STUDY THE CHEMICAL AND TECHNOLOGICAL PROPERTIES OF SOME EGYPTIAN COTTON VARIETIES FERTILIZED WITH THREE DIFFERENT SOURCES OF NITROGEN AND CHEMICALLY TREATED

By

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ABSTRACT

This paper study and evaluate the technological and chemical properties of some Egyptian cotton fibers fertilized by three different compounds as source of nitrogen (Urea, Ammonium nitrate and Ammonium sulphate) and chemical treated (control, scouring and Mercerization). In our study three cotton fibers varieties were used [Giza 93 (Extra long stable), Giza 94 and Giza 95 (Long stable)] for 2019 season. The experimental design was split split-plot design with 3 replicates where nitrogen sources and chemical treated allocated in sub plots the verities were allocated in main plot, while the sub plots involved the nitrogen sources. The cotton fibers samples were subjected to chemical treatment (scouring pretreatment) at concentration 3 % of Sodium hydroxide (NaOH) and mercerization treatment at concentration 20 % of Sodium hydroxide (NaOH) and dying process by direct blue dye. The properties were examined fiber strength (g/tex), elongation %, maturity degree, fineness diameter stiffens and Toughness as (technological properties) and sugar %, wax %, ash %, moisture regain %, accessibility %, crystallinity percent, color strength (K/S) as (chemical properties). The results showed that, ammonium sulphate and mercerized samples were given high level value in technological properties fiber strength (g\tex) ,elongation % naturity degree and fineness diameter. Also, chemical properties were given high level value in moisture regain %, accessibility %, amorphous cellulose, color strength (K/S), toughness, fiber diameter and elongation % while, caused decreases in crystallinity percent, strength (g\tex) and stiffness .

Key word: *Egyptian cotton fibers, nitrogen fertilization, mercerization, dyeing process.*

1. INTRODUCTION

Cotton plays a leading role in the agriculture and industrial economy of the Arab Republic of Egypt. Cotton is characterized by the variation in shape of the fibers, each consisting of a single cell in the form of tube of cellulose which has collapsed, flattened and twisted as it is dried, (Collier, 1974).

Nitrogen is often the most limiting nutrient in agricultural production systems, where N additions are commonly required to achieve maximum yields. During the past century, the use of synthetic N sources have surpassed the use of organic sources (manures and legume rotations) in agricultural systems throughout most of the world (Smil, 2001); as a necessity to feed an increasing population. However, a renewed interest in use of manure has recently occurred due to the increasing cost of synthetic N sources and the need to deal with the large amounts of manure generated by concentrated animal production systems.

Efficient nitrogen (N) management in cotton production is vital in order to attain adequate growth and development. Traditionally, N is provided to cotton plants through soil incorporated fertilizer applications at different stages during the growing season. However, soil incorporated N can experience a series of chemical alterations along with numerous loss mechanisms (leaching, volatilization and denitrification) that can render N unavailable for plant uptake. Furthermore, soil incorporated N has dealt with much inspection over the years for its role in many unfavorable environmental conditions. From early root and vegetative growth to active reproductive development, N is essential in every stage of cotton production and the requirement is substantial. James, 2014.

One alternative includes the use of slow-release N fertilizers that release their N content over a prolonged period of time through semipermeable coatings or by creating N compounds that exhibit varying degrees of resistance to chemical or microbial decomposition.

Ammonium nitrate can be applied directly into the soil surface (Brady and Weil, 2008) and can readily disassociate into NH_4^+ and NO_3^- (Havlin *et al.,* 2005). However, due to national security concerns over its explosive capabilities, NH_4NO_3 usage has declined over the years and is even banned in a number of countries (Mengel and Kirkby, 1987). Ammonium sulfate is relatively easy to manage, can provide an ample supply of sulfur (S) to the plant and significantly decreases soil pH (Brady and Weil, 2008) which can be an asset in high pH soils.

Most recent developments in the cotton fiber properties are related to improvement in physical and chemical properties as well as Dyeability of modified cotton fibers to improve its properties as the demand for this natural fiber cannot be met by any other fiber (Patel 2005). In the fiber there will be progressively more and more randomness in the orientation of the molecules until in some places, there will be little or no indication of order. The ordered regions are known as crystalline and the disordered regions as amorphous. It is the simultaneous presence of both types of regions that gives fibers their unique chemical and physical properties.

