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Anomalies in the Textile Exchange Organic Cotton Market Report 2022 Indicate Continued Fraud is Likely

Townsend, Statistician, DNFI

Email: terry@cottonanalytics.com

The organic cotton industry has repeatedly been roiled by a circus of fraudulent certification claims, and the rise in price premiums during 2020 and 2021 created incentives that probably exacerbated the problem. The most recent report from the Textile Exchange for organic cotton certified area and production during 2020/21 (Organic Cotton Market Report, October 2022 (OCMR)) contains numerous anomalies that should raise suspicions.

All agriculture was essentially organic until the end of WWII, and organic production systems are as legitimate as any other. Organic can be an appropriate production system, especially for resource-poor small holders, and the more cotton that is produced around the world, the better.

The problem with organic is that advocates over-promise by claiming benefits that do not occur. Organic production systems are systematically lower-yielding, labor requirements are systematically greater, and environmental benefits are transitory at best. There is not a single major agricultural university anywhere in the world that recommends wholesale adoption of organic production methods by commercial growers.

The main benefit farmers receive from producing organic cotton is price premiums. This creates an incentive for farmers to use higher-yielding conventional means to grow cotton, and then for someone along the value chain, perhaps the farmer, or a gin, a merchant, or spinner to get it certified as organic.

Statistics on certified organic area devoted to cotton and organic fibre production are contained in the most recent OCMR. Yields calculated from the published data indicate that fraudulent practices increased during 2020/21. According to the Textile Exchange, world production of certified organic cotton rose 37% from 249,153 tonnes in 2019/20 to 342,265 tonnes in 2020/21.

In eight countries accounting for 307,214 tonnes of 2020/21 production (90% of the world total), yields for organic cotton were equal to or higher than overall yields in each country.

Farmers producing crops using certified organic methods have fewer tools to enhance soil fertility, protect crops from pests, control crop growth or defoliate prior to harvest. (Conventional farmers can use any agronomic practice that works, including organic practices, but organic farmers are limited to using only practices permitted under organic certification schemes.)

Therefore, almost by definition, yields in organic agriculture will be lower than yields achieved by conventional farmers. If farmers could really achieve improved yields using organic production methods, all of them would do so. The outcomes reported by the Textile Exchange for 2020/21 are not only unlikely, they are literally, not figuratively, unbelievable. The Textile Exchange reports that Kazakhstan produced 14,893 tonnes of organic cotton on 8,865 certified hectares in 2020/21, for a yield of 1,680 kilograms per hectare. The yield for all cotton in Kazakhstan in 2020/21 was 634 kilograms

2020/21 Organic Cotton Production & Yields					
Source organic production and area: Organic Cotton Market Report 2022					
Source: total yields, International Cotton Advisory Committee					
	Organic Fibre Tons	Certified Hectares	Kgs/Ha Organic	Kgs/Ha Total	Pct. Organic/Total
Kazakhstan	14,893	8,865	1,680	634	265%
Tajikistan	13,648	9,806	1,392	540	258%
Kyrgyzstan	30,945	21,423	1,444	860	168%
India	130,849	230,125	569	433	131%
Egypt	437	404	1,082	833	130%
China	33,687	15,727	2,142	1,892	113%
Pakistan	1,925	3,098	621	600	104%
Turkey	80,830	43,329	1,865	1,827	102%
Total Above	307,214	332,777			
Peru	694	1,086	639	827	77%
Uganda	2,551	7,940	321	430	75%
Greece	1,827	2,284	800	1,121	71%
Uzbekistan	465	1,035	449	692	65%
Argentina	2.0	5	400	693	58%
USA	5,821	12,035	484	918	53%
Benin	1,893	8,199	231	480	48%
Ethiopia	60	174	345	745	46%
Spain	26	54	481	1,046	46%
Burkina Faso	647	4,035	160	349	46%
Tanzania	20,932	235,992	89	220	40%
Mali	63	1,486	42	432	10%
Brazil	70	14,591	5	1,719	0%
World Total	342,265	621,693			

The yield for all cotton in Kazakhstan in 2020/21 was 634 kilograms per hectare (International Cotton Advisory Committee, November 2022), meaning that the organic yield was 265% of the total yield.The organic cotton yield in Tajikistan, calculated from the TE report, was 258% of the national yield, Kyrgyzstan, 168%.

Kazakhstan, Tajikistan and Kyrgyzstan accounted for 59,486 tonnes of organic cotton production in 2020/21, and their weighted average yield was 1,491 kgs/ha. Meanwhile, Uzbekistan reported an organic cotton yield of 449 kgs/ha, which was about two-thirds of its national yield. It is not believable that yields in three neighboring Central Asian countries exceeded the yield in Uzbekistan by that degree.

India is the largest producer of organic cotton in the world accounting for 38% of the 2020/21 world total. The Textile Exchange reports that

India produced 130,849 tonnes of organic cotton fibre on 230,125 organic certified hectares in 2020/21, indicating a yield of 569 kgs per hectare. The national yield in India for all cotton was 433 kgs per hectare that season, putting the organic yield 31% above the national yield.

India is a big country with a range of agronomic conditions, and if organic cotton were grown only in certain areas tailored to organic production methods, a yield above the national average might be possible. However, organic cotton in India is grown in the same regions as conventional cotton, and all cotton producers face the same challenges with pest pressure and maintenance of soil fertility.

The Textile Exchange itself had reported in its previous Organic Cotton Market Report 2021 that growth in India would occur in 2020/21 because higher prices would lead existing producers to dedicate a larger share of their certified organic land to growing cotton versus other crops. In other words, organic cotton production did not rise in 2020/21 under the influence of particularly advantageous zones of growth or new varieties or any other specific factor that would explain a yield above the national average.

Rather, the increase in Indian organic cotton production in 2020/21 was a simple result of expanded area by established producers, and it is just not realistic to think that Indian farmers producing cotton organically can achieve higher yields than farmers using conventional practices. If they could, all farmers in India would have switched back to organic practices years ago, and the world would be awash in millions of tonnes of organic cotton.

Turkey is the second largest producer of organic cotton, and the Textile Exchange reports that Turkey produced 80,830 tonnes of organic cotton on 43,329 hectares in 2020/21, for a yield of 1,865 kgs/ha, just a bit above the national yield. While the yield result is questionable, it is possible because of the unique agronomic conditions in the GAP region of Eastern Turkey.

Nevertheless, organic cotton production in Turkey is worth flagging because of the implications for irrigation water use. All cotton in the GAP region of Turkey is irrigated, along with all cotton in Central Asia. The increase in organic production in those countries undermines the claim by the Textile Exchange that organic cotton uses less irrigation water on average than conventional cotton.

China is reported to have produced 33,687 tonnes of organic cotton fibre in 2020/21 with an average yield 13% above the national yield. Like India, China grows cotton in many regions with a wide range of agronomic conditions, and it might be possible to achieve high yields on small areas with special conditions that favor organic production. However, organic cotton is grown in China in Xinjiang, Gansu, Hubei, and Shandong, the same regions where all cotton production occurs. Almost all cotton in China carries biotech traits (GMO) because of heavy pest pressure, and organic farmers in China do not have access to many tools of plant protection that conventional farmers have. Therefore, it is not realistic to believe that yields achieved by organic cotton farmers in China exceed the average yields achieved by conventional growers by 13%. If they did, all farmers would switch to organic methods.

Egypt and Pakistan also reported organic yields higher than the national results, but each produced only a small amount of organic cotton in 2020/21, and so differences between yields of organic and conventional cotton can be explained as small-sample results.

The Textile Exchange reports in the text of its report that their confidence in the statistics reported by the certification agencies is low in many instances, and that some estimates had to be interpolated from incomplete government reports. Nevertheless, the Textile Exchange published the data, confident that most brands and retailers will ignore the details and just grab onto the headline numbers in support of their consumer-facing marketing programs.

Given that organic products themselves cannot be directly certified, rather it is the land and production methods used in organic agriculture that are certified, it follows that statistics on certified organic cotton area are probably fairly accurate. However, many organic farmers also have land that is not certified organic on which they grown conventional crops, and it would not be difficult for an organic farmer to gather seed cotton from different fields and call it all organic.

Further, once seed cotton is taken in loose form from the farm to be ginned, co-mingling can easily happen. Heaps of seed cotton are often co-mingled in market yards, in the backs of trucks on the way to gins, in storage yards at gins, and seed cotton can be co-mingled as it moves through the gin. Given that price premiums are paid for organic cotton, the incentive always is to label conventional cotton that has been co-mingled with organic cotton as organic, never the other way around. That is how you get impossibly high yields for organic cotton production.

We all respond to incentives. Price premiums for organic cotton rose during 2020 and 2021, and sure enough, claims of organic cotton production rose with them.

Comparative Study of Cotton Fibre and Yarn Quality Ginned on Both Reciprocating and New Rotary Roller Gin-Stand

Ibrahim, A. E.[1], M. A. M. Negm[2] Aly A. A. El-Banna,[1]. and R.M. K. Ibrahim[3]

[1]Faculty of Agriculture., Saba Basha, Alexandria Univ. Alexandria, Egypt
[2]Cotton Research Institute, Agric. Res. Center, Giza, Egypt
Eastern Company for Cotton Export, Cotton and Textile Industries Holding Company, Egypt.
* Crosponding Auothor : mohamed.negm@arc.sci.eg

Abstract

Egyptian Government has a policy objective to restore Egypt's position as the world's leading or among the world's leading producers of fine has demonstrated that an ambitious program of the development of fine cotton output is a realistic objective. The Cotton and textile industries Holding Company "HC" has an important part to play in achieving the policy objective. First, it is the Holding Company's responsibility to provide the sector with ginning capacities that separate lint from the annual seed cotton output to the highest quality standards. Second, the HC has a role also to play in contributing with other responsible government agencies in the policy programs to promote cotton agriculture and the enabling mechanisms to assist and incentivize farmers to grow more cotton. The current research paper was carried out at New Fayyoum Gin-plant "Rotary knife, Bajaj Continental" and Old Fayyoum Gin-plant "Single roller Gin Stand in both Giza 95 cotton varieties grown in Upper Egypt and Giza 94 cotton variety grown in Delta Egypt. Fibre quality, seed coat fragments, contaminations, and the number of neps were compared with both ginning types.

Therefore, it is important to conclude that the rotary gin-stand reduces the trash content, impurities, and short fibres in cotton lint and consequently, the waste percentage in blowroom . High productivity, which resulted in maintenance of the fibre quality despite an increase in the number of neps. Hence, it is preferable to redraw the policy of ginning in Egypt to develop the ginneries sector with rotary gins equipped with seed-cotton and lint cleaners.

Keywords: Ginning technology, reciprocate gin, Rotary gin, fibre, and yarn quality.

Background

Almost all Egyptian cotton is extra fine cotton classified as Long-Staple or Extra Long Staple (ELS). The government intends to implement policies that will restore Egypt's position among the world's leading producers of LS and ELS. The country's installed ginning capacity to process the cotton crop that is aged and technically obsolete does not permit the processing of raw cotton to high quality and efficiency standards. In parallel with agricultural policies to promote regeneration of cotton production, a pre-condition of restoring Egypt's leadership position in fine cotton will be therefore the installation of new ginning and processing plants to replace the current inadequate facilities. The Holding Company's ginning subsidiaries are involved also in cotton exporting and domestic cotton trading activities. However, this ginning technical diagnostic concentrates on the physical processing of the cotton crop. It addresses the status of the Holding Company's ginning facilities against criteria for quality and efficient processing and indicates the configuration of facilities and the ginning technologies and capacities required to fulfill the objective of restoring Egypt's position as a leading fine cotton producer.

There are 25 ginneries in the three subsidiaries. There has been no capital replacement program for 40 years and the ginning park is antiquated between 40- and 140-year-old. All the ginneries are using the basic same model roller gins that are technically obsolete and with yield and production rates a fraction of modern standards, high energy consumption, and critically important low ginning performance. The ginned lint contains contaminants, residual trash, and the ginning process damages the lint quality. The ginneries have no mechanical handling of cotton to the gins, no pre-cleaning or post-ginning cleaning, there is no moisture measurement or control and the ginneries do not have laboratories for fibre testing. Human contact with seed cotton and lint due to manual handling increase the risk of contamination.

Most of the ginneries work one or two shifts per day and starting and stopping a gin requires the use of more electric power consumption. McCarthy roller gin gained worldwide acceptance during the late 18th century and early 19th century and continued to be in extensive use in many countries among them Egypt. Its ginning capacity, however, remained relatively low, about 30Kg of lint per hour. The rotary knife-gins have virtually eliminated the use of McCarthy gins in the USA. In Egypt, The Cotton and Textile Industries Holding Company installed new four ginning mills equipped with Bajaj Continental machine and complete fibre laboratory fitted with HVI instrument. Due to the importance of cotton ginning in Egypt, the Cotton and Textile Industries Holding Company, in its effort to continuously improve the Egyptian cotton competitiveness in world markets, will install a new three rotary gin plants to cover all areas of cotton production, as a start point for the development of the textile sector in Egypt. Further work is necessary to better define the quality effect of ginning type "conventional reciprocating and rotary-knife gin-stand" on lint out-turn, fibre properties of two Egyptian cotton varieties. Sharma (2008) stated that the sole purpose of all ginning technology developments is to obtain optimum fibre parameters at the lowest cost. The main objectives of the development in cotton ginning technologies are (to obtain the maximum length of fibre on seed without breakage, to preserve inherent qualities of fibre, to obtain undamaged clean seed, to obtain lint-free of trash and contaminants, and with the lowest cost per unit of ginning. Therefore, cotton ginning technology should be such which is adjustable for different varieties of cotton and compatible with various practices, such as machine picking, manual picking, etc. Moreover, volumes of cotton available at different places vary; hence the technologies should have capabilities to provide optimum output at the lowest cost for different needs of higher or lower volumes available.

Van der Sluijs (2015) compared the impact of saw and roller ginning on Long Staple Upland cotton variety. There was a significant difference between the two ginning methods in some of the average fibre results, with the roller ginned fibre longer and more uniform with fewer short fibre and fibrous neps, as well as stronger with higher elongation with slight but significantly smaller seed coat, nep, and total trash size. By the roller gin increasing the lint out- turn except for bundle strength and increasing the micronaire values.

Delhom *et al*. (2017), studied new Upland cultivars processed by both saw and roller ginning. Four diverse Upland cultivars were processed by saw ginning and high-speed roller ginning and analyzed by ginning method. Results overall showed that the roller gin, when compared to the saw/ gin, produced staple length longer, higher length uniformity, and less short fibre, and contained 25% fewer neps. The overall objective of the research reported here was intended to determine the practical benefits that Rotary roller ginning Egyptian cotton delivers to a textile mill. Specific objectives were: (1) to compare the differences in fibre quality due to Rotary "high-speed roller ginning or Macarthy reciprocating ginning using two cultivars of Egyptian cotton; (2) to highlight the textile processing differences of Rotary and conventional roller-ginned cotton for both carded and compact ring-spun yarn production.

Results and Discussion

Lint out-turn and gin-stand capacity and lint grade

The two methods of ginning were exerted a significant difference at 0.05 probability levels on the lint out-turn. The reciprocating ginned lint of Giza 94 showed a significant increase in lint out-turn of 2.32% more than rotary ginned lint (38.73% and 36.41% respectively). The reciprocating ginned lint of Giza 95 showed a significant increase in lint out-turn of 2.25% more than rotary ginned lint (39.38% and 37.13% respectively). The relatively higher value of lint out-turn for reciprocating ginned cotton compared with rotary ginned could be explained by the fact that roller ginned lint has extra materials composed primarily of foreign matter, non-lint content, aborted seed motes, and short fibres. The decrease in lint out-turn due to cleaning machinery in the rotary gin plant system could be probably, ascribed to the removal of stones, trashes, unopened immature seed cotton locks during seed-cotton cleaning, in addition to the removal of a proportion of immature fibres during lint cleaning. Regarding gin-stand capacity, both ginning methods significantly affected the gin-stand capacity at a 0.05 probability level. The capacity of the McCarthy roller gin is almost 31 Kg/h, while the capacity of the rotary knife is 400 kg/h.

The composite Giza 95 and Giza 94 seed-cotton, regardless of ginning treatment, had a similar grade namely “Good”, but in the case of the lint cotton ginned on reciprocating knife gin-stand, the grade was Good +3/16 for each variety. While, in the case of lint ginned on rotary gin-stand, lint cotton was Good+7/16 for each of varieties, according to Egyptian cotton classification. The seed-cotton and lint cleaners improve the lint grade due to the extraction of a lot of trashes and impurities. Regarding machines’ sequence of rotary gin-stand, the seed-cotton and lint cleaners were the most important machines in ginnery in relationship to maintaining and improving fibre quality and accordingly, lint grade. This finding is agreed with El-Sayed et. Al. 2008 and Gordon et.al. 2011, who reported that processing lint through lint cleaner decreases the amount of trash grade and improved the color and grade index.

It could be fairly stated that in seed-cotton and lint cleaning in rotary knife ginning plant in Fayyoum, the removal of contamination, impurities, is usually accompanied by shortening of the length distribution. In practice, the trash content of lint cotton is a major concern for, mainly, spinning mills. Therefore, it is important to conclude that the rotary gin-stand reduce the Contamination, trash content, impurities, and short fibres, high productivity, which maintains the fibre and yarn quality despite reducing the ginning out-turn, meaning that it is important to redraw the policy of ginning in Egypt to development the ginneries.

Raw fibre properties and lint grade

The HVI Results were summarized in Table 1. Quality attributes measured by the HVI were superior in fibre length parameters for the rotary ginning than for the roller ginning treatment. Generally, the effects of ginning treatment on fibre length, uniformity index, and short fibre index measurements were statistically insignificant at a 0.05% level of probability. Although insignificant between both ginning types, the rotary ginning recorded a high level of quality in all fibre properties compared with single roller reciprocating ginning.

For Giza 94, the Upper half mean length recorded 33.40 and 33.51 mm, uniformity index averaged 85.69% and 86.77%, short fibre Index averaged 6.7 and 6.3%, trash content averaged 23 and 47, trash area averaged 0.36% and 0.59%, nep content averaged 165 and 101 on the Rotary gin and reciprocating knife gin, respectively. Fibre strength, elongation, Micronaire, and maturity ratio were insignificantly affected regarding ginning treatment. For Giza 95, the Upper half mean length recorded 30.69 and 28.7 mm, uniformity index averaged 85.1% and 83.5%, short fibre Index averaged 6.6 and 8.3%, Micronaire reading averaged 4.45 and 4.29 trash content averaged 31 and 59, trash area averaged 0.24% and 0.59%, nep content averaged 79 and 93 on the Rotary gin and reciprocating knife gin respectively. Fibre strength and elongation were insignificant regardless of ginning treatment, the rotary gin recorded 37.6 g/tex while the McCarthy roller gin recorded 35.34g/tex. The presence of trash and its subsequent removal during the ginning process affects color characters due to getting rid of a considerable proportion of foreign matter mixed with fibres that led to decreased non-lint content and improving the grade and the fibre brightness. While foreign matter remaining mixed with the seed cotton, as in the case of reciprocating ginned lint, resulted in decreasing the fibre brightness.

Rotary ginned cotton receive more aggressive cleaning through the seed cotton cleaner and lint cleaner, which reduces nonlint content and can improve color appearance through combing and aligning of the fibres but also can cause entanglements of fibres, known as neps, to form more readily than in roller ginning and its associated lint cleaning (Tables 1 and 2). The Rotary-ginned cotton had an average of 25 additional neps per gram than the Reciprocate roller-ginned cotton (Table 2). Fibrous neps can cause appearance issues in yarns and fabrics and must be reduced substantially during the carding process or the mill risks quality problems in downstream processing. It is advantageous for a textile mill to begin processing with cotton that contains fewer neps as it reduces the need for the mill to remove material during processing.

Table 1: Average HVI test Results for Rotary and conventional ginning mill

	UHM (mm)	UI (%)	SFI (%)	Strength (g/Text)	Elongation (%)	Micronaire	Mat. Ratio	Rd	+b	Tr Cnt	Tr Ar	Nep count
Average new Rotary Gin Giza 94	33.40	85.69	6.70	40.10	6.36	4.00	0.86	77.70	9.00	23.00	0.36	125
Average Variety in old Gin Giza 94	33.51	86.77	7.30	40.55	6.20	4.00	0.87	76.20	9.00	59.00	0.59	101
Average new Rotary Gin Giza 95	30.69	85.10	6.60	37.60	6.80	4.45	0.86	69.70	11.20	31.00	0.24	79.00
Average Variety in old Gin Giza 95	28.70	83.53	8.30	35.34	6.20	4.29	0.88	68.00	11.80	59.00	0.59	93.00
Observed Significance Level for Mean Difference												
LSD at 0.05%	3.686	2.150	1.241	3.842	0.451	0.355	0.015	7.580	2.328	29.831	0.277	30.653

NS: Non-Significant at 0.05% level of probability

Table 2: Average AFIS test Results for Rotary and conventional ginning mill

	SFC(w)	UQL(w)	L(n)	Fineness	Maturity Ratio	IFC	Total Nep Cnt	SCNep Count	Trash Count	VFM
	%<12.7 mm	(mm)	(mm)	(mtex)		(%)	(Cnt/g)	(Cnt/g)	(Cnt/g)	(%)
Average new Rotary Gin Giza 94	4.9	35.4	23.7	143	0.94	5.4	160	5	20	0.52
Average Variety in old Gin Giza 94	5.1	34.8	23.3	147	0.91	4.7	176	7	59	1.66
Average new Rotary Gin Giza 95	5.2	31.4	21.2	155	0.95	5.3	165	5	18	0.55
Average Variety in old Gin Giza 95	5.7	31.3	21.0	160	0.92	4.5	210	8	66	1.76
Observed Significance Level for Mean Difference										
LSD at 0.05%	0.54	3.46	2.22	12.21	0.03	0.70	35.80	2.38	40.24	1.08

NS: Non-Significant at 0.05% level of probability

Yarn Quality

Spinning mills always focus on realization (output versus input) and, therefore, many spinning mills install elaborate systems to capture and accurately record waste figures from the various processes. There was a significant difference in the total waste (blowroom to carding) extracted from the two ginning methods, with the total trash extracted from the Rotary ginned fibre almost 3% less than that extracted from the reciprocate roller ginned fibre. The reciprocate roller ginned cotton's increased waste was extracted during the blowroom (3.6%).

For average Giza 94 yarn results, spinning end breakage varied from 26 to 18 end/1000spindle/h for Ne 40 in both reciprocate and Rotary gin, respectively. yarn strength ranged from 24.33 to 25.86, (C.V%) ranged from 11.45% to 12.11%, in terms of imperfections; thin places ranged from 15 to 12 per 1000 meters, thick places ranged from 43 to 35 per 1000 meters and neps ranged from 132 to 70 per 1000 meters, while the yarn hairiness index recorded 4.4 for Ne 40 in both reciprocate and Rotary gin, respectively.

For average Giza 95 yarn results, spinning end breakage varied from 35 to 23 end/1000spindle/h for Ne 40 in both reciprocate and Rotary gin, respectively. yarn strength ranged from 17.65 to 19.14, (C.V%) ranged from 14.32% to 13.23%, in terms of imperfections; thin places ranged from 32 to 28 per 1000 meters, thick places ranged from 55 to 48 per 1000 meters and neps ranged from 100 to 65 per 1000 meters, while the yarn hairiness index recorded 4.4 for Ne 40 in both reciprocate and Rotary gin, respectively.

The average yarn results for the two ginning methods are listed in Tables 3 and 4 and illustrated in figures1 and 2.

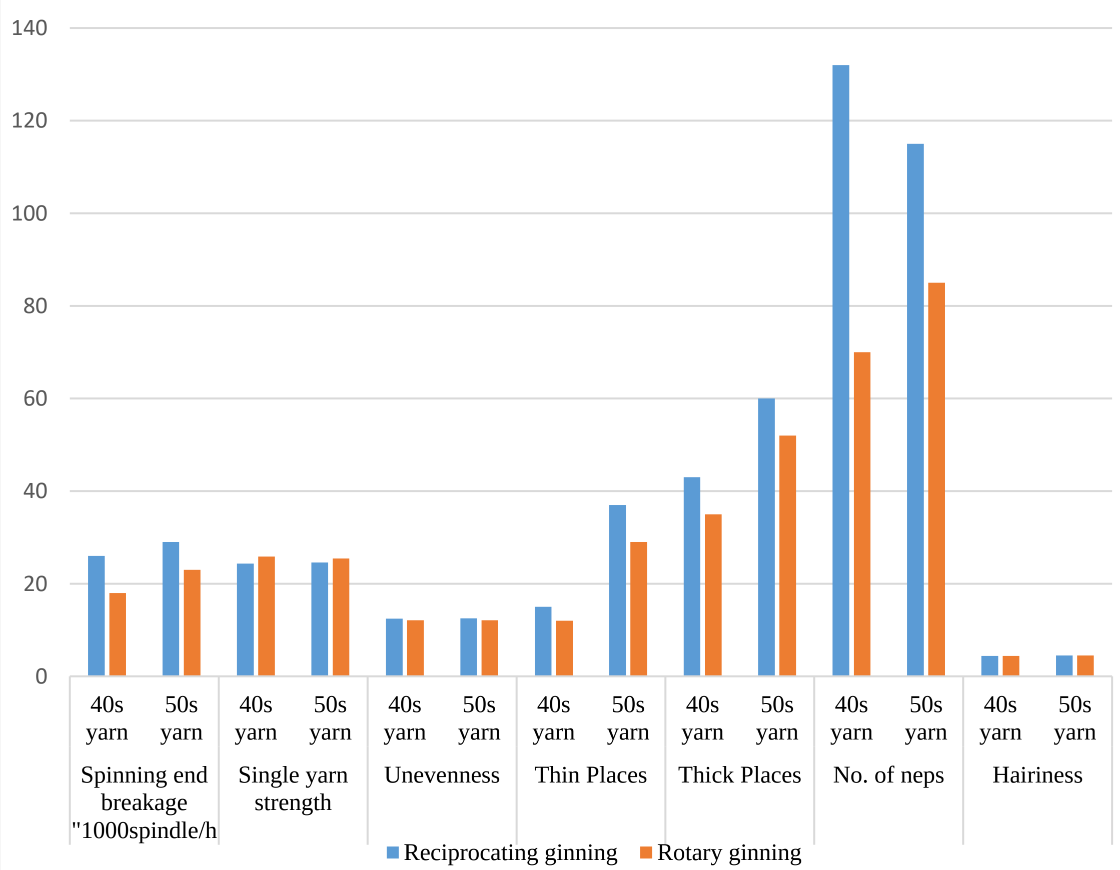

Figure 1: Yarn quality properties of both two ginning methods for Giza 94

Table 3. Yarn quality properties of both two ginning methods for Giza 94

	Count	Reciprocating ginning	Rotary ginning	L.S.D at 0.05%
Blow-room and card waste		7.80 %	4.20 %	1.08
Spinning end breakage "1000 spindle/h"	40s yarn	26	18	N.S
	50s yarn	29	23	N.S
Single yarn strength cN/Tex	40s yarn	24.33	25.86	N.S
	50s yarn	24.57	25.44	N.S
Unevenness (%)	40s yarn	12.45	12.11	N.S
	50s yarn	12.53	12.12	N.S
Thin Places (-50%)	40s yarn	15	12	N.S
	50s yarn	37	29	N.S
Thick Places (+50%)	40s yarn	43	35	N.S
	50s yarn	60	52	N.S
No. of neps	40s yarn	132	70	N.S
	50s yarn	115	85	N.S
Hairiness	40s yarn	4.4	4.4	N.S
	50s yarn	4.5	4.5	N.S

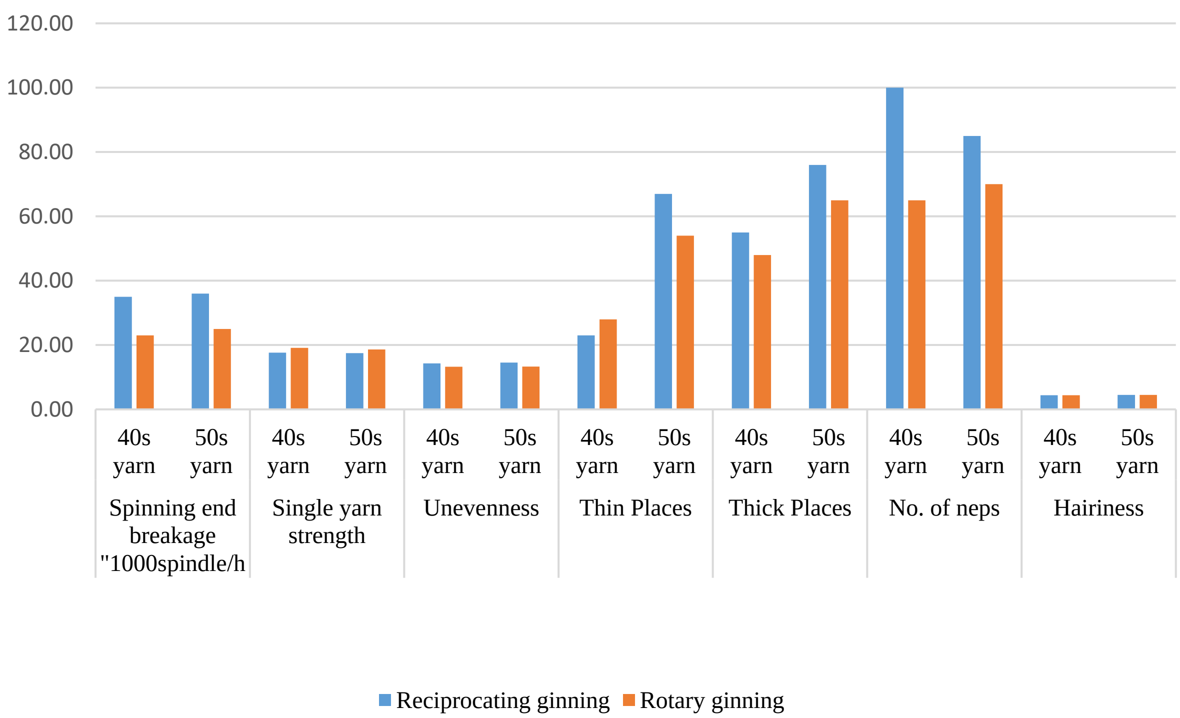

Figure 2: Yarn quality Properties of both two ginning methods for Giza 95

Table 4. Yarn quality properties of both two ginning methods for Giza 95

	Count	Reciprocating ginning	Rotary ginning	L.S.D at 0.05%
Blow-room and card waste		8.50%	4.80%	0.51
Spinning end breakage "1000 spindle/h”	40s yarn	35.00	23.00	N.S
	50s yarn	36.00	25.00	N.S
Single yarn strength “cN/Tex”	40s yarn	17.65	19.14	N.S
	50s yarn	17.50	18.63	N.S
Unevenness (%)	40s yarn	14.32	13.23	N.S
	50s yarn	14.55	13.32	N.S
Thin Places (-50%)	40s yarn	23.00	28.00	N.S
	50s yarn	67.00	54.00	N.S
Thick Places (+50%)	40s yarn	55.00	48.00	N.S
	50s yarn	76.00	65.00	N.S
No. of neps	40s yarn	100.00	65.00	N.S
	50s yarn	85.00	70.00	N.S
Hairiness	40s yarn	4.40	4.40	N.S
	50s yarn	4.50	4.50	N.S

CONCLUSIONS

Undoubtedly, the overall quality improvements of Rotary roller-ginned Egyptian cotton over reciprocating cotton are consistent. High production Rotary roller ginning of Egyptian cotton consistently reserves the longer and more uniform length fibres for the same cotton. The reciprocate roller-ginned cotton is processed through the gin with more than two percentage points higher turnout and higher in trash area, trash content, and foreign fibre matter. This was simply a matter of increased nonlint content, as the higher turnout was not preserved through blowroom operations in the spinning mill with an average of 3.6 percentage points more loss for reciprocate ginned cotton compared to Roller ginned cotton. Carded yarn production for medium count yarns was more efficient, with fewer thin, thick, unevenness and ends down using Rotary-ginned cotton.

Material and Methods

Two experiments were conducted at the Fayyoum gin-plant, Misr for Cotton Ginning, Cotton and Textile Industries Holding Company, to evaluate the effect of conventional reciprocating and rotary-knife gin-stand of Bajaj Continental make on lint out-turn, fibre quality of Giza 95 grown in Upper-Egypt and Giza 94 transferred from Delta Egypt to Upper Egypt. 2000 Tons of homogenous bulk of seed cotton for each of Giza 95 and Giza 94 cotton varieties of 2018/2019 crop were used in this study. The seed-cotton grade was classified as Good + ¼. The ginning machinery sequence was typical of that found in Fayyoum ginnery. 1000 Tons of each Giza 95 and Giza 94 seed cotton were ginned in the process sequence in the rotary gin i.e., rock trap, Big J, inclined cleaner, extractor-feeder, roller gin stand, Pima lint cleaner, and the other 1000 tons was ginned in the ordinary reciprocating-knife roller gin-stand, figures 3 and 4 and table 5. The time required for ginning each ton and the weight of ginned lint was recorded. The lint out-turn was estimated as the percentage of ginned lint about the seed cotton weight.

The principal raw cotton fibre properties of the ginned lint were measured on the High-Volume Instrument (HVI) and Advance Fibre Information System (AFIS). The lint grades were determined by qualified lint classers. All fibre properties were carried out under standard atmospheric conditions of (65 % ± 2) relative humidity and (21.0°C ±1) temperature degree.

Table 5. Ginning treatment, production speed, and outturn

Variety	Seed Cotton Grade	Gin type	Outturn	Production/machine/h	Lint Grade
Giza 95	Good	Rotary	37.13	400 Kg/h	Good +7/16
Giza 95	Good	Reciprocate	39.37	30 Kg/h	Good +3/16
Giza 94	Good	Rotary	36.41	400 Kg/h	Good +7/16
Giza 94	Good	Reciprocate	38.73	30 Kg/h	Good +3/16

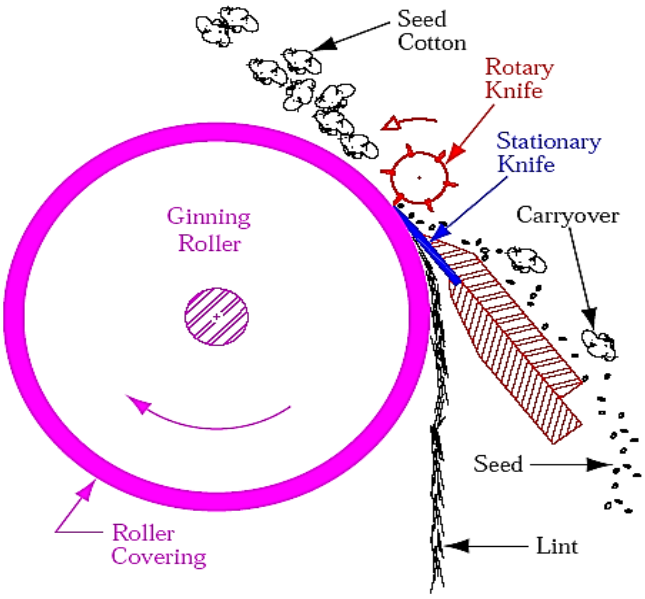

Figure 3: Principle of Rotary Knife Gin

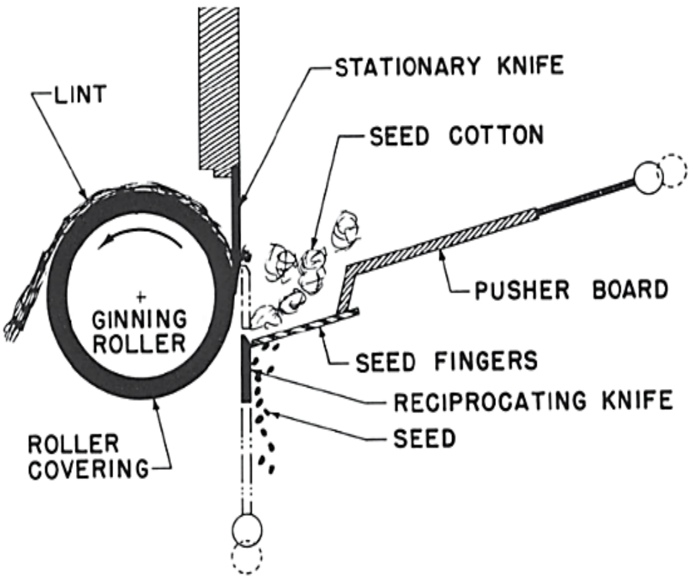

Figure 4: Principle of McCarthy Roller Gin (Ref. Carlos et al. 2017)

Spinning Processing. The ginned lint cotton was processed and opened, carded, and drew on a Truetzschler line, while roving, spinning was processed on a Marzoli line as shown in Fig. 5 to produce carded ring spun yarns, Ne 40 and Ne 50. Yarn evenness and imperfections (thin and thick places and neps), as well as hairiness, was measured with a Uster Tester 3. While single yarn strength was measured with a Statimat ME.

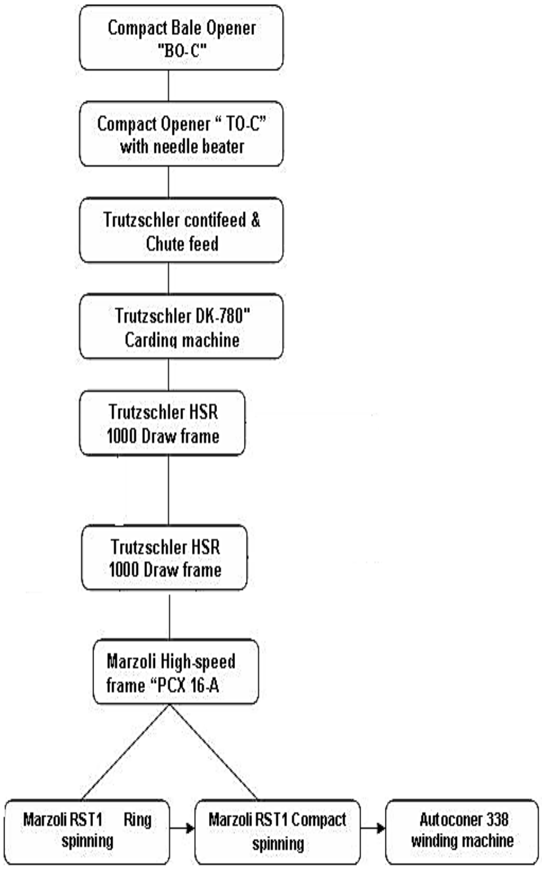

Figure 5. Outline yarn mechanical process

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Impact of Fiber Quality Properties of Some Egyptian Cotton Varieties and Upland Cotton on Yarn Quality

Eman R. El-Sayed and Eman Y. Abd-Elkawe

Cotton Research Institute, Agricultural Research Center, Giza, Egypt
***Corresponding author**: Emanrashwan28@gmail.com

Abstract

This investigation was carried out to study the effect of fiber properties for some Egyptian cotton, upland cotton varieties and yarn counts on compact combed yarn properties. In addition to study the relationships between fiber and yarn quality properties. For these purposes, two Egyptian commercial cotton varieties G94 and G95 as long staple cottons and two upland cotton varieties Ultima and Greek as long staple cotton were used in this study. All cotton yarns combed were spun on compact spinning system. The linear densities of the yarns obtained were 40, 50 and 60 with similar twist multiplier (4.2). Fiber and yarn quality properties were tested and compared. The results showed that Giza94 gave the best fiber and yarn quality properties compare to other varieties under study. Giza94 recorded the highest value of yarn strength (cN/tex) and the lowest value of unevenness (CV) and yarn imperfections. While, the lowest mean value of yarn strength (cN/tex) and the highest mean value of yarn unevenness (CV) and yarn imperfections were obtained by Greek cotton. As yarn count is increased, the yarn strength (cN/tex) and yarn elongation % are decreased whereas their unevenness and yarn imperfections increased. Positive and highly significant correlations between Yarn strength at yarn count 40s, 50s and 60s and each of fiber length (UHM), uniformity index (%) and fiber strength (g/tex). While, negative significant correlation was found between yarn strength (cN/tex) and micronaire value % at the same counts.

Key Words: Egyptian cotton, Upland cotton, Combed yarns, Yarn imperfections, linear densities

INTRODUCTION

Cotton is the most popular fiber in the textile fashion industry and it is a major part of the global textile industry despite availability of many other natural, synthetic, and regenerated fibers (Hanna 2017). There are several reasons for the difficulties facing the cotton industry in Egypt including increase in production expenses, deterioration of cultivated varieties in yield traits and fiber quality and lower demand for Egyptian cotton in international markets due to its higher prices than other cottons of nearly similar quality properties. So, the cotton breeding programs are concerned improvements of lint yield and fiber quality for meeting demands of producers and the textile industry. Moreover, there is a trend in Egypt now to introduce and cultivate upland cotton cultivars in the new reclaimed lands to provide the needs of the Egyptian textile industry without dependence on imports (Nassar et al 2013).

Competition from synthetic fibers, mill modernization and global market competition have led to increase in the demand for improving fiber quality, while changes in the textile industry and fiber measurement technology have resulted in a steady improvement in cotton fiber quality. Many different upland cotton varieties are marketed to producer each year. These varieties are distinguished from each other by plant type, maturity, fiber properties, added value traits, yield traits, and environmental adaptation. To assist producers, both public and private entities conduct multilocation cultivar trials to evaluate plant and fiber performance. Modern textile industries need longer, Stronger, finer and more uniform cotton fibers (Foulk et al 2009).

A better understanding of new varieties is necessary to expedite processing in textile mills and to encourage the use of certain cotton varieties. Hsieh (1999) reported that Spinning requires long, strong fibers to endure stresses sustained during mechanical operations in ginning, opening, cleaning, carding, combing, and drafting. Individual fiber strength and fiber interactions **(**length, friction and twist) determined yarn strength. Ureyen and Kadoglu (2006) reported that Cotton is exposed to numerous processes, starting from harvesting until the final product. All these processes effect of the fiber quality properties as well as yarn quality properties. Fiber length and strength are the most important and desirable fiber quality parameters because of the role each plays in optimizing textile processing efficiency as well as producing high quality end product. Deussen (1993) and Kenndy (2018) concluded that fiber fineness, maturity, trash, uniformity index, fiber length, and fiber strength affected spinning efficiency.

Joy et al (2010) reported that improving fiber length while holding other fiber quality parameters constant leads to higher quality ring spun yarns. exhibited the highest quality cotton fiber that produced the highest quality yarn, i.e., longer fibers carded yarn as indicated by greater yarn tenacity, better yarn elongation and less hairiness. Combing process plays an important role in improving the quality of raw material by removing short fiber, trash particles and neps present in it. Combed yarn has better appearance, yarn strength, yarn evenness, and luster than carded yarn Subramanian and Gobi (2004)**.**

Compact spinning is one of the most important improvements in ring spinning which is implemented by adding a fiber condensing device on ring spinning frame to condense the fiber bundle and decrease or eliminate spinning triangles, with the spun yarn structure and quality having a qualitative development since the fiber tension distributions in the spinning triangles are more uniform (Nikolic et al 2003; Chang and Yu 2003). El Sayed and Sanad (2007) reported that compact spinning system is more appropriate for long staple cotton varieties, coarse and medium counts than for the extra-long staple cotton varieties and finer counts. The change in the quality properties of yarn depending on the fiber quality properties. The unevenness (CV) of the yarns increased with the increase of yarn count, neps, short fiber index and trash content. Also, Yarn strength increased with the increase of fiber length, uniformity and fiber strength. Whereas, it decreased with the increase of neps, short fiber index and trash content. Therefore, suitable cotton should be selected to produce high quality yarns suitable for the field of use (Oner et al 2018).

Hanen et al. (2017) found that short fiber index and fiber strength had significant effects on yarn strength. Stronger fibers gave stronger yarns. While, shorter fibers gave weaker yarn. So, the longest fibers produced the best evenness. The purposes of this investigate were to study the effect of fiber properties and yarn counts on compact combed yarn properties for some Egyptian cotton varieties and upland cotton. In addition to determine the relationships between fiber and yarn quality properties.

In this study, the quality properties of the two commercial Egyptian cotton varieties were compared with those of the two Upland cotton varieties from the standpoint of quality level.

RESULTS AND DISCUSSION

Table 1. Summary of main of effect

	Strength (cN/tex)	Elongation %	CV %	Thin places -50%	Thick places + 50	Neps +200
V "variety"	0.21*	0.15*	0.27*	1.93*	3.80*	3.61*
C "Count"	0.18*	0.13*	0.23*	1.67*	3.29*	3.13*
V X C	0.36*	0.26*	0.47*	3.34*	6.58*	6.26*

Yarn Quality Properties

Data presented in Table 3 showed that all yarn properties were significantly affected by varieties. Giza94 was superior to all the studied varieties in all yarn properties except yarn elongation %. On the other side, Giza 95 gave the highest mean values of yarn elongation % and thin places/400m. Greek cotton gave higher unevenness (CV %) and thick places compare to Ultima variety. While Ultima variety recorded higher yarn strength (cN/tex) and neps /400m compare to Greek cotton. Generally, properties of Egyptian cottons surpassed on upland cottons in yarn properties especially in yarn strength. These results were due to the higher maturity ratio, fiber length and fiber strength and lower short fiber index in Egyptian cottons compare to upland cottons.

Table 2. Main effects of cotton varieties and yarn counts on yarn quality properties for Egyptian and upland cotton varieties.

Treatments	**Yarn properties**					
Cotton varieties	**Strength (cN/tex)**	**Elongation %**	**CV %**	**Thin - 50%**	**Thick +50%**	**Neps 200%**
Giza94	24.02	4.98	11.31	1	6	12
Giza95	21.28	5.73	13.05	9	23	24
Ultima	20.57	4.87	13.15	4	36	47
Greek	16.58	4.99	13.30	5	42	38
LSD	0.21	0.15	0.27	1.93	3.8	3.61
Yarn count	**Strength (cN/tex)**	**Elongation %**	**CV %**	**Thin - 50%**	**Thick +50%**	**Neps 200%**
40	21.49	5.61	11.82	3	17	22
50	20.66	4.96	12.83	3	25	30
60	19.68	4.87	13.46	8	38	40
L.S.D	0.18	0.13	0.23	1.67	3.29	3.13

These results are in accordance with many investigators such as Ureyen and Kadoglu (2006); Faulkner et al. (2012); Cai et al. (2013) and Oner et al (2018) who stated that Yarn tenacity increases with the increase of fiber length, uniformity index and fiber strength, whereas it decreases with neps, short fiber index and trash content. On the other hand, the increase of fiber fineness, maturity, fiber length and uniformity causes the reduction of unevenness of the yarn**.**

All yarn properties were significantly affected by yarn counts. Yarn count 40's gave the highest values of single yarn strength (cN/tex) and elongation%. Also, the same count gave the lowest values of unevenness (CV%) and yarn imperfections. on the other hand, yarn count 60s recorded the lowest values of yarn strength (cN/tex), elongation % and the highest mean values of unevenness (CV%) and yarn imperfections. It is inferred that as yarn becomes finer, single yarn strength (cN/tex) and yarn elongation (%) decreased significantly. Whereas their unevenness (CV %) and imperfections increased. The differences in single yarn strength, yarn elongation and yarn evenness could be attributed to the variance in the number of fibers in yarn cross section of different yarn counts.

These results agree with those obtained by El-Sayed (2002); Doaa (2003); Asal (2003) and Abdel-Ghaffar et al (2019) who reported that yarn count had significant effect on single yarn strength, yarn elongation, yarn unevenness, number of thin places and number of neps. The yarn unevenness (CV %) increased with increasing yarn count that may be due to the lower number of fibers in the cross section of fine yarns.

Single Yarn Strength

The interaction between cotton varieties and yarn counts (V × C) was significantly effect on single yarn strength as shown in Table 4 and Figure 1. Giza 94 recorded the higher value of single yarn strength than Giza 95, Ultima and Greek cotton in all yarn counts. While Greek cotton gave the lowest value of single yarn strength in all yarn counts. Giza 95 was insignificantly higher value of single yarn strength than Ultima in 40s yarn count. Generally, for all cotton varieties, the yarn count (40s) gave the highest value of single yarn strength (cN/tex). While yarn count (60s) gave the lowest value of single yarn strength (cN/tex).

Table 3. Single yarn strength for different yarn counts of Egyptian and upland cotton varieties.

Cotton varieties	**Yarn counts**		
	40s	**50s**	**60s**
Giza94	24.51	24.28	23.27
Giza95	21.93	21.63	20.3
Ultima	21.86	20.27	19.58
Greek	17.67	16.47	15.59
Uster provisional at 5%	21.62	22.18	22.66
LSD at 5%	**0.36**		

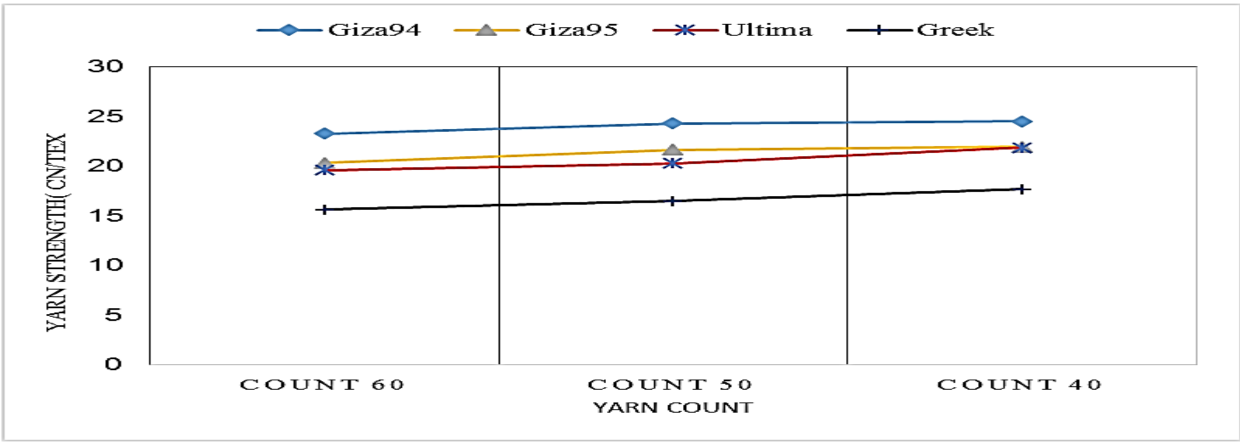

Fig.1. Effect of cotton varieties and yarn counts on compact combed yarn strength

Yarn Unevenness (CV %)

Data presented in Table 5 and Figure 2 showed the interaction between cotton varieties and yarn counts (V × C) was significantly effect on yarn unevenness (CV%). Giza 95 in 40s yarn count gave the lowest value of yarn unevenness (CV %). While Greek cotton using the same count gave the highest mean value for CV%. Also, Greek cotton was insignificantly higher value yarn unevenness than Ultima in all yarn counts.

Table 4. Interaction between cotton varieties and yarn counts (V × C) for yarn unevenness

Cotton varieties	Yarn count		
	40	50	60
Giza94	10.98	11.05	11.91
Giza95	10.85	13.62	14.68
Ultima	12.66	13.31	13.49
Greek	12.72	13.43	13.75
Uster provisional at 5%	11.19	11.61	11.97
LSD at 5%	**0.47**		

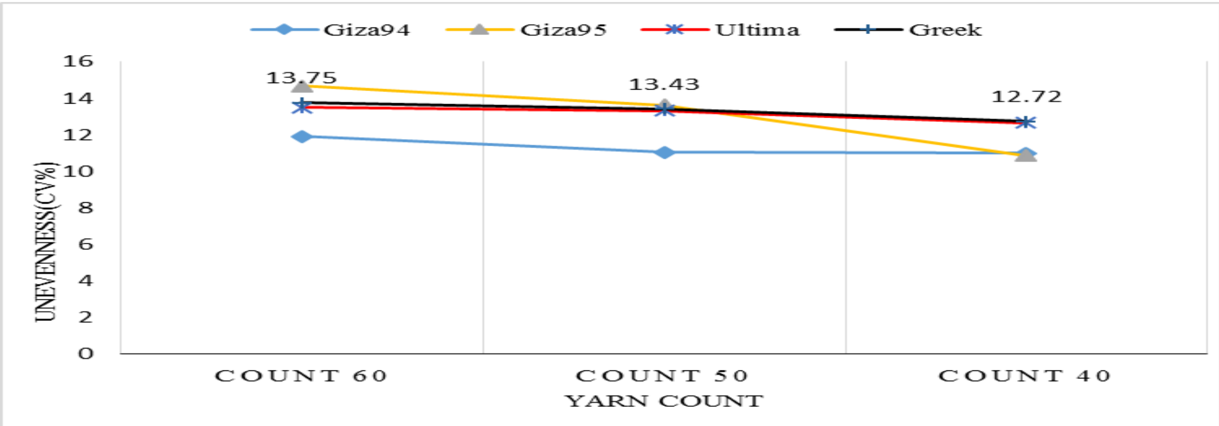

Fig.2. Interaction effect of cotton varieties and yarn counts on compact combed yarn unevenness

Yarn Imperfections

Table 5 and Figure 3 showed the interaction between cotton varieties and yarn counts (V × C) was significantly effect on yarn imperfections (thin places-50%, thick places+50% and neps +200). Giza 94 recorded the lowest yarn imperfections in all yarn counts. On the other hand, Ultima recorded the highest number of neps at all yarn count and thick places at 40s yarn count. While, Greek cotton recorded the highest number of thick places at 50s and 60s yarn counts.

Table 5: Interaction between cotton varieties and yarn counts (V × C) for single yarn strength

Yarn properties	**Thin**			**Thick**			**Neps**		
Cotton varieties	**Yarn count**			**Yarn count**			**Yarn count**		
	40s	**50s**	**60s**	**40s**	**50s**	**60s**	**40s**	**50s**	**60s**
Giza94	1	1	3	3	6	9	6	13	19
Giza95	4	6	16	10	23	35	18	25	29
Ultima	3	3	7	29	31	49	35	49	57
Greek	2	5	9	26	42	58	28	31	53
Uster provisional at 5%	1	2	5	16	20	24	36	41	44
LSD at 5%	**3.34**			**6.58**			**6.25**		

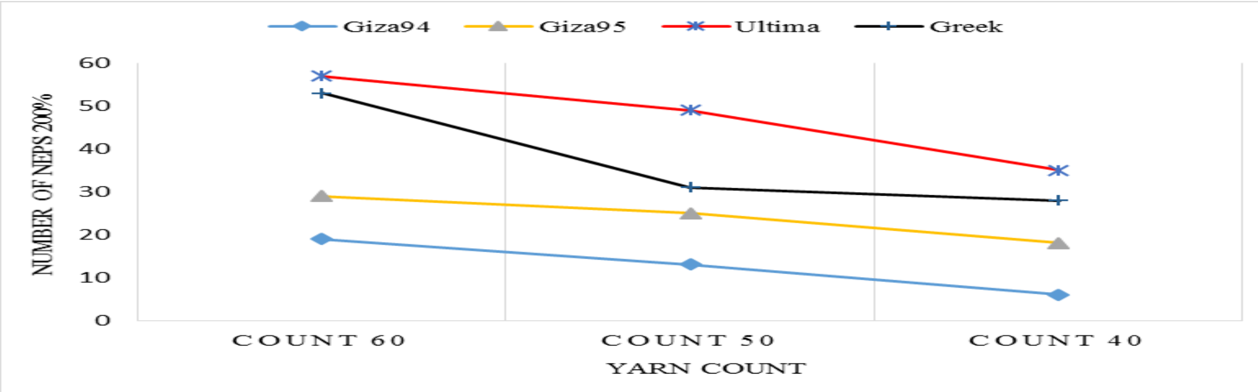

Fig.3. Effect of cotton varieties and yarn counts on compact combed yarn neppiness

These results are in accordance with the findings of Hagar and Hassan (2016); Tolba (2017) and Gadallah and Abdel Twab (2019) who reported that yarn technological properties (lea count strength product, yarn hairiness, C.V. %, neps/100m, thin places/100m and thick places/100m) were significantly affected by the interaction between cotton varieties and yarn counts.

Correlation

The correlation between yarn strength and fiber properties under different yarn counts shown in Table 6. The results indicated that yarn strength at count 40s, 50s and 60s correlated positively and highly significant with fiber length (UHM), uniformity index (%) and fiber strength (g/tex). On the other hand, negative significant correlation was found between yarn strength (CN/TEX) and Micronaire value % at the same counts. These results mean that yarn strength (CN/TEX) decreased with increasing Micronaire value.

Generally, it could be concluded that single yarn strength correspondingly increased by increasing numbers of fibers in yarn cross-section. Furthermore, yarn strength increased with increasing the number of longer fibers in yarn due to the greater number of points of contact and cohesion between them, and consequently increased yarn strength (El-Shakankery et. al. 2014).

The results were in agreement with those obtained by Fares et al (2010), Mohammed (2011) and Youns (2017) who found that fiber strength was the contributors to yarn strength.

Table 6. Correlation coefficient between yarn strength and fiber properties for different yarn counts

Yarn properties	Yarn strength		
Yarn count	**40s**	**50s**	**60s**
Fiber properties			
Upper Half Mean "mm"	0.813**	0.776**	0.812**
Uniformity Index "%"	0.798**	0.787**	0.803**
Short Fiber Index "%"	- 0.368	- 0.435	- 0.444
Strength "g/tex"	0.955**	0.969**	0.975**
Micronaire	- 0.750**	- 0.712**	- 0.720**

**. Correlation is significant at the 0.01 level

*. Correlation is significant at the 0.05 level

MATERIALS AND METHODS

The present investigation was conducted in El Giza Company for Fine Spinning and Waving. The raw materials in the current study included two Egyptian commercial cotton varieties i.e. Giza 94 and Giza 95 as long staple cotton varieties and two upland cotton varieties i.e. Ultima and Greek similar to its qualities with Egyptian commercial varieties. All varieties were spun using compact spinning system. Each cotton fiber material was spun into three counts 40s, 50s and 60s combed yarns at constant twist multiplier (4.2). Combed yarns were manufactured from the same varieties, eliminating 20% of noils during combing.

Cotton fiber and yarn testing were carried out in the laboratories El Giza Company for Fine Spinning and Waving. High Volume Instrument (HVI) was used to determine fiber length (UHM), fiber uniformity (%), short fiber index, fiber strength (g/tex), fiber elongation (%), micronaire value, fiber maturity ratio (%), fiber reflectance (Rd%) and fiber yellowness degree (+b) according to (ASTM, D:4605-1986).

Yarn strength (cN/tex) and yarn elongation (%) were measured by Uster Tensorapid 4 (according to ASTM., D2256-02) with testing speed of 5000mm/min and test length of 50cm used for the testing of tensile properties. Average of 120 breaks per sample. Yarn evenness (C.V. %) and number of imperfection i.e., thin places (-50%), thick places (+50%) and number of neps (+200%) were measured according to (ASTM., D1425-96) by the Uster Tester 4 with testing speed of 400mm/min. The average of four tests was taken for results.

Results were compared with the Uster provisional 50% level (Zellweger Uster, 2018). All samples were opened and left for 24 hours at least under the standard conditions of 65% ± 2% relative humidity and 21 ± 1°C temperature before being tested.

Table 7. Fiber quality properties for Egyptian and upland cotton varieties.

Fiber properties	Cotton varieties			
	Giza 94	**Giza 95**	**Ultima**	**Greece cotton**
Upper Half Mean "mm"	34.15	29.88	31.65	29.5
Uniformity Index "%"	87.33	84.43	85	84.05
Short Fiber Index "%"	5.78	8.18	8.48	7.35
Strength "g/tex"	42.9	35.83	34.93	29.3
Elongation "%"	6.38	8.43	9.4	9.15

Fiber properties	Cotton varieties			
	Giza 94	Giza 95	Ultima	Greece cotton
Micronaire value	3.98	4.28	4.18	4.55
Maturity "%"	0.93	0.90	0.89	0.84
Reflectance (Rd)	78.83	66.20	74.68	68.83
Yellowness (+b)	9.15	11.93	8.35	8.98

Fiber properties of the studied cotton varieties were presented in Table 7. noticed that Giza94 had the longest fiber and the highest uniformity index, strength, maturity ratio and reflectance degree compared to other cotton varieties. While, Giza94 had the lowest mean values of micronaire, short fiber index % and fiber elongation %. In contrary, Greek cotton had the lowest mean values for maturity ratio%, fiber length (mm), uniformity index %, fiber strength (g/tex) and yarn strength (cN/tex).

Statistical Procedures

The experimental design of this study was conducted as a completely randomized design with four replications and analyzed as factorial experiment according to the method described by Gomez and Gomez (1984). The collected data was computed using the SPSS 20.0 as a statistical program. The L.S.D. at 5% level of probability was used to calculate the significant differences between the mean values of treatments according to Snedecor and Cochran (1981). Multiple Correlation analysis was performed between fiber and yarn properties.

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Genotypes By Environment Interaction Effect And Biplot Analysis (Gge) For Seed Cotton Yield In Some Egyptian Cotton Genotypes (*Gossypium* Barbadens L)

El-ADLY*, H.H, Y.I.M.Al-HIBBINY and A.H.MABROUK
Cotton Research Institute, Agricultural Research Center, Giza, Egypt
* hassaneladly2015@yahoo.com

Abstract

Seed cotton yield is a trait governed by multiple genes that cause changes in the performance of genotypes depending on the cultivation environment, therefore plant breeders always test their genotypes across diverse environments to assess consistency of superior genotypes for wide adaption. Twelve Egyptian cotton genotypes (G) were studied across three various environments (E) representing Middle and Upper Egypt during the three seasons (S) 2016, 2017 and 2018. Genotypes (G) across environments (E) over years (Y) revealed significant differences for seed cotton yield. Significant values of mean squares due to genotypes environment interaction (G × E) and genotypes x year interaction (G × Y) for (SCY K/f). Moreover, the interaction effects due to (Y × E × G) were also significant for seed cotton yield (SCY K/f), indicated that (SCY K/f) of cotton genotypes is mostly affected by environment and years. Environment significance explained by 73.3% (7.2%, 32.3% and 35.9%) for year, environment and their interactions, respectively of the total sum squares due to G, E and (G × E) interaction however partitioning of variance components for environment revealed that both predictable (E) and unpredictable (Y) components were important source of variation. The environment (E), genotype (G) and (G × E) interaction effects explained about 43, 9% (32.3%, 4.4% and 7.2%), respectively, of the total sum squares variance components. According to ideal genotype Biplot analysis, genotypes G1, G5 and G7 are more stable and had the high yielding ability compared with the grand mean performance with other genotypes thus genotypes identified as ideal genotypes for seed cotton yield (SCY K/f).

Keywords:
Cotton, GGE-biplot, multilocation varietal experiment, Egypt, environment adaptation

Background

Egyptian cotton germplasm has narrow genetic base and little variation is available for development of high yielding cotton cultivars. Cotton genotype performance depends on genotype (G), environment (E) components and interactions (GE) between them, however genotype environment (GE) interaction become more important and challenging when ranking of breeding lines change in different environments (Baker and lean 1988 and Ali *et al.* 2017). Genotype environment (GE) interaction complicate the process of selection of genotypes with superior performance, for this reason the Plant breeders evaluate genotypes performance at various environments triats because the interaction components provide basic information related to adaptability of cotton genotypes. Numerous methods have been developed to reveal patterns of Genotype environment (GE) interaction, such as joint regression (Finlay and Wilkinson 1963, Eberhart and Russell 1966 and Perkins and Jinks 1968).Stable expression of different attributes of cotton genotypes in different environments is very difficult to attain (Kerby *et al* .2000).

GGE Biplot analysis is believed to be very effective in explaining patterns of genotype environment (GE) interaction and usually is the first choice of plant breeders to identify best performing genotypes for targeted environments (Yan *et al*., 2007). The GGE Biplot analysis is the graphical approach to assess genotypes main effects integrated with genotype by environment interaction (GE) for evaluation of genotypes under diverse environments (Yan and Hoiland 2010). GGE Biplot has very useful features such as visually assessing the discrimination ability of the genotypes to different environments, relationship among the genotypes and environments and ideal environment and genotype (Yan, 2001).

In the current study, cotton genotypes collected from Egyptian cotton breeding program, Cotton Research Institute were used to assess their relative performance of genotypes a cross different environments using GGE Biplot analysis to identify the ideal genotypes which have stable yielding for lint cotton yield in Middle and Upper Egypt regions for future breeding program.

Results and Discussion

The present investigation included the evaluation of 12 long staple cotton genotypes belong to Egyptian cotton (*Gossypium barbadense*. L) at the three different locations representing Middle and Upper Egypt in the three seasons 2016, 2017 and 2018 in order to study genotypes performance and stability under different environments. Mean performance of 12 Egyptian cotton genotypes for seed cotton yield (SCY K/f) showed in Table (2). Genotypes G2, G5, G8 and G9 recorded significant seed cotton yield (SCY K/f) compared with the grand mean performance for all cotton genotypes. On the other hand, the genotypes G1 and G7 gave insignificant higher seed cotton yield.

Combined analysis of variance Table (1), revealed significant mean squares of years (Y), environments (E) and years × environments interactions (Y × E) for seed cotton yield (SCY K/f), possibly due to environmental condition change across various environments over years. Significant values of mean squares due to genotypes (G) and (G × E) interaction and (G × Y) interaction indicated that differential genotype expression across environments depends on the reaction of genotype on changing environmental conditions across locations and years. The second order interaction (Y × E × G) were significant for seed cotton yield (SCY K/f), indicated that seed cotton yield of cotton genotypes is mostly affected by environment and years. Significant environmental effects explained about 73.3% (7.2%, 32.3% and 35.9%) for year, environment and their interactions, respectively of the total sum squares due to G, E and (G × E) interaction Table (2), However partitioning of variance components for environment revealed that both predictable (E) and unpredictable (Y) components were important source of variation. The environment (E), genotype (G) and (G × E) interaction effects explained about 43, 9% (32.3%, 4.4% and 7.2%) respectively, of the total sum squares variance components. Significant differences of all source of variation could help cotton breeder for selecting stable genotypes. The present data were in agreement with Killi and Harem (2006) Satish and Chabra (2009). Campbell *et al.* (2012) and Gul et *al* (2016). They reported that effect of genotypes × environments interaction (G × E) was significant for seed cotton yield. These Results indicated that the cotton crop as well as other crop varieties showed differential responses when grown under different locations and years.

Table (1): Mean performance of 12 Egyptian cotton genotypes for seed cotton yield (SCY K/f) for three seasons at three locations.

Code	Genotypes	2016	2017	2018	G. Means
G1	[(G91 × G90)] ×G85	10.21	11.27	9.09	10.19
G2	[(G91 × G90)] × [G83 × (G75 × 5844)]	10.06	11.41	9.46	10.31
G3	[(G91 × G90)] × [(G85 × G83)]	9.80	10.53	9.28	9.87
G4	[(G91 × G90)] × [(G83 × G80) × G89]	10.31	10.97	8.67	9.98
G5	[(G90 × Aust)] × [G83 × (G75 × 5844)]	10.33	11.34	9.66	10.44
G6	[(G91 × G90)] × Karshink	10.19	10.30	9.20	9.90
G7	[(G83 × G80) × Dandara] × [(G90 × Aust)]	10.86	10.25	9.49	10.20
G8	[(G91 × G90)] × G80	10.44	11.49	9.37	10.43
G9	(Giza 90 × CB 58)	10.64	11.48	9.24	10.45
G10	[(G83 × G80) × G89] ×Aust	10.69	9.72	8.61	9.67
G11	Giza 95	10.21	8.69	9.72	9.54
G12	Giza 90	9.28	9.89	7.91	9.03
Grand means		10.25	10.61	9.14	10.00
LSD 0.05		0.31	0.21	0.21	0.27

Table (2) : Analysis of variance for seed cotton yield (SCY) trait across different environments.

SOV	df	SS	MS	GE%
R	5	1707695.142	341539.028	
Y	2	9869070.559	4934535.279**	7.2
E	2	44324540.32	22162270.16**	32.3
Y x E	4	49347043.28	12336760.82**	35.9
G	11	6417546.92	583413.356**	4.4
Y x G	22	5923804.293	269263.832*	4.3
E x G	22	9937044.978	451683.863**	7.2
Y x E x G	44	11570455.75	262964.903*	8.4
Er	535	69081958.53	129125.156	

Seed cotton yield (SCY K\f) and stability of 12 Egyptian cotton genotypes were assessed from the coordination of the middle environment (CAE), (Fig.1). Genotypes on the extreme right on the CAE ordinate axis indicate a relatively stable. Stability of these genotypes depends on their distance from AE abscissa. Genotypes G1, G3, G5 and G7 were the best stable genotypes compared with other genotypes. On the other hand, the genotypes G2, G4, G6 and G8 showed the absolute length of the projection of a genotype stable. On contrast the genotypes G11was the most unstable genotype. From above Results it could be concluded that the genotypes G1, G5 and G7 are stable and had the high yielding ability compared with the grand mean performance and be incorporated as breeding materials in future of breeding program to produce stable and high yielding cultivars. These Results are in agreement with those obtained by Farias *et al* (2016), Saide (2016), Baker (2017) and Imtiaz et al (2017).

The ideal genotype can be used as a benchmark for selection, genotypes that are far away from the ideal genotype can be rejected in early breeding cycles, while genotypes that are lose to it can be considered in further test (Yan *et al* 2009). An ideal genotype should have a mean seed cotton yield (SCY) that is consistently high over all environments of interest.

This ideal genotype is graphically defined by the longest vector in PC1 and PC2 without projections, and represented by arrow in center of concentric circles (Yan and Rajcan, 2002). Although this genotype is more of a representative model, it is used a reference for assessing genotypes. Thus, the genotypes G2 and G5 which fell into the center of concentric circles were ideal genotypes in terms of higher yield ability and stability, compared with the genotype with the rest genotypes. In addition, genotype G1 and genotypes G8 and G3 located on the second and third concentric circles, respectively, are closest ideal in terms of high seed cotton yield and phenotypic stability (Fig. 2). The genotypes G9, G10, G11 and G12 were undesirable genotypes because they were at distant from the first concentric circle. Baker (2017) using Biplot analysis of phenotypic stability in some Egyptian cotton genotypes and they found that the genotype G8 {(G91× G90) × [(G80 × G83) × Dendera]} was ideal genotype and had high cotton productivity and phenotypic stability.

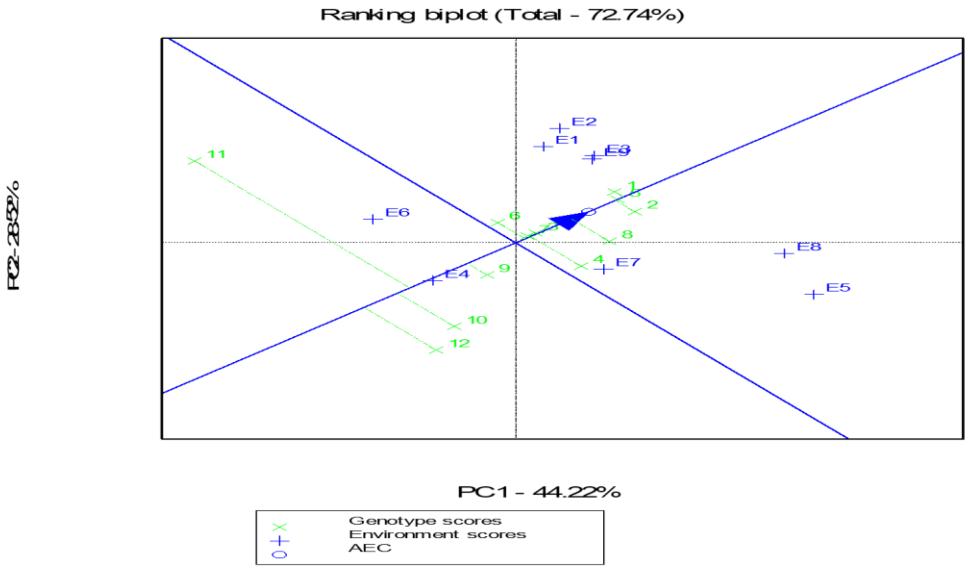
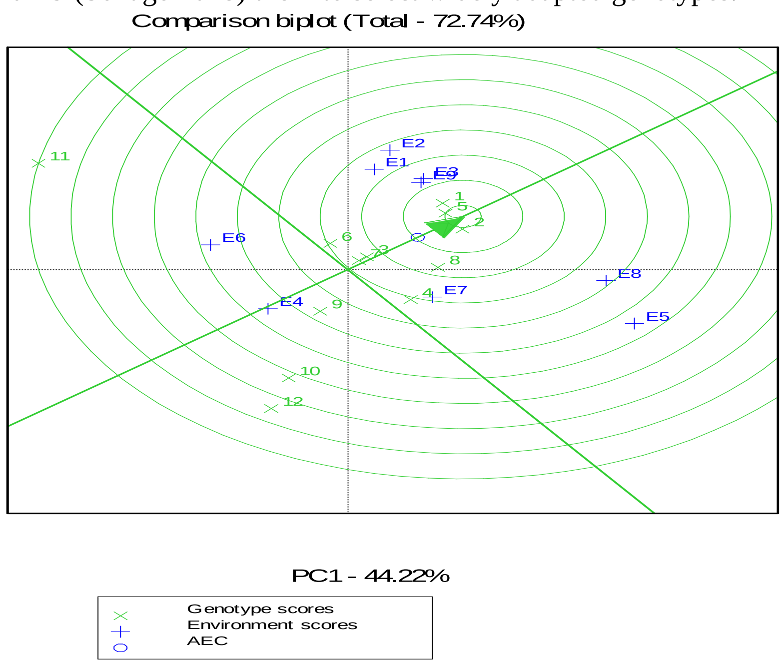
