.1079 | 0.0546 | **1.2249** | -0.3108 | -0.0191 | -0.0239 | -0.0102 | -0.0385 | -0.025 | -0.9613 | -0.1149 |
| **LI** | -0.0053 | 0.0159 | -0.0007 | 0.0056 | 0.3002 | 0.0325 | -0.0368 | -0.0244 | 0.3482 | **-1.0935** | 0.0036 | 0.001 | -0.0047 | -0.0521 | -0.0494 | 0.7547 | 0.1947 |
| **UHML** | 0.0371 | -0.0145 | 0.0021 | -0.1155 | 0.2952 | 0.0368 | 0.0577 | -0.0584 | -0.0999 | -0.017 | **0.2345** | -0.0475 | 0.0002 | -0.0366 | -0.0127 | 0.1376 | 0.3991 |
| **UR** | 0.0093 | -0.0404 | 0.0003 | -0.0387 | 0.0399 | -0.2076 | 0.0163 | 0.0223 | -0.2327 | -0.0084 | -0.0886 | **0.1257** | -0.0049 | 0.0811 | 0.013 | 0.2502 | -0.0632 |
| **STR** | 0.025 | -0.0314 | 0.0003 | 0.1597 | -0.1889 | 0.1574 | 0.1785 | -0.06 | 0.1421 | -0.0585 | -0.0006 | 0.007 | **-0.0877** | -0.0286 | 0.0064 | -0.0739 | 0.1468 |
| **ELP** | 0.01 | 0.0228 | -0.001 | -0.0505 | -0.1314 | -0.1132 | -0.0869 | -0.0122 | -0.1771 | 0.2142 | -0.0322 | 0.0383 | 0.0094 | **0.2661** | 0.013 | -0.0376 | -0.0682 |
| **MIC** | 0.007 | -0.0397 | 0.0002 | -0.0497 | 0.3725 | 0.1307 | 0.0153 | 0.0209 | 0.2258 | -0.3986 | 0.0219 | -0.0121 | 0.0041 | -0.0255 | **-0.1354** | 0.1776 | 0.3149 |
| **GOT** | -0.0015 | 0.0124 | 0.0004 | -0.0066 | 0.1986 | -0.0293 | 0.0726 | -0.0711 | -0.8168 | -0.5724 | 0.0224 | 0.0218 | 0.0045 | -0.0069 | -0.0167 | **1.4416** | 0.2531 |

Residual Effect: 0.1872

**DFF**: Days to first flowering **PH**: Plant height (cm) **MB**: Number of monopodial branches **SB**: Number of sympodial branches **NB**: Number of bolls per plant
**BW**: Boll Weight (g) **NLB**: Number of locules per boll **NSB**: Number of seeds per boll **SI** : Seed index (g) **LI**: Lint Index (g)
**UHML**: Upper Half Mean Length (mm) **UR**: Uniformity ratio (%) **STR**: Bundle strength **(g/tex)** **EL**: Elongation percent (%) **MIC**: Micronaire value (µg/inch)
**GOT**: Ginning outturn (%) **SCYPP**: Seed Cotton yield per plant (g)