Wimonrat *et al.* (2009) stated that, the scouring process represents the first step in the processing of natural fibers. It aims to remove dirt and impurities and preparing the fibers for further processing.

Mercerization of cotton materials increase the hydroscopic of the fiber and improve its dyeability. The structure properties, degree of polymerization and relative availability of (OH) groups are also modified with mercerization, thus increasing the free hydroxyl groups (OH). The change in cellulose physical properties are irreversible when the fibers swell with maximum water absorption; the cross-section of cotton fibers is increased under mercerization which causes swelling and facilitates penetrations of water sorption inside the fibers (Abd elaziz, 2005).

A new theory of mercerization as a physico-chemical change caused by sodium hydroxide solution forming dipole reaction of cellulose of the cotton fiber, and resulting in the formation of hydrogen bonds and salvation of cellulose (Ras, 1963).

It is well known fact that cotton fibers can be considerably modified in term of crystallinity, orientation of crystallites, tensile and mechanical properties by subjecting them to swelling treatments. However, the improvement-produced dose is not entirely the results of changes in crystallinity and orientation, but it could be attributed to the reduction of structure imperfections in cotton fibers during swelling and stretching process.

Orr *et al.*, (1959) stated that has Fiber elongation at break on slack mercerization and mercerization, at the original length, a considerable variation in fiber bundle elongation at break, due to the different varieties of cotton used. And added that, the slack mercerized fibers showed considerably greater elongation. They also added that, the samples with low strength uniformity increase more in strength with slack mercerization than samples with high strength uniformity.

Direct dyes are commonly used on cotton fibers. These dyes are mixed in all purpose dyes along with the acid dyes. The color of direct dyes on cotton fibers is not bright in respect to other dyes. The wash fastness of these dyes is not very good. One more benefit of using direct dyes is that these can be used in the same dye bath with the acid dyes (Alliance Organics LLP, 2014**).**

The present study was planned to study the response of three different genotypes of cotton to different source of nitrogen and chemical treated.

2.MATERIALS AND METHODS
2.1.MATERIALS

Three commercial varieties of Egyptian cotton are: long stable (Giza 94 and Giza 95), and Extra-long stable (Giza 93) were used for the experiments at the Cotton Research institute where. The experimental design was laid out in a split- split plot based on a Randomized Complete Blocks Design arrangement with three replicaes according to Gomez and Gomez (1984). The main plots were assigned to the three cotton genotypes, and different nitrogen sources were allocated to sub-sub plots. Each sub plot consisted of 6 ridges with 3 meter length and 20 cm apart. The sub plot area was 14.4 m^2 treatment included 27 treatment which were the combination of three

genotypes (Giza 93, Giza 94 and Giza 95), three nitrogen sources (urea, ammonium nitrate and ammonium sulphate) and three chemical treated (control, scoring and Mercerization).
Table (1) shows the quality properties for three varieties of Egyptian cotton fibers are used in this study.

2.2.2.2. Mercerization process
The method of Al-Ashwat (1974) for mercerizing was followed. The fibers were immersed in sodium hydroxide 20 %, at room temperature for 2 minutes. This concentration was used because it is used by the industry, and then the Samples were washed with distilled

Table (1): The Egyptian cotton fiber quality properties.

Cotton variety	Color	Value of color		Maturity ratio (MR	Fiber length		Total reducing sugars%	Fiber strength& elongation		Fiber perimeter µ
		Brightness (Rd)	Yellowness (+b)		NHML	Uniformity Index%		Strength (g/tex)	Elongation %	
Giza93	Creamy	66.4	11.5	0.94	37.5	88.1	0.18	49.0	6.4	43.52
Giza94	White	78.9	8.4	0.96	33.5	86.5	0.156	44.4	7.4	48.1
Giza95	Creamy	66.8	11.8	0.95	30.1	85	0.130	37.7	8.3	52.5

2.2. METHODS
2.2.1. Fertilization
Two field experiments were carried out at the first week of April, for two seasons (2017 and 2018) to study the response of the three cotton varieties to fertilization by different nitrogen source in chemical and technological properties. The cotton varieties (Giza 93, Giza 94 and Giza 95) were fertilized with three different sources of nitrogen (three sources *i.e.* urea (46.5 %), ammonium nitrate (NH_4NO_3) (33.5 %) and ammonium sulphate $(NH_4)_2SO_4$ (20.5 %). Nitrogen (N) at the rate of 60 kg N/fed, as recommended, was split in two equal doses and side-dressed before the second and third irrigation from each source of nitrogen. Also, Potassium at the rate of 48 kg K_2O/fed as potassium sulphate was split and side-dressed before the second and third irrigation. On the other hand, Phosphorus was applied at the rate of 30 kg P_2O_5/fed in the form super phosphate (15.5 % P_2O_5) was broadcasted during seed bed preparation in the form of ordinary super phosphate. All other Agricultural practices were applied according to the recommendations of the Agricultural Research and Experimental Station, Faculty of Agriculture, Cairo University, Giza, Egypt for cotton cultivation in the regions.
2.2.2. Chemical Treatments
2.2.2.1. Scouring (pretreatment)
In order to the elimination of non cellulosic material used sodium hydroxide 3 % on weight of fibers (owf) using liquor ratio 1:30 at boiling for 90 min at 100º C. Then washing with hot water and cold water and air dried at room temperature. This method was carried out according to Hebiesh *et al.* (1970).

water. Residual alkali in the fibers was removed by immersion in 1% aqueous hydrochloric acid (HCL) for 5 min.then the samples were dried in an oven at 100º C, for 60 minutes.
2.2.2.3. Dyeing process
The dyeing was carried out at 10 % on weight of fibers (owf) with direct blue dye with 6 % (owf) at 1:50 LR (material to liquor ratio), for 60 min at 50º C at neutral pH. Then salt was added to the dyeing bath in three times, followed by adding the dye solution. Then the temperature was raised to boiling through 15 min, and the dyeing was continued at this temperature for 45 min, finally the dyeing was stopped and the dyeing bath was cooled. Washing off: dyed samples were thoroughly rinsed with running water, then soap with a solution containing 5 g/l nonionic detergent at 70º C for 15 min. and finally, rinsing with water After washing the samples were left to be air dried. (Wang *et al.*, 2007).
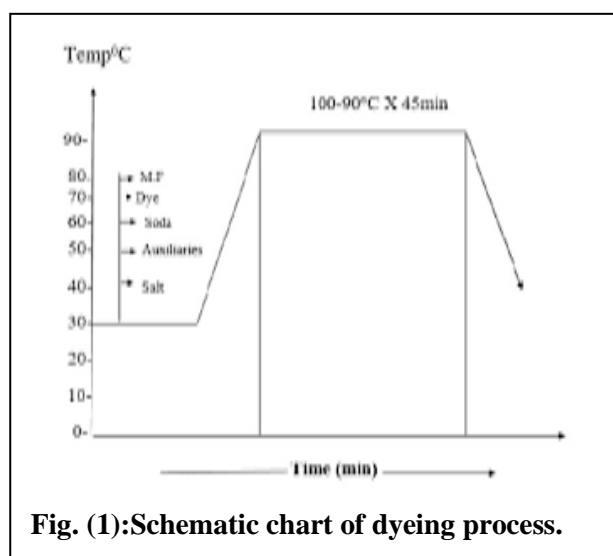

Fig. (1):Schematic chart of dyeing process.

2.2.3. Measurements
2.2.3.1. Technological properties
2.2.3.1.1. Strength and elongation

The tensile strength (g/tex) and elongation (%) were measured by Stelometer instrument at 1/8 inch gauge length according to ASTM D1445- 1967, at the fiber testing Lab., Cotton Research Institute under constant conditions of temperature (70° C ± 2) and relative humidity (65 % ± 2%).

2.2.3.1.2. Fiber maturity and fineness diameter

The Micromat instrument was used to determine micronaire reading, maturity ratio (MR), and fiber fineness and Diameter μ, (ASTM -D; 2818-1982).

2.2.3.1.3. Fiber toughness and stiffness

From the value of flat bundle tenacity and elongation at 1/8 inch gauge length, the flat bundle toughness and stiffness were calculated according to the following equations (Grover and Hamby, 1960):

$$\text{Fiber toughness} = \frac{strength \times elongation\%}{2}$$

$$\text{Fiber stiffness} = \frac{strength}{Elongation\%}$$

2.2.4.Chemical properties
2.2.4.1. Moisture regain %

The moisture regain of fibers was determined according to **A.S.T.M. (1976)** using the oven drying method and was calculated according to the Following equation:

$$\textbf{Moisture regain \%} = \frac{W0 - Wd}{Wd}$$

Where: W0: Weight of specimen as received, Wd: Weight of dry specimen

32.2.4.2. Accessibility %

Accessibility percent was calculated by using the constant values according to Valentine, (1954). Moisture sorption= Moisture regain ×162/1800.
Accessibility % = Moisture sorption × 100/1.53.

2.2.4.3. Cellulose crystallinity %

The use of iodine absorption method to measure crystallinity of cellulose fiber suggested by Schwertassak (1954) was adopted. A cotton fiber or yarn sample of 0.3 g was treated with 2ml iodine solution [5 g iodine and 40 g potassium iodide / 50 ml distilled water]. A volume of 100 ml saturated solution of sodium sulphate was added, and then left in darkness for an hour. The iodine remaining in the solution was determined by titration of 50 ml with N/50 thiosulphate solution to which 50ml distilled water and 1ml starch solution 1 % was added. In the meantime a blank on the original iodine solution was determined in a similar manner. Calculations were made as follows:

$$\frac{(a - b) \times 2.04 \times 2.54}{0.3}$$

Where: a: Volume (ml) of thiosulphate solution for blank
b: Volume (ml) of thiosulphate solution required for a cotton samples.

A ratio of ml of iodine adsorbed per g of cellulose gave a value for the amorphous fraction of cellulose; fiber crystallinity was obtained by subtracting the amorphous fraction percent from 100.

2.2.4.4. Sugar % and wax %

The following method of Conrad (1944) was used for the determination of total wax and total soluble sugars in cotton fiber:

Place 5g. of well-cleaned fiber in a coarse timble in large soxhelts, then 250 ml of 95 % ethanol was added, continue the extraction for 6 hours, replace condenser and continue until ethanol has passed over and only 75-85 ml of liquid remain in extraction flask, then add 100ml of reagent grade chloroform to the seperatory funnel and mix. This should give a completely homogenous solution. Now add to mix 75ml water to cause mixing and separation two layers. Remove the chloroform from wax by evaporating, after the wax residue appears to be dry, cool and weight the beaker, the wax content. The levels of extraction consist of total soluble sugar measured according to (Smith *et al.,* 1956) by using phenol/ sulphric acid method.

2.2.4.1. 5. Ash %

The ash of fibers was determined according to A.A.T.C.C. (1994). Using the oven drying method and was calculated according to the following equation:

$$\textbf{Ash} = \frac{Wa - Wb}{Wo - Wb}$$

Wa: weight of sample and gait before dried, Wb: weight of sample and gait after dried, and Wo: weight of gait before dried

2.2.4.1.6.Color strength (K/S)

The reflectance value of a specimen for the wave length of 400nm–700nm using spectrophotometer (Lambda 35, Perkin-Elmer, USA). The measurement was performed in accordance to Trotman, 1984. Using CIE color system coordinates. By using this reflectance value into the Kubelka Munk's equation color strength (K/S) can be determined using (Kubelka–Munk equation)

$$K/S = \frac{(1-R)^2}{2R}$$

Where, R=Reflectance of an incident light from the dyed material, K=Absorption, and S= Scattering coefficient of the dyed fabric.

Statistical analysis

Data were conducted statistically analyzed according to procedures out lined by Sendecor and Cochran (1981). The least significant differences (L.S.D) test at 50 % level of significant was used to compare treatment means.

3. RESULT AND DISCUSSION

The data concerning the effect of chemical modification on technological (mechanical and physical) and chemical properties of three fertilized Egyptian cotton varieties by three different sources of nitrogen is discussed below.

3.1. Mechanical Properties:

3.1.1. Strength (g/tex) and Elongation (%)

The results in Table (2) cleared that, there were significant differences among the three genotypes, nitrogen sources and chemical treatment in strength and elongation %. Giza 93 fertilized with ammonium sulphate with control chemical treated was superior in strength while Giza 93 with ammonium sulphate with scouring chemical treated was superior in strength, and Giza 93 with ammonium sulphate and mercerization treated recorded the best value in Elongation %. Fiber strength is the force required to break a standard bundle of cotton

fibers. Strength measurements are reported in g /tex. Table (2) showed that, the mechanical properties obtained for fiber tensile strength (g/tex) and elongation %. Scouring and mercerization treatment led to a clear decrease in fiber strength which might be attributed mainly to the increase in spiral angle of the fiber due to its swelling De Boer, 1973).

On the other hand, it was found that slack mercerization of fibers caused a higher increase in elongation %. This increase may be attributed to various factors including, the decrease in crystallinity of cellulose, the increase in the spiral angle, and the removal of morphological weak points in the structure of the fiber (Orr *et al.,* 1959). Fertilizer N sources effects on fiber strength were highly variable. It is interesting to note that fiber strength with ammonium sulphate (AS) was highest and Urea (U) lowest, whether this was due to differences in varieties, environment or their interaction among years cannot be determined. Regardless of this variation in treatment effects among years, all strength measurements fell into the base or strong range and therefore would not have affected cotton value (Dexter *et al.,*2014).

3.1.2. Toughness (g/tex) and Stiffness (g/tex)

The result in Table (3) showed that there were significant differences among the three genotypes, nitrogen sources and chemical treatment in toughness (g/tex) and stiffness (g/tex) where as Giza 93 fertilized with ammonium sulphate with control chemical

Table (2): Strength and elongation of cotton fiber as affected by the interaction among cultivars, nitrogen sources and chemical treatments.

Treatments		Strength (g/tex)			Elongation %		
Cultivars (A)	Nitrogen Sources (B)	Chemical Treatments (C)			Chemical Treatments (C)		
		Control	Scouring	Mercerization	Control	Scouring	Mercerization
Giza 93	**Urea (U)**	32.66	30.74	28.18	6.21	8.17	11.51
	Ammonium Nitrate (AN)	32.94	31.46	29.34	6.97	8.30	11.69
	Ammonium Sulfate (AS)	34.78	33.02	30.78	7.26	8.81	12.04
Giza 94	**Urea (U)**	28.77	26.94	24.75	6.20	7.87	10.83
	Ammonium Nitrate (AN)	29.48	27.66	25.36	6.57	7.95	11.23
	Ammonium Sulfate (AS)	30.07	28.69	26.38	6.58	8.25	11.81
Giza 95	**Urea (U)**	26.74	24.39	22.46	6.07	7.42	11.77
	Ammonium Nitrate (AN)	27.08	24.98	22.91	6.13	7.44	10.36
	Ammonium Sulfate (AS)	27.65	25.64	23.88	6.17	8.52	10.38
L.S.D0.05 (A×B×C)		0.71			0.68		

Table (3): Toughness and stiffness of cotton fiber as affected by the interaction among cultivars, nitrogen sources and chemical treatments.

Treatments		Toughness (g/tex)			Stiffness (g/tex)		
Cultivars (A)	Nitrogen Sources (B)	Chemical Treatments (C)			Chemical Treatments (C)		
		Control	Scouring	Mercerization	Control	Scouring	Mercerization
Giza 93	Urea (U)	101.41	125.57	162.18	5.26	3.76	2.45
	Ammonium Nitrate (AN)	114.80	130.56	171.49	4.73	3.79	2.51
	Ammonium Sulfate (AS)	126.25	145.45	185.30	4.79	3.75	2.56
Giza 94	Urea (U)	89.19	106.01	134.02	4.64	3.42	2.29
	Ammonium Nitrate (AN)	96.84	109.95	142.40	4.49	3.48	2.26
	Ammonium Sulfate (AS)	98.93	118.35	155.77	4.57	3.44	2.23
Giza 95	Urea (U)	81.16	90.49	116.57	4.41	3.29	2.16
	Ammonium Nitrate (AN)	83.00	92.93	118.67	4.42	3.36	2.21
	Ammonium Sulfate (AS)	85.30	95.23	127.35	4.48	3.01	2.03
L.S.D0.05 (A×B×C)		1.24			0.22		

treated superior in toughness, while Giza 93 was ammonium sulphate with scouring chemical treated was superior in toughness (g/tex) and stiffness (g/tex), and Giza 93 with ammonium sulphate and mercerization treated scored the best value in toughness (g/tex) and stiffness (g/tex). The results of fiber toughness of the investigated cotton varieties mercerized as well as the achieved increase as percentage of the control are shown in Table (3). Mercerization process increased fiber elongation as a whole and fiber strength in few cases, (Kamal 1980).It can be concluded that fiber stiffness decreases as a result of mercerization process, (Ahmed 1981).

3.2. Physical Properties:

3.2. I. Fiber diameter and maturity %

Data in Table (4) reported that there were significant differences among the three genotypes, nitrogen sources and chemical treatment in fiber diameter and maturity %, where Giza 93 fertilized with ammonium sulphate treated with control chemical was superior in toughness while Giza 93 with Ammonium sulphate treated,with scouring chemical was superior in fiber diameter and maturity %, and Giza 93 treated treated with ammonium sulphate and mercerization scored the best value in fiber diameter and maturity %,

Table (4) shows fiber fineness diameter that chemical modification scouring and mercerization result in increase in fiber diameter due to removing the outer wax layer of the cotton fiber, while fiber maturity showed that a decrease. This could be due to the swelling of fibers in NaOH which caused increase in spiral angle, and partially to the decrease in crystallinity, (Lawson *et al.,* 1979, Shereen and Heba, 2019).

3.3.Chemical Properties:

3.3.1. Mositure regain% and Accessibility %

The data in Table (5) indicated that the mercerization process caused an increase in moisture regain % from 6.78 to 8.87 for Giza 93, from 6.80 to 9.06 for Giza 94, and from 6.77 to 9.13 for Giza 95 with (ammonium sulphate) treatment. This may be due to the changing in the structure of cellulose in cotton fibers and increase the percentage of amorphous cellulose and also increasing the free hydroxyl groups (OH) which attract the water molecules. (Abdel-Aziz, 2001 and Abdel-Aziz (2015). Also, Mercerization process caused an increase in accessibility % for all Egyptian cotton varieties. Because increase in amorphous cellulose, regains due to decrease in crystallinity present so increasing the free hydroxyl groups (OH) due to increase accessibility %.

Table(4): Fiber diameter and maturity of cotton fiber as affected by the interaction among cultivars, nitrogen sources and chemical treatments.

Treatments		Diameter μ			Maturity %		
Cultivars (A)	Nitrogen Sources (B)	Chemical Treatments (C)			Chemical Treatments (C)		
		Control	Scouring	Mercerization	Control	Scouring	Mercerization
Giza 93	Urea (U)	16.44	16.89	17.51	75	69	63
	Ammonium Nitrate (AN)	16.53	16.78	17.78	77	70	65
	Ammonium Sulfate (AS)	16.61	16.90	17.83	80	75	70
Giza 94	Urea (U)	16.60	16.48	17.34	70	67	60
	Ammonium Nitrate (AN)	16.49	16.73	17.53	74	70	65
	Ammonium Sulfate (AS)	17.35	17.96	18.32	75	73	68
Giza 95	Urea (U)	17.16	17.90	18.63	69	65	60
	Ammonium Nitrate (AN)	17.54	17.94	18.65	70	70	65
	Ammonium Sulfate (AS)	17.82	18.11	18.83	73	72	68
L.S.D0.05 (A×B×C)		0.28			0.14		

be due to variety and grade of some

Table (5):Moisture regain% and accessibility of cotton fiber as affected by the interaction among cultivars, nitrogen sources and chemical treatments.

Treatments		Moisture Regain %			Accessbility %		
Cultivars (A)	Nitrogen Sources (B)	Chemical Treatments (C)			Chemical Treatments (C)		
		Control	Scouring	Mercerization	Control	Scouring	Mercerization
Giza 93	Urea (U)	6.26	7.08	8.62	36.82	41.65	50.71
	Ammonium Nitrate (AN)	6.56	7.18	8.68	38.59	42.24	51.06
	Ammonium Sulfate (AS)	6.78	7.81	8.87	38.88	42.94	50.18
Giza 94	Urea (U)	6.30	7.59	8.55	37.60	44.65	50.29
	Ammonium Nitrate (AN)	6.74	7.76	8.91	36.65	45.65	52.41
	Ammonium Sulfate (AS)	6.80	7.97	9.06	39.11	44.88	50.29
Giza 95	Urea (U)	6.24	7.31	8.33	38.71	43.00	51.94
	Ammonium Nitrate (AN)	6.63	7.50	9.00	39.44	43.12	50.90
	Ammonium Sulfate (AS)	6.77	7.63	9.13	39.40	43.22	51.71
L.S.D0.05 (A×B×C)		0.22			N.S		

3.3.2. Wax%, Sugar% and Ash.

The typical mature cotton fiber contains about 0.6 % wax where most of the values reported in the literature ranged between 0.4 and 1.3 % (Rollins, 1965). The differences in fiber content of the major chemical constituents may be due to variety and grade of some Egyptian cotton . However, Giza 83 variety attained the highest value of total reducing sugar, while Giza 80 gave the highest values of both wax and ash content. (Amal, 2003). The pedegree of Giza 95 was: Giza 95 (Giza83 × (Giza75×5844) × Giza 80). (Table (6).

Table (6): Wax, sugar and Ash of cotton fiber as affected by the interaction among cultivars, nitrogen sources and chemical treatments.

Treatments		Control			K/S	
Cultivars (A)	Nitrogen Sources (B)	Chemical Treatments (C)			Chemical Treatments (C)	
		Wax%	Sugar%	Ash%	Scouring	Mercerization
Giza 93	Urea (U)	1.58	0.13	0.993	3.1	4.2
	Ammonium Nitrate (AN)	1.50	0.12	0.992	4.5	5.1
	Ammonium Sulfate (AS)	1.60	0.13	0.991	4.8	5.7
Giza 94	Urea (U)	1.60	0.16	0.993	1.2	2.8
	Ammonium Nitrate (AN)	1.70	0.16	0.990	1.4	3.0
	Ammonium Sulfate (AS)	1.66	0.17	0.992	3.0	3.4
Giza 95	Urea (U)	0.80	0.14	0.996	1.9	2.6
	Ammonium Nitrate (AN)	1.91	0.14	0.991	2.5	3.7
	Ammonium Sulfate (AS)	1.70	0.15	0.994	2.8	3.9
L.S.D0.05 (A×B×C)		0.56	N.S	0.33	0.23	

3.3.3. Cellulose Crystallinity %.

Data in Table (7) cleared that there were significant differences among the three genotypes, nitrogen sources and chemical treatment in the ratio of amorphous regains, whereas Giza 93 fertilized with ammonium sulphate with control chemical treated was superior in toughness while Giza 93 with ammonium sulphate with scouring chemical treated was superior in the ratio of amorphous regains, and Giza 93 with ammonium sulphate and mercerization treated scored the best value in the ratio of amorphous regains. The results show that, scouring and mercerization process caused a decrease in cellulose crystallinity %. It could be noticed that, mercerization decreased, in general, the crystallinity % of cotton fibers. This reduction results lead to increasing the ratio of amorphous regains, (Morton and Hearle, 1975).

Table(7): cellulose crystallinity of cotton fiber as affected by the interaction among cultivars, nitrogen sources and chemical treatments.

Treatments		Amor.			Cryst.		
Cultivars (A)	Nitrogen Sources (B)	Chemical Treatments (C)			Chemical Treatments (C)		
		Control	Scouring	Mercerization	Control	Scouring	Mercerization
Giza 93	Urea (U)	8.6	15.5	29.7	91.4	85.5	70.3
	Ammonium Nitrate (AN)	7.8	13.9	29.2	92.2	86.2	71.0
	Ammonium Sulfate (AS)	6.9	12.1	28.5	91.1	86.1	71.5
Giza 94	Urea (U)	10.0	18.9	33.3	90.0	81.1	69.7
	Ammonium Nitrate (AN)	9.2	18.1	31.1	90.8	81.9	68.9
	Ammonium Sulfate (AS)	8.6	17.3	30.4	90.4	84.7	68.6
Giza 95	Urea (U)	10.7	16.9	36.3	89.3	84.1	66.7
	Ammonium Nitrate (AN)	11.1	14.6	35.7	89.9	84.4	66.3
	Ammonium Sulfate (AS)	10.4	19.0	34.5	89.6	81.1	66.5
L.S.D0.05 (A×B×C)		0.49			N.S		

Amor. =Amorphous cellulose   Cryst. = Crystallinity cellulose

The chemical structure and microstructure of cotton fibers have significant influence on the properties of the fibers, as cotton fibers consist of almost cellulose which has a crystalline/amorphous micro-fiber structure. Elementary fibrils are built from ordered crystallites and less-ordered amorphous regions statistically alternated along the fiber. The ratio between crystalline and amorphous areas strongly influences the characterizes stics of cotton fiber (Yatsu *et al.,*1986; Nikolić *et al.,* 2011).

CONCLUSION

Nitrogen is the most essential nutrient needed to optimized crop yield and economic return. However, N use efficiency of most fertilizer is just 30 to 50%. The different cotton varieties showed differential response to chemical treatments as mercerization process is an important operation which causes disorientation of non-crystalline chains and, therefore, influences the crystallinity proportion decrease, together with the amorphous regions increase and dyeability of dyeing process. It is considered as an irreversible reaction. These results are very important for the cotton breeder and the finishing textile industry.

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دراسة الصفات الكيميائية و التكنولوجية لبعض أصناف القطن المصرى المسمدة بثلاث مصادر مختلفة للنيتروجين والمعاملة كيميائياً

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ملخص

يدرس هذ البحث تقييم الصفات التكنولوجية و الكيميائية لبعض ألياف القطن المصرى المسمدة بثلاث مركبات مختلفة كمصدر للنتروجين (اليوريا ، نترات الأمونيوم وكبريتات الألومنيوم)و المعالج كيميائيا (كنترول، الغلى، المرسرة). فى دراستنا نستخدم ثلاثة أصناف من القطن المصرى (جيزة93 (فائق الطول) جيزة 94 ، جيزة 95 (طويل)) موسم 2019. كان تصميم التجربة هو تصميم القطع المنشقة فى 3 مكررات حيث كانت الصناف فى القطع الرئيسية ومصادر النتروجين فى القطع المنشقة الأولى والمعاملات الكيميائية فى القطع المنشقة الثانية.تعرضت عينات ألياف القطن إلى معاملات كيميائية (الغلى معاملة أولية) عند تركيز 3% هيدروكسيد صوديوم ومعاملة المرسرة عند تركيز 20% هيدروكسيد صوديوم و عملية الصباغة بالصبغة المباشرة الزرقاء. الصفات التى يتم فحصها هى المتانة (جرام/تكس)، الإستطالة%، درجة النضج وقطر الشعرة ومعامل إمتصاص الجهدToughies ومعامل الصلابةStiffness(صفات تكنولوجية)، نسبة السكر % ، نسبة الشمع %، نسبة الرماد%، الرطوبة المكتسبة %، درجة النشاط الكيميائى %، درجة عمق اللون (K/S) (صفات كيميائية).

أظهرت النتائج أن العينات المرسرة والمسمدة بنترات الأمونيوم أعطت أعلى قيمة فى الصفات التكنولوجية (المتانة جرام/تكس، الإستطالة %، درجة النضج وقطر الشعرة)، كما أعطت أعلى قيمة فى الرطوبة المكتسبة (درجة النشاط الكيميائى، نسبة السليلوز الغير متبلور، درجة عمق اللون و معامل إمتصاص الجهد Toughies وقطر الشعرة والإستطالة ، بينما سببت إنخفاض فى نسبة التبلور ، المتانة ، معامل الصلابةStiffness.