INTERNATIONAL COTTON RESEARCHERS ASSOCIATION

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# Content




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# 9th Asian Cotton Research and Development Network (ACRDN) meeting and International conference Venue: ICAR-CIRCOT, Adenwala Road, Matunga, Mumbai, Maharashtra, India 08-06 December2023

The ICAC is delighted to extend our warm invitation to you for the 9th Asian Cotton Research and Development Network (ACRDN) meeting and International conference, organized by the Indian Society for Cotton Improvement (ISCI) in collaboration with the International Cotton Advisory Committee (ICAC), ICAR-Central Institute for Research on Cotton Technology (CIRCOT), ICAR-Central Institute for Cotton Research (CICR), and the Indian Fibre Society (IFS).

The event will take place from December 6th to 8th, 2023, at ICAR-CIRCOT, Adenwala Road, Matunga, Mumbai, Maharashtra, India.

The ICAC and ICRA are pleased to announce that the 9th ACRDN, taking place from December 6th to 8th, will be held following the 81st ICAC Plenary meeting. The ICAC Plenary will be hosted from December 2nd to 5th, 2023, at the Jio World Convention Centre, G Block, Bandra Kurla Complex, Bandra East, Mumbai, Maharashtra, India.

This remarkable gathering serves as the inaugural event for the centenary year celebrations of ICAR-CIRCOT, coinciding with the golden jubilee of ISCI. Under the theme "Innovations for a Resilient and Sustainable Cotton Production and Viable Value Chain," the conference aims to foster collaboration and advance research in the Asian cotton industry.

The Asian region stands as the most vibrant hub of cotton production, processing, consumption, and trade globally. Together, China, India, Pakistan, and Uzbekistan account for 56% of the world's cotton acreage and 51.4% of the production. Moreover, China, India, Pakistan, Bangladesh, Vietnam, Uzbekistan, and Indonesia collectively consume 80.6% of the world's cotton, transforming it into value-added products. Notably, China, Bangladesh, India, and Vietnam, in conjunction with Turkey, represent 52% of the world's Textile and Apparel (T&A) exports.

The Asian Cotton Research and Development Network (ACRDN) was established by the International Cotton Advisory Committee (ICAC) in 1999 to foster regional cooperation in cotton research among Asian countries. Since then, eight successful meetings have taken place in Pakistan (1999), Uzbekistan (2002), India (2005), China (2008), Pakistan (2011), Bangladesh (2014), India (2017), and Uzbekistan (2019), yielding fruitful recommendations. It is our honor to cordially invite you to the 9th ACRDN meeting in Mumbai, India.

The challenges faced in cotton production and processing are numerous, on production front the foremost being climate change, besides fluctuations in production, resurgence of pests and diseases, deterioration in soil health, challenges in mechanization and access to latest technologies, and on the processing front, issues of fibre quality, contamination, trash content, traceability, circularity and sustainability vis-a-vis synthetic fibres are major concerns.

The ACRDN provides a wonderful ambience to bring together the cotton technologist, researchers, policy makers, industrial stakeholders and traders to share their experience and research findings covering the entire gamut of the cotton value chain. Delegates from various cotton growing and processing countries of Asia viz., Bangladesh, China, Uzbekistan, Iran and experts from USA, Africa, will be participating in the meeting. The purpose of the meeting is to create a platform to interact and discuss the recent innovations in the field of cotton production, processing, consumption and trade.

ICRA take this opportunity to cordially invite you to participate in the 9th ACRDN meeting and the international conference and make the event a grand success.

For detailed information about the ACRDN conference, please refer to the brochure accessible through this link: ACRDN9- Meeting Brochure-Mumba2023-.pdf

We also encourage interested overseas researchers, excluding Indian participants, to contact keshav@icac.org for potential financial assistance from the ICAC to cover registration fees. It is important to note that financial support will be provided on a first-come, first-served basis to the first 25 overseas researchers whose oral presentations have been accepted for the conference.

We eagerly look forward to welcoming you to India in December 2023

# ICRA Call for Applications: ICRA-ASIA YOUNG SCIENTIST INNOVATION MEDAL – 2023

**Dear Cotton researchers**

**ICAC www.icac.org and ICRA www.icracotton.org, are pleased to announce the call for applications for the ICRA-ASIA YOUNG SCIENTIST INNOVATION MEDAL - 2023. You will find the official announcement along with the application form, which can be downloaded by clicking on the following link:**
**ICRA Asia Medal -2023Annoucement.docx**
**To be considered for the medal, please complete the application form and submit it along with PDF copies of three research papers on cotton, authored by yourself (with at least one paper where you are the first author), to the following email addresses: Cottonspinning@gmail.com (Dr. Mohamed A. M. Negm, Chairman ICRA), keshav@icac.org (Dr. Keshav R Kranthi, Chief Scientist, ICAC), and icrasecretariatpak@gmail.com (ICRA Secretariat). When submitting your application, kindly use 'ICRA-Asia-Medal2023-' followed by your name as the subject of the email.**
**Please note that the deadline for submitting applications is August 31st, 2023. The winner of the medal will be notified on September 15th, 2023. We encourage all eligible individuals to seize this opportunity and participate in this prestigious award. If you have any further inquiries or require additional information, please do not hesitate to reach out to us. Thank you for your attention, and we look forward to receiving your applications.**

**ICRA-ASIA YOUNG SCIENTIST INNOVATION MEDAL – 2023**

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# ICAC to Hold 81st Plenary Meeting in Mumbai, 5-2 December 2023

**ICAC to Hold 81st Plenary Meeting in Mumbai, 5-2 December 2023**

**The International Cotton Advisory Committee (ICAC) is pleased and grateful to accept the invitation from India's Ministry of Textiles to hold its 81st Plenary Meeting in Mumbai from 5-2 December 2023.**

**The local Organising Committee in India will be finalising the theme of the conference in the coming days. The four-day event will feature a variety of sessions covering all sectors of the supply chain, including:**

- **A Technical session entitled, 'Climate-Smart Innovations as Game Changers for Cotton Production'; and**
- **A Private Sector Advisory Council session entitled, 'Private Sector Guidelines for Policy Making on Traceability'.**

**The 81st Plenary Meeting will be opened by an inaugural session featuring a welcome speech from India's Minister of Textiles, Mr Shri Piyush Goyal, at 2:00 pm on 2 December. At the conclusion of the 81st Plenary Meeting, attendees will have the option to participate in a two-day technical tour to a variety of facilities that will provide deeper insight into India's cotton and textile industries.**

**The specifics of the tour will be announced in the coming weeks, as will information about where and how to register for the conference.**

# Data About Organic Cotton Production in Turkey Warrants Skepticism

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**Member of the Discover Natural Fibres Initiative and consultant on natural fibre issues. Former Executive Director of the International Cotton**

In its Organic Cotton Market Report (OCMR) 2022, the Textile Exchange stated in declarative sentences that that they estimated the 2020/21 global harvest at 342,265 tonnes of organic cotton fibre produced on 621,691 hectares of certified organic land. Growth from 2019/20 was estimated at 37%, and organic production represented 1.4% of all cotton grown.

The Textile Exchange prefaced those statements with pages of disclaimers that it is "purely an aggregator" of data, that it doesn't perform certification work itself, that data is provided by external sources, that it has "done what it can" to overcome challenges, and it devoted a whole page to the ten steps it is taking to "improve traceability and prevent fraud."

Then, after all these disclaimers, the Textile Exchange went ahead and reported 37% growth in production in 2020/21, secure in the knowledge that most readers would focus on that headline number. The publication included charts and tables, pictures of smiling farmers and stories of growth and success, all reported with amazing, confidence-enhancing, precision to single tonnes and hectares.

The Textile Exchange did not say that its estimate of production is almost surely inflated, that there are many reasons to be highly skeptical of the numbers reported by the certification agencies, and readers had to go to the next page and study a chart to realize that the Textile Exchange itself had low confidence in the data (Data Confidence one out of three) from five countries, India, Kirghizstan, Tajikistan, Turkey and Uganda, who together accounted for 76% of the certified organic total in 2020/21. (On another page, the Textile Exchange says it rates its confidence in the data for Turkey as two out of three.)

Among the reasons to be skeptical is that yields calculated from reported certified area and production are too high to be true. The Textile Exchange reported that organic yields in eight countries accounting for 307,214 tonnes of 2020/21 production (90% of the world total), were equal to or higher than overall yields in each country. Almost by definition, yields in organic agriculture are lower than yields achieved by conventional farmers, and the organic cotton yields reported for 2020/21 in and of themselves raise suspicion of fraud.

Specific information from Turkey provide a case study in why skepticism about the statistics contained in the 2022 OCMR is warranted. The organic cotton yield reported for Turkey was 2% higher than the overall yield for cotton in the country. An organic yield equivalent to conventional yields is possible, but highly unlikely. If farmers could achieve organic yields just as high as conventional yields without the use of purchased inputs, they would all do so. At a minimum, the Textile Exchange has an obligation to explain how such high yields could be achieved, and nowhere did they even address the issue.

Further, the Textile Exchange claims that production of organic cotton in Turkey rose from 24,288 tonnes in 2019/20 to 80,830 tonnes during 2020/21, a three-fold increase in one year! In contrast, the Ministry of Agriculture and Forestry, Government of Turkey, reports that production of organic cotton fell from 24,300 tonnes in 2019/20 to just 6,075 tonnes in 2020/21, a four-fold decrease during the same year! Why would the two data sets, essentially equal in 2019/20, diverge so much in 2020/21?

The Government of Turkey counts cotton as organic only if it is produced in compliance with the regulations established for the Turkish organic standard, but the Textile Exchange includes all production certified to standards recognized by IFOAM, including the EU and USDA standards. A key difference is that compliance with Turkish regulations covering organic standards requires that every farm be individually audited. In contrast, farmers seeking certification under the EU or USDA organic standards may form groups, with only a few members of each group being audited, but with all members receiving certification.

The Textile Exchange explains that organic certification is driven by demand in end markets where final goods are sold (correspondence with a spokesperson for the Textile Exchange). Since the EU and the USA are the largest retail markets for organic textile products, the Textile Exchange says that Turkish farmers chose to certify to EU and USDA standards in 2020/21, rather than to the Turkish organic standard.

However, term “organic” was not controlled in the EU with respect to textiles as of 2020/21, and cotton certified to the Turkish organic standard could have been sold in the EU as organic. Second, the ultimate end use destinations for organic products could not have changed that dramatically between 2019 and 2020. The Textile Exchange, which claims to be painting a clearer picture of the sector to give industry a starting point to recognize issues and anomalies when they arise, does not explain why the two data sets diverged as much as they did in 2020/21. It would be naive to think that the ease of certification within groups, versus the Turkish requirement for farm-by-farm certification, was not a factor.

There are two options for testing to determine the authenticity of organic cotton. The first is a DNA test to determine whether the cotton contains GMOs (whether the tools of biotechnology have been used to impart genetic traits that confer resistance to chewing pests or efficient management of weeds), and the second is a pesticide residue test. Neither test is dispositive; neither test proves that cotton was produced using organic methods. Rather, each test can only prove that the cotton is not organic.

DNA tests can determine whether the cotton was cultivated from GMO or non-GMO seeds, but since all cotton in Turkey lacks biotech traits, the absence of GMOs does not prove that cotton was produced using organic methods. Most pesticides, other than plant growth regulators, are applied on cotton prior to boll opening, and regulated pesticides in most producing countries are biodegradable within 14 days anyway. Therefore, pesticide residues are difficult to detect, even on cotton lint. After bale opening, blending in the blow room, spinning, weaving or knitting, and dyeing and finishing, finding residue from agricultural pesticides on fabric or finished fabric and clothing is nearly impossible. Therefore, not being able to detect pesticide residue does not prove much. Even if you take fibres to a laboratory and subject them to forensic scrutiny, you are not going to be able to verify the production methods used. Since conventional production practices are higher-yielding, and with premiums being paid for certified organic cotton, the temptation is great to claim organic and see if anyone catches you.

Farmers, ginners and traders around the world are aware that it is possible to make fraudulent claims of organic cotton content without much risk. Afterall, no one is ever put in jail or fined for making a false claim of organic certification. None of the five countries for which the Textile Exchange admits having low confidence in the 2020/21 data have a system of permanent bale identification numbers (PBI’s). Therefore, bales can be swapped, and once bales arrive at a spinning mill, there is no way to trace back to the farm or gin of origin. Since the bale of cotton looks the same anyway, why not try calling it organic?

A company making a fraudulent claim of organic content risks losing certification and becoming a delisted-supplier, losing the certified organic price premium, possible customs detainment, and reputational damage. None of that means much. Within the cotton industry, the most important body enforcing rules covering international trade is the International Cotton Association (ICA), headquartered in Liverpool but operating worldwide. As of this week, there are 630 companies on the ICA list of unfulfilled awards (the default list). Theoretically, these companies are prevented from trading with members of the ICA and therefore would be hard pressed to continue in business. In reality, the consequences of being on the ICA default list are ephemeral, and if the ICA default list is of little consequence, for sure no one is going to worry much about being delisted as an organic cotton supplier. (The largest merchant handling organic cotton in Turkey was just added to the ICA default list in June.)

Given that there is no objective method of proving whether cotton was produced organically or not, it is impossible to measure just how skeptical we should be of statistics. Nevertheless, it is clear that unwarranted certification occurs. Based on reasonable estimates of yields in each producing country, an estimate of world production of organic cotton of less than 200,000 tonnes in 2020/21 would not be surprising.

The Textile Exchange should not have published a quotable estimate of 37% growth in 2020/21. Instead, they could have published a range for estimated production. They could have reported that the amount certified totaled 342,000 tonnes, but that authentic production was surely far less, and no one really knows by how much. A careful country-by-country analysis indicates that despite all the hype and subsidy that goes into the promotion of organic cotton, authentic world production may not be growing at all.

The people at the Textile Exchange are well intended, and it is true that they are merely reporting what the certification agencies claim. No one ever advances their career within the community of organic enthusiasts by being skeptical of reports of growth. Nevertheless, dubious reports that stretch credulity undermine consumer confidence in all sustainability claims, discourage honest producers, ginners and traders from making legitimate efforts at compliance, and divert time and attention from industry activities that might actually work. By publishing a headline number of 37% growth in production, while shielding behind disclaimers that most readers ignore, the Textile Exchange is enabling brands and retailers to make consumer-facing claims of organic cotton content to boost sustainability credentials, while continuing their fast-fashion business models built primarily on the use of polyester.

The Textile Exchange should withdraw the Organic Cotton Market Report 2022, audit the numbers and issue a revised report with data ranges that provide a realistic picture of the industry. The organic cotton sector must look honestly at itself and ask, why, if organic is supposed to help farmers, there is so much cause for skepticism and so little compliance with organic standards in the first place.

# STABILITY OF CHEMICAL PROPERTIES OF SOME EGYPTIAN COTTON VARIETIES

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## Abstract

This investigation was carried out to evaluate the chemical properties of ***Gossypium barbadense*** **L.** of seven cotton genotypes long staple varieties (Giza 90, Giza 95, Giza 98, Giza 94 and Giza 86) and extra-long staple varieties (Giza 96 and Giza 92), during five growing seasons from 2017 to 2021.

The treatment regimes were evaluated using a randomized complete block design with three replications. The results for mean square cleared that for all treatments, genotypes, years and the interaction between years and genotypes highly significant for all the studied traits with except Sugar and wax and the results indicated that the genotypes effects changed from one year to another.

From the results of GGE biplot analysis cleared that the G2 and G3 were staples for Ash, G1, G2 and G4 were staple for moisture % and G4 was staple for Oil%. Also, the results obtained that the G4 was unstable for Ash, G5, G6 and G7 were unstable for moisture % and G2 and G3 were unstable for oil and had less mean performance.

As a result of the GGE biplot ranking genotypes and environments based on both ideal genotypes and ideal environments for the Ash trait showed that the ideal genotypes were Giza 86(G4) for Ash trait, Giza 90(G1) and Giza 95 (G3) for moisture % trait and Giza 94(G5) and Giza 92(G6) for oil trait, while the ideal environments were E1, for Ash trait, E2. E4 and E5 for moisture trait and E1, E2 and E3 for oil trait.

**Keywords:** Egyptian cotton; genotypes; Stability; chemical properties.

## Introduction

Egyptian cotton is one of the most important crops of Egyptian agriculture and one of the most natural fibers used in textile industry. Egyptian cotton varieties belong to *Gossypium* barbadense species and have high fiber quality which the quality of fiber is subject to the influence of cultivar genotype, as well as agronomic practices and environmental conditions (30). Since cotton is produced in the field rather than at a manufacturing facility, it remains complicated to control all the chemical and physical properties that affect Fiber processing and spinning which are affected by many other factors as surface characteristics and contaminants of cotton. Therefore, analyzing cotton fiber content is necessary to determine the chemical composition of cotton fibers, which differ by variety and growth condition.

Cotton will become a source of fiber, oil and protein. There are four products of cotton plant viz. lint, seed, stalk and leaves. Out of these, lint is the main product and rests are by-products (11). Cotton fibers are the purest form of cellulose, Nearly Mature cotton contains 93 to 96% cellulose mostly of α-cellulose, and the rest is non-cellulosics substances that are located on the outer layers and inside the lumen of the cotton fiber. (38, 26).

Non-cellulosic materials on raw cottons may impact yarn processing efficiency and product quality, non-cellulosic containing 1.3% protein, 0.9% pectic substances, 1.2% ash, 0.6% wax, 0.8% organic acids, 0.3% sugars, and 0.9% other components. Concentrations of these substances are influenced by factors such as genetics of the particular variety, growing area, atmospheric changes, growth period, growing and chemical treatments furthermore any pests present, and contamination encountered in during cotton picking, ginning, and baling processes. The weight of the fiber, wax, metals, and other surface related materials can directly influence the fiber performance in textile spinning and processing. (19, 24)

One of the non-cellulosic components in the cotton fibers is sugar which derived from physiological and entomological .Sugars occurs on raw cottons through two sources. The first, normal plant sugars are part of the growing process. The most predominant of these carbohydrates are the monosaccharide's glucose and fructose. But Plant sugars do not usually cause problems because the sugars are in low levels and evenly distributed on the fibers.(24)

The second source, honeydew (insect sugars) primarily cotton aphids, Aphis gossypii, and silver leaf whiteflies, Bemesiaargentifoli occurs in the form of highly sticky droplets of more complex concentrated carbohydrates on the surface of cotton. , known as: Trehalulose and melezitose sugars produced from these insects and caused cotton stickiness. (19)

Arafa, et al. 2012, studied the relationship between some Egyptian cotton fibers properties and the degree of deterioration caused by fungal infection , it has been found that the relationship between reducing Sugar % and fiber damage index was strong and there was direct relationship strengthen the correlation between them. This may be due to that the cotton fibers contain high sugar content is a good growing media so it attracting the microorganisms (5). High Performance Liquid Chromatography (HPLC) used to separate, and quantify these sugars and determining their overall contributions to cotton stickiness. Sticky cotton lint contaminates equipment in gins and textile processing, requires costly stoppages for cleaning and repair. (12, 18)

Waxes and pectins are non-cellulosic components in the cotton fibers most responsible for the hydrophobicity and low water wet-ability of raw cotton fibers. Cotton waxes are all lipid compounds found on cotton fiber surfaces including waxes, fats, and resins .True waxes are esters, higher fatty acids, hydrocarbons, aldehydes, glycerides, sterols, acyl components, resins, cutin, and suberin are also found in the wax portion of the cuticle of cotton fiber in different quantities. (15).

There is a major influence on fiber properties if hydrophilic fibers like cotton, as it absorbs or desorbs moisture. In general, the moisture content of the cotton fiber has a significant influence on the characteristics of the fibers. (25)

Cottonseed contains hull and kernel. The hull produces fiber and linters. The kernel contains oil, protein, carbohydrate and other constituent such as vitamins, minerals, lecithin, sterols etc. Cottonseed could either be processed by the traditional crude method of crushing seed without delinting or by scientific processing of cottonseed, which involves removal of linters, decortication, separation of hull, expelling, solvent extraction and refining of oil. Scientific processing results in extraction of entire cottonseed oil, while the oil cake obtained by traditional method still contains about 7% residual oil. The cottonseed meal obtained through scientific method contains negligible oil and has very high by-pass type protein content of 40 to 42%. Cottonseed oil has a ratio of 2: 1 of polyunsaturated (65-70%) to saturate (26-35%) fatty acids. (10)

The selection of genotypes that have a wide range of adaptability is an important target for plant breeders of numerous methods for studying the behavior of genotypes in many environments by Shukla's (1977) stability variance(29), and from the newest method in this way the use of GGE biplot in interpretation these points.

The GGE (genotype + genotype by environment) concept based on the understanding that the main effect of genotype and genotype by environmental interaction are both sources of variation. That are relevant to evaluation and that they must be consider simultaneously, not alone or separately, for favorable genotype evaluation. GGE-biplot may be used to perform analysis similar to the popular model of additive main effect and multiplicative interaction (AMMI) model, however, the GGE biplot eliminates the effect of the environment and focuses on the genotype (G) and GEI components relevant to the genotype evaluation. (8).

The biplot technique provides a powerful solution to this problem (16). The performance of each genotype in each environment is a measure of a primary environmental effect (E), a primary genotype effect (G), and an environmental interaction genotype (IEG) (35).

The choice of genotype requires evaluating the genotypes in many environments, and selecting the genotype that has a wide range of adaptability and stability is very important (28, 27). The objective of this study was to use the GGE-biplot technique to determine the most suitable genotype and stability over most environments and determine discriminating ability and representatives of environments.

The methodology uses a biplot to show the factors (genotype and genotype by environment interaction) that are also the sources of variation. In this study, genotype–focused scaling was used in visualizing for genotypic comparison with environment-focused scaling for environmental comparison. Besides, the symmetric scaling was preferred in visualizing the which–won– where pattern of the MEYTs yield data (33).

The aim of this study was to illustrate the chemical composition of typical mature cotton fibers, the chemical composition of seven of commercial raw Egyptian cottons has been quantitatively investigated during five growing seasons from 2017 to 2021.

## MATERIAL AND METHODS

### 1. MATERIALS:

Cotton samples representing Egyptian cotton varieties are prepared in order to perform different fiber tests determining their chemical properties.

Seven cotton genotypes belonging to ***Gossypium barbadense* L.** as shown in **Table 1** were obtained from the GenBank of Cotton Breeding Sector, Cotton Research Institute, Agricultural Research Center, Egypt. Experimental fields were conduct at Sakha Experimental Station, Agricultural Research Center, Kafr El-Sheikh government, Egypt, during five growing seasons from 2017 to 2021.

**Table 1: Origin and pedigree of the seven cotton genotypes under study**

| No. | Genotypes | Pedigree | Origin |
|---|---|---|---|
| G1 | Giza 90 | Giza 83 x Dandra | Egypt |
| G2 | Giza 98 | ((G.83 x G.80 x G.89) x A107)) | Egypt |
| G3 | Giza 95 | (Giza 83 x (Giza 75 x 5844)) x Giza 80 | Egypt |
| G4 | Giza 86 | Giza 75 x Giza 81 | Egypt |
| G5 | Giza 94 | 10229 x Giza 86 | Egypt |
| G6 | Giza 92 | Giza 84 x (Giza 74 x Giza 68) | Egypt |
| G7 | Giza 96 | (Giza 84 x (Giza 70 x Giza 51B)) x S62 | Egypt |

Seven genotypes were evaluated regimes in a randomized complete block design with three replications. Each experimental plot consists of five rows and the genotypes were planted under the standard agronomic practices following proper plant geometry with 4 m row length, 70 cm x 30 cm row to row and plant to plant spacing, respectively. Finally, the plot size was 13 $m^2$ at each growing seasons. All agronomic and cultural practices were done manually and regularly during the five growing seasons. The normal treatment received eight irrigations during the growing season as the recommended rules, and estimate the chemical traits i.e.: - Sugar, Wax, Ash, Moisture and Oil.

## 1. CHEMICALS AND AUXILIARIES:

Ethanol (Ethyl alcohol) $C_2H_5OH$, Sulfuric acid $H_2SO_4$, Chloroform ($CHCl_3$), Phenol and Distilled water.

## EVALUATION TESTS

Lint cotton samples were pre conditioned for 24 hours, under the standard conditions of (65 ± 5 %) relative humidity and (20 ± 2 C°) temperature according to ISO: 6359-1971 standard method before testing using cotton testing instruments:

All tests of the fibers of these varieties to determine the chemical fiber properties were performed at Cotton Research Institute, Agricultural Research Center (ARC), and Giza, Egypt.

### 1.1. Determination of reducing Sugar content:

The levels of extractable that are removed from cotton fiber by 95% ethyl alcohol determined in 6 hours soxhlet extraction according to the methods of (Dubois1956). This extraction consists of waxes, organic acids, sugars, hydrocarbon contaminants. (13)

The sugar content was determined by using the standard curve previously prepared.

### 1.2. Determination of Wax %:

Determination of total wax in cotton fiber by the method (Conrad, 1944). (9)

### 1.3. Determination of Moisture content (%):

The standard moisture regain were measured on lint after equilibration in a standard atmosphere using oven drying method. (7)

### 1.4. Determination of Ash %:

Ash content was determined by the method by adopted and recommended by AOAC (1990). The amount of ash was calculated on the basis of original cotton weight. Triplicate 3g ± 0.05 of raw cotton were ashed for 6 hr at 650 °C in a muffle oven. After ashing the residues were weight and ash content was calculated for each sample. (4, 6)

### 1.5. Oil extraction:

A known weigh of the ground sample (about 5.0 gm) was extracted with hexane for 6 hours in Soxhlet after the solvent was evaporated and residue was dried to a constant weight.

Oil contents were measured by following the formula.

Oil Contents (YM) = a/M (g) × 100

Where,

YM: Oil content (%); a: Fat amount accumulated in flask (g); M: sample weight (g). according to AOAC., (2005).(1,2)

## 2. STATISTICAL ANALYSIS

Before the combined analysis of variance, the variance homogeneity of experimental errors was examined by Bartlett's test. The analysis of variance (ANOVA) explained to partition the variations due to the effect of genotypes, years, environments and their interaction, also significant difference within these factors was estimated using LSD test at (0.05 and 0.01) probability level according to Gomez and Gomez, 1984. (17)

The GGE-biplot was constructed based on the first two principal components (PCs) resulting from singular value decomposition (SVD), by estimating each element of the matrix through, also the multivariate graphical technique of GGE biplot was used to determine the stable genotypes following formulas described by Yan et al., 2000 ; Yan and Kang, 2003 and Yan et al 2007.(36,35,37)

$$Y_{ij} = \mu + e_j + \sum_{n=1}^{N} \lambda_n \gamma_{in} \delta_{jn} + \varepsilon_{ij}$$

$Y_{ij}$ = mean response of ith genotype (i = 1,...,I) in the $j^{th}$ environment (j = 1,..,J).

$\mu$ = grand mean.

$e_j$ = environment deviations from the grand mean.

$\lambda_n$ = the Eigen value of PC analysis axis.

$\gamma_{in}$and $\delta_{jn}$ = genotype and environment PCs scores for axis n.

N = number of PCs retained in the model.

$\varepsilon_{ij}$ = residual effect N $(0,\sigma^2)$.

GenStat version $17^{th}$ statistical package software was used to generate the E and G×E interaction biplot used to analyze the multi-environment trial data. Bartlett's test and combined analysis of variance for data and GGE-biplot based on five patterns: (a) determining the best genotype in each environment, (b) coordinates of the average environment, (c) ranking the genotypes based on the ideal genotype, (d) ranking the environments based on the ideal environment, and (e) examining the relationship among the environments were used for graphical analysis.

## RESULTS AND DISCUSSIONS

A combined analysis of variance was executed to delineate the primary effect and measure the interactions among and within the sources of variations

**Table 2: Analysis of variance for the studied chemical traits**

| S.O.V | d.f | Mean sum of squares | | | | |
|---|---|---|---|---|---|---|
| | | **Moisture** | **Sugar** | **Ash** | **oil** | **Wax** |
| **Replications** | **2** | 0.029 | 0.005 | 0.001 | 0.236 | 33.761 |
| **Treatments** | **34** | 0.154** | 0.003 | 0.007** | 9.278** | 33.357 |
| **Genotypes (G)** | **6** | 0.207** | 0.003 | 0.001 | 12.652** | 32.282 |
| **Years (Y)** | **4** | 0.213** | 0.004 | 0.006** | 5.307** | 33.382 |
| **G x Y** | **24** | 0.138** | 0.007 | 0.006** | 9.084** | 33.617 |
| **Error** | **68** | **0.022** | **0.008** | **0.001** | **0.24** | 33.**58** |
| **Coefficient of Variation %** | | **2.277** | **32.547** | **1.228** | **2.231** | **458.123** |

The analysis of variance, a statistical technique that amalgamates data from multiple sources, has been shown in Table 2. The mean squares for treatment, environments, genotypes, and the interaction between genotypes and environments (G×E) were discovered to be significantly divergent ($p \leq 0.01$ and $p \leq 0.05$) for the variables of moisture, ash, and oil. However, no significant variations were observed for sugar and wax. The present investigation has shown a significant level of differentiation among G×E interactions and genotype effects, demonstrating the existence of diverse multi-environments with distinct genotypes.

**Table 3: Mean performance of chemical properties of cotton fibers**

**Table 3.1: Moisture % of cotton fibers**

| Genotypes | Moisture (%) | | | | | |
|---|---|---|---|---|---|---|
| | **2017** | **2018** | **2019** | **2020** | **2021** | **Mean** |
| **Giza 90** | 6.767 | 7.013 | 6.533 | 6.650 | 6.773 | **6.747** |
| **Giza 98** | 6.633 | 6.900 | 6.667 | 6.700 | 6.767 | **6.733** |
| **Giza 95** | 7.500 | 7.000 | 6.467 | 6.767 | 6.733 | **6.893** |
| **Giza 86** | 6.767 | 7.167 | 6.700 | 6.503 | 6.800 | **6.787** |
| **Giza 94** | 6.700 | 6.667 | 6.333 | 6.500 | 6.700 | **6.580** |
| **Giza 92** | 6.633 | 6.633 | 6.467 | 6.400 | 6.667 | **6.560** |
| **Giza 96** | 6.400 | 6.733 | 6.500 | 6.667 | 6.500 | **6.560** |
| **Mean** | **6.771** | **6.873** | **6.524** | **6.598** | **6.706** | **6.694** |
| | **LSD Genotypes (G) at probability level** | | | | | |
| **0.05** | **0.111** | | | | | |
| **0.01** | **0.146** | | | | | |
| | **LSD Years (Y) at probability level** | | | | | |
| **0.05** | **0.099** | | | | | |
| **0.01** | **0.127** | | | | | |
| | **LSD G x Y at probability level** | | | | | |
| **0.05** | **0.244** | | | | | |
| **0.01** | **0.330** | | | | | |

table 3.1 The effect of genotypes on moisture was significant, whereas genotype G 95 recorded the highest value (6.893) followed by G86 (6.787). On the other hand genotypes G 92 andG 96 recorded the lowest value (6.560). The genotype G95 in year 2017 gave the highest value (7.0) and the genotype G94 in year 2019 gave the lowest value(6.33). The results of the present study for moisture content were in agreement with the results observed by Rabadia et al., (2021).(32).

**Table 3.2: Reducing Sugar% of cotton fibers**

| Genotypes | Reducing Sugar (%) | | | | | |
|---|---|---|---|---|---|---|
| | 2017 | 2018 | 2019 | 2020 | 2021 | Mean |
| **Giza 90** | 0.123 | 0.137 | 0.170 | 0.147 | 0.153 | **0.146** |
| **Giza 98** | 0.130 | 0.147 | 0.177 | 0.167 | 0.177 | **0.159** |
| **Giza 95** | 0.143 | 0.137 | 0.190 | 0.183 | 0.183 | **0.167** |
| **Giza 86** | 0.140 | 0.170 | 0.127 | 0.150 | 0.190 | **0.155** |
| **Giza 94** | 0.153 | 0.123 | 0.170 | 0.147 | 0.173 | **0.153** |
| **Giza 92** | 0.143 | 0.133 | 0.193 | 0.170 | 0.173 | **0.163** |
| **Giza 96** | 0.177 | 0.153 | 0.143 | 0.170 | 0.160 | **0.161** |
| **Mean** | **0.144** | **0.143** | **0.167** | **0.162** | **0.173** | **0.164** |
| | **LSD Genotypes (G) at probability level** | | | | | |
| **0.05** | **0.038** | | | | | |
| **0.01** | **0.055** | | | | | |
| | **LSD Years (Y) at probability level** | | | | | |
| **0.05** | **0.038** | | | | | |
| **0.01** | **0.046** | | | | | |
| | **LSD G x Y at probability level** | | | | | |
| **0.05** | **0.088** | | | | | |
| **0.01** | **0.113** | | | | | |

table 3.2 Showed the effect of genotypes on reducing sugar was significant, whereas genotype G 95 recorded the highest value (0.167) followed by G92 was recorded ( 0.163) while genotype G90 recorded the lowest value (0.123), whereas the genotype G86 in year 2021 recorded highest year and the genotype G90 recorded the lowest year.

The results of present study for reducing Sugar were in agreement with the results observed by Venkatesh et al., (2016) and Munawar 2021, It is rather interesting to note that the values of total reducing sugar % for all the varieties were in normal range under 0.3 % (not sticky) which not cause any processing problems (31, 23).

**Table 3.3: Ash% of cotton fibers**

| Genotypes | Ash (%) | | | | | |
|---|---|---|---|---|---|---|
| | 2017 | 2018 | 2019 | 2020 | 2021 | Mean |
| **Giza 90** | 0.980 | 0.995 | 0.993 | 0.987 | 0.994 | **0.990** |
| **Giza 98** | 0.999 | 0.999 | 0.998 | 0.995 | 0.993 | **0.997** |
| **Giza 95** | 0.999 | 0.992 | 0.996 | 0.994 | 0.993 | **0.995** |
| **Giza 86** | 1.072 | 0.966 | 0.987 | 0.998 | 0.993 | **1.003** |
| **Giza 94** | 1.010 | 0.987 | 0.985 | 0.986 | 0.999 | **0.993** |
| **Giza 92** | 0.994 | 0.988 | 0.992 | 0.998 | 0.993 | **0.993** |
| **Giza 96** | 0.990 | 0.985 | 0.992 | 0.998 | 0.994 | **0.992** |
| **Mean** | **1.006** | **0.987** | **0.992** | **0.994** | **0.994** | **0.995** |
| | **LSD Genotypes (G) at probability level** | | | | | |
| **0.05** | **0.008** | | | | | |
| **0.01** | **0.017** | | | | | |
| | **LSD Years (Y) at probability level** | | | | | |
| **0.05** | **0.005** | | | | | |
| **0.01** | **0.009** | | | | | |
| | **LSD G x Y at probability level** | | | | | |
| **0.05** | **0.018** | | | | | |
| **0.01** | **0.023** | | | | | |

Table 3.3 showed the values for ash% of the cotton fibers, the effect of genotypes on ash content was significant, whereas genotype G86 recorded the highest value (1.003) followed by G98 (0.997) whereas genotype G90 recorded the lowest value (0.990). The genotype G86 in year 2017 recorded the highest value and the genotype G96 in year 2018 recorded the lowest value. The results of present study for ash% could be adversely responded with McCall (1951) and Amal (2003), (22, 21).

**Table 3.4: Wax % of cotton fibers**

| Genotypes | Wax (%) | | | | | |
|---|---|---|---|---|---|---|
| | 2017 | 2018 | 2019 | 2020 | 2021 | Mean |
| **Giza 90** | 0.580 | 0.627 | 0.573 | 0.577 | 0.600 | **0.591** |
| **Giza 98** | 0.627 | 0.580 | 0.587 | 0.593 | 0.683 | **0.614** |
| **Giza 95** | 0.627 | 0.670 | 0.533 | 0.620 | 0.687 | **0.627** |
| **Giza 86** | 0.663 | 0.550 | 0.950 | 0.707 | 0.647 | **0.703** |
| **Giza 94** | 0.590 | 0.747 | 0.970 | 0.858 | 0.730 | **0.779** |
| **Giza 92** | 0.410 | 0.983 | 1.120 | 0.567 | 0.820 | **0.780** |
| **Giza 96** | 0.657 | 0.757 | 0.960 | 0.650 | 0.773 | **0.759** |
| **Mean** | **0.593** | **0.702** | **0.813** | **0.653** | **0.706** | **1.265** |
| | **LSD Genotypes (G) at probability level** | | | | | |
| **0.05** | **4.224** | | | | | |
| **0.01** | **5.604** | | | | | |
| | **LSD Years (Y) at probability level** | | | | | |
| **0.05** | **3.568** | | | | | |
| **0.01** | **4.731** | | | | | |
| | **LSD G x Y at probability level** | | | | | |
| **0.05** | **9.435** | | | | | |
| **0.01** | **12.537** | | | | | |

The values for the Extracted wax was shown in table 3.4. The effect of genotypes on wax was significant, as genotype G 92 recorded the highest value (0.780) followed by G94 (0.779) whereas genotype G90 recorded the lowest value (0.591). The genotype G92 in year 2019 gave the highest value also the genotype G92 in year 2017 gave the lowest value. The results of present study for wax matched with the findings of Amal (2003), and Mahmoud (1996), (21, 20).

**Table 3.5: Seed-Oil % of cotton seeds**

| Genotypes | Seed-Oil (%) | | | | | |
|---|---|---|---|---|---|---|
| | 2017 | 2018 | 2019 | 2020 | 2021 | Mean |
| **Giza 90** | 20.647 | 17.760 | 22.030 | 21.338 | 19.895 | **20.334** |
| **Giza 98** | 20.563 | 18.167 | 20.457 | 23.170 | 22.053 | **20.882** |
| **Giza 95** | 20.483 | 18.663 | 23.077 | 20.937 | 22.227 | **21.077** |
| **Giza 86** | 20.910 | 20.173 | 22.223 | 22.753 | 22.700 | **21.752** |
| **Giza 94** | 22.497 | 21.283 | 23.390 | 22.337 | 24.800 | **22.861** |
| **Giza 92** | 23.080 | 24.257 | 24.240 | 24.223 | 20.283 | **23.217** |
| **Giza 96** | 20.973 | 21.643 | 20.077 | 20.170 | 18.960 | **20.365** |
| **Mean** | **21.308** | **20.278** | **22.213** | **22.133** | **21.560** | **21.498** |
| | **LSD Genotypes (G) at probability level** | | | | | |
| **0.05** | **0.365** | | | | | |
| **0.01** | **0.488** | | | | | |
| | **LSD Years (Y) at probability level** | | | | | |
| **0.05** | **0.302** | | | | | |
| **0.01** | **0.400** | | | | | |
| | **LSD G x Y at probability level** | | | | | |
| **0.05** | **0.818** | | | | | |
| **0.01** | **1.077** | | | | | |

Table 3.5.Showed Oil extraction %, The analytical data show considerable variation in the seed-oil contents of the cottons according to the genotype., the effect of genotypes on oil extraction was significant, whereas genotype G 92 recorded the highest value (23.217) followed by G94 was recorded (22.861) while genotype G90 recorded the lowest value (20.334), whereas the genotype G92 in year 2018 recorded highest year and genotype G90 in year 2018 recorded the lowest year.The results of present study for oil extraction matched with the findings of Amer, et al., (2020) and Eldessouky et al., (2021) where evaluated cottonseed oil content of some Egyptian genotypes to improve seed oil content. (3, 14).

## GGE biplot

Globally, crop farming is performed with equal efficacy in the absence of genotype by environment (GxE) interaction, yielding consistent results independent of environmental conditions, according to Yan et al. (2002), the primary factor contributing to variation in genotype assessment in multi-environment trials is the effect of genotype (G) in addition to GxE interactions. The biplot can be used to identify three major components, including the "which-won-where" pattern proposed by Yan et al. (2002), which is an effective tool for visualizing the pattern of GEI based on the correlation between G and E.

Figures 1, 2 and 3 illustrate the polygon view of the GGE-biplot pattern for ash%, moisture%, and seed-oil%, respectively. The G+GxE variation was recorded as 96.99%, 98.57%, 97.33%, and 83.44% for ash%, moisture%, and seed-oil%, respectively (Figures 1, 2 and 3), confirming the presence of distinct interaction between genotype and environment for all the traits (34).

The genotypes that constitute the perpendicular for the three traits under investigation are G4, G5, G6, G7, and G1 for ash and moisture. Similarly, genotypes G1, G2, G3, G5, G6, and G7 form the perpendicular for the oil trait. These particular genotypes are positioned at the farthest distance from the origin point .Notably, genotype G5 exhibited a maximum number of pods and exceptional stability in ENV1, while genotypes G2, G3, G6, and G7 performed optimally in ENV3. On the other hand, genotypes G1 and G4 produced the highest number of pods and demonstrated remarkable stability in ENV2, ENV3, ENV4, and ENV5. Furthermore, genotype G3 excelled in moisture preservation under ENV1. While genotype G6 performed optimally in oil production under ENV2 as showed in Figures 1, 2, and 3.

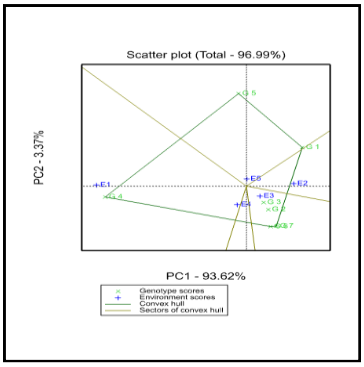


**Figure 1: "Which-won-where" pattern of GGE biplot polygon for ash**

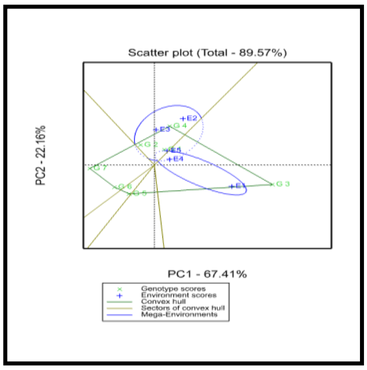


**Figure 2: "Which-won-where" pattern of GGE biplot polygon for moisture**

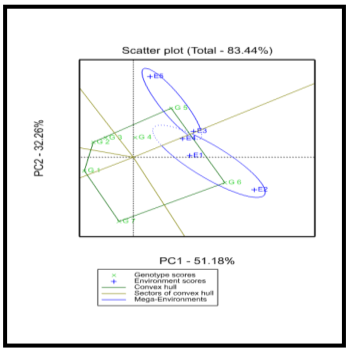


**Figure 3: "Which-won-where" pattern of GGE biplot polygon for oil**

The analysis of 'mean vs. stability' and ideal genotype assessment can be achieved through the GGE biplot pattern. In cases where SVP=1 (single value portioning), the average environment axes (AEA) line will intersect at the biplot's origin (34) reported that the mean of PC1 and PC2 of the environmental scores is defined in such instances. This is demonstrated in Figures 4, 5, and 6 for ash, moisture, and oil, respectively. The arrow sign on the AEC abscissa line indicates the ranking of genotypes with greater trait values. The genotypes which close to the AEC line in the right side are the most stable genotypes for each trait. G2, G3 for ash, G1, G2 and G4 for moisture% and G4 for oil%. The genotypes which located in the left side had lower performance and unstable. G4 for ash, G5, G6 and G7 for moisture and G2 and G3 for oil are not stable and had less mean performance.

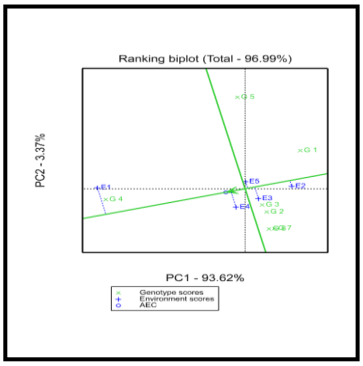


**Figure 4: Mean vs. stability' pattern of GGE biplot for ash**

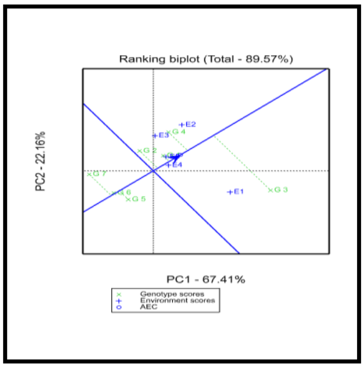


**Figure 5: Mean vs. stability' pattern of GGE biplot for moisture**

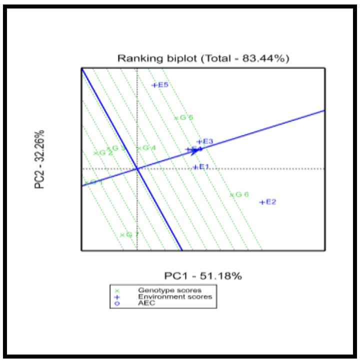


**Figure 6: Mean vs. stability' pattern of GGE biplot for oil**

The GGE biplot ranking genotypes based on the ideal genotype and ideal environment: It is important to the cotton breeder to know both ideal genotype and ideal environment. The ideal genotype should have high stability coupled with higher mean performance and located on the first concentric circle of the biplot. On the other hand, the ideal environment located in the first concentric circle in the biplot, (35). GGE biplot ranking genotypes and environments based on both ideal genotype and ideal environment is presented in Figures 7, 8 and 9 for ash, moisture and oil traits, respectively. The ash trait showed that the ideal genotypes are Giza 86 (G4) for ash trait, Giza 90 (G1) and Giza 95 (G3) for moisture trait and Giza 94 (G5) and Giza 92 (G6) for oil trait. While, the ideal environments were E1 for ash, E2, E4 and E5 for moisture and E1, E2 and E3 for oil trait. The breeder used the ideal genotypes as a benchmark for selection because it had the highest mean performance and good stability under the tested environments and the ideal environment has the highest ability to discriminate the genotypes.

Stability is only significant to farmers when this trait is associated with high mean performance. These results indicate that considering the multi locations data analysis using the GGE-biplot method was more reliable than considering the collected data at each location (33). The GGE-biplot is an excellent analytical data tool for identifying the best genotypes at each environment.

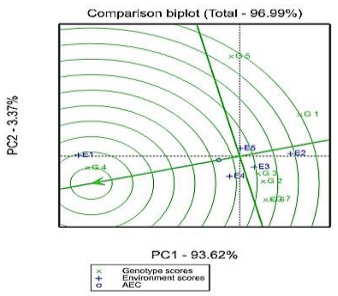


Figure 7: The GGE biplot 'genotypes ranking' pattern for genotype comparison with ideal genotype showing G + G × E interaction effect of seven cotton genotypes under five growing seasons for ash trait

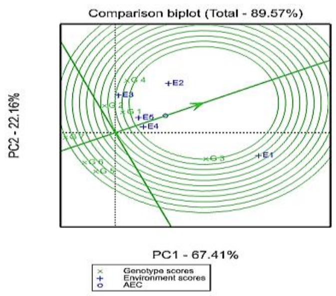


Figure 8: The GGE biplot 'genotypes ranking' pattern for genotype comparison with ideal genotype showing G + G × E interaction effect of seven cotton genotypes under five growing seasons for moisture trait

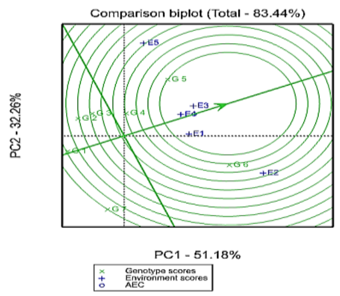


Figure 9: The GGE biplot 'genotypes ranking' pattern for genotype comparison with ideal genotype showing G + G × E interaction effect of seven cotton genotypes under five growing seasons for oil

## CONCLUSION

In the present study, we measured the Stability of some chemical properties of some Egyptian cotton varieties, so for actual results in fiber traits, and cottonseed oil, due consideration may be given the chemical characterization of each cultivars of Egyptian cotton for the future cotton breeding programmers.

The results revealed that all characteristics of Egyptian cotton varieties such as reducing sugar, wax, ash, moisture and seed-oil differed according to all agronomic and agricultural practices done during the five growing seasons. Results indicated that there are some variability in chemical constituents among genotypes in all traits. Most of traits differed significantly from one year to another; genotypes/years interactions were significant for some traits. Last but not least the present investigation provided considerable information that could be useful for cotton breeders, statisticians and agronomists to understand the nature of the relationship between the most important factors affecting of cotton.

## REFERENCES

1- A.O.A.C (2005). Official Methods of Analysis Mehod 945(16) Oil in cereal adjuncts 18th ed AOAC international Gaithersburg, MD.
2- Abdelmoez W.; R. Abdelfatah; A. Tayeb, H. Yoshida (2011). Extraction cottonseed oil using subcritical water technology. AIChE Journal, 57(9).
3- Amer E. A.; El-Hoseiny H.A. and Hassan S. S. (2020). Seed Oil Content, Yield and Fiber Quality Traits in Some Egyptian cotton Genotypes. J. of Plant Production, Mansoura Univ., Vol 11 (12):1469 – 1476.
4- AOAC (1990). Food composition, additives and natural contaminants. In: Official Methods of Analysis. Helrich, K. (ed). Association of Official Analytical Chemists International 2, 15th Edition, Arlington, VA, USA.
5- Arafa S.A. and S.O. Bahlool (2012). The relationship between Egyptian cotton fiber physical and chemical properties and the degree of

deterioration caused by fungal infection. J. Adv. Res., 1, P. 1-15.
6- ASTM- D2495-07., Moisture content and regain of cotton fibers (2019).
7- Azza A. El Aziz M., (1990). Chemical studies on fibers and tarns of Egyptian cotton. Thesis Master of Science, (Agric. Biochem). Cairo Univ.
8- Blanch S. B., G. O. Myers, J. Z. Zumba, D. Caldweel and J. Hayes (2006). Stability comparison between conventional and near-isogenic transgenic cotton cultivars. The Journal of cotton Sience 10:17-28.
9- Conrad C. M. (1944). Determination of wax in cotton fiber, A New Alcohol Extraction Method. Ind. Eng. Chem. Anal. 16: PP.745.
10- Dinesh K. Agarwal and N. Gopalakrishnan (2007), Seed Oil Improvement in Cotton, ICAR, 15-22.
11- Dinesh k. Agarwal, phundan singh.,,mukta chakrabarty, A.J shaikh,S G gayal (2003). Cottonseed oil quality,Utilization and processing . Central institute for cotton research,Nagpur , cicr technical bulletin no: 25 technical bulletin from cicr (www.cicr.org.in) .
12- Donald E. Brushwood (1997). Measurement of Sugar on Raw Cotton by Hplc, Individual Carbohydrate Concentrations and Their Relationship to Stickiness Potential. Cotton Quality Research Station Clemson, SC.
13- Dubois M., Gilles, K.A., Hamilton, J.K, Rebers, P.A., and smith , F. (1956) Colorimetric method for determination of sugars and related substances Analytical chemistry, 28(3),350-356.
14- Eldessouky S. E. I., El-Fesheikawy, A. B. A. and Baker, K. M. A. (2021). Genetic variability and Association between oil and economic traits for some new Egyptian cotton genotypes. Bull. Natl. Res. Cent. 45 (43).
15- Freytag R., Donzé, J.-J., (1983). Handbook of Fiber Science and Technology, Vol. 1, Chemical Processing of Fibres and Fabrics, Fundamentals and Preparation, Part A. Marcel Dekker, NY.
16- Gabriel K. R. (1971). The biplot graphic display of matrices with application to principal component analysis. Biometrika 58: 453-467.
17- Gomez K. A. and A. A. Gomez (1984). Statistical Procedures for Agricultural Research (2nd Ed.). John Wiley & Sons Inc. New York. USA.
18- Jay S. Bancroft, Robert Hutmacher, Larry Godfrey, Peter B. Goodell, Michael McGuire, Paul Funk, and Steve Wrigh(2006). Comparison of Sticky Cotton Indices and Sugar Composition, January Journal of Cotton Science 10(2).
19- Jonn A, High Volume Instrument and Glucose Analysis of Acid Treated, Rinsed, and/or Heated and Autoclaved Cotton Fibers (2005). September Clothing and Textiles Research Journal 22(4):178-184.
20- Mahmoud Azza, A. (1996). Response of Egyptian cotton to chemical modification treatments of fiber and yarn. Ph.D. Thesis, Biochemistry Dep., Fac. of Agric., Cairo University.
21- McCall E. L. and Jurgens, J. F. (1951). Chemical Composition of Cotton. Text. Res. J. 21: 19-21.
22- Mohamed Amal, S., (2003). Defferences in Fiber Contents of the Major Chemical Constituents Due to Variety and Grade of Some Egyptian cotton. Egypt. J. Agric. Res., 81 (2), 659-670.
23- Munawar W., Hameed A., Khan M. K. R. (2021). Differential Morphophysiological and Biochemical Responses of Cotton Genotypes under Various Salinity Stress Levels during Early Growth Stage. Front. Plant Sci. 12:622309.
24- Nasir Mahmood, Muhammad Qamar Tusief, Danish Iqbal, Muhammad Ilyas

Sarwar, Mubashir IslamGill (2022). Yarn quality analysis in non-cellulosic and metal contents of cotton fibre of various locations. Volume 8 Issue 1.

25- Noorullah soomro (2014). Effect of drying methods on quality of cotton fibers before ginning, European Scientific Journal August edition vol.10, No.24.

26- Phillip J. Wakelyn, Noelie R. Bertoniere, Alfred D. French, Devron P. Thibodeaux, Barbara A. Triplett, Marie-Alice Rousselle, Wilton R. Goynes Jr., J. Vincent Edwards, Lawrance Hunter, David D. McAlister, Gary R. GambleCotton Fiber Chemistry and Technology 2006.Edition 1.

27- Shaker S. A. (2017). Evaluation and stability analysis of Egyptian cotton cultivars. Egypt. J. plant breed. 21 (5): 665 – 683.

28- Shaker S. A. (2013). Evaluation and stability parameters of some Egyptian long staple cotton genotypes. Egypt. J. plant breed. 17 (2): 390 – 406. Special Issue.

29- Shukla's G.K. (1977). Some statistical aspects of partitioning genotype – environmental components of variability. Heredity, 29: 237-245.

30- Tesema G.B. and K. Hussein (2015). Comparison of different quantification methods to define fiber quality of Ethiopian. Indian & Egyptian cottons .Int. J. of Fiber and Textile Res., 5 (2): 9-15.

31- Venkatesh I., Bhattiprolu, S. L., Prasadji, J. K. and Rao G. R. (2016). Biochemical analysis of cotton genotypes infected with Alternaria leaf spot disease. J. Cotton Res. Dev. 30 (2) 265-270.

32- Vraj Rabadia, Vrinda S Thaker and Y. D. (2021). SinghRelationship between Water Content and Growth of Seed and Fibre of Three Cotton Genotypes. Journal of Agronomy and Crop Science 183(4):255 – 261.

33- Yan W. (2002). Singular-value portioning biplot analysis of multi-environment trail data. Agron. J. 94: 990-996.

34- Yan W. and I. Rajcan (2002). Biplot evaluation of test sites and trait relations of soybean in Ontario. Crop Sci. 42 (1): 11-20.

35- Yan W. and M.S. Kang (2003). GGE biplot analysis: A graphical tool for breeders, geneticists, and agronomists. CRC Press LLC.

36- Yan W., L. A. Hunt, Q. Sheng and Z. Szlavnics Cultivar evaluation and mega-environment investigation based on GGE biplot. Crop Sci. 40 (3): 597-605 (2000).

37- Yan W., M. Kang; B. Ma; S. Woods and P. Cornelius (2007). GGE biplot vs. AMMI analysis of genotype-by-environment data. Crop Sci., 47: 643-655.

38- Ylhsieh (2007). Chemical structure and properties of cotton” University of California, USA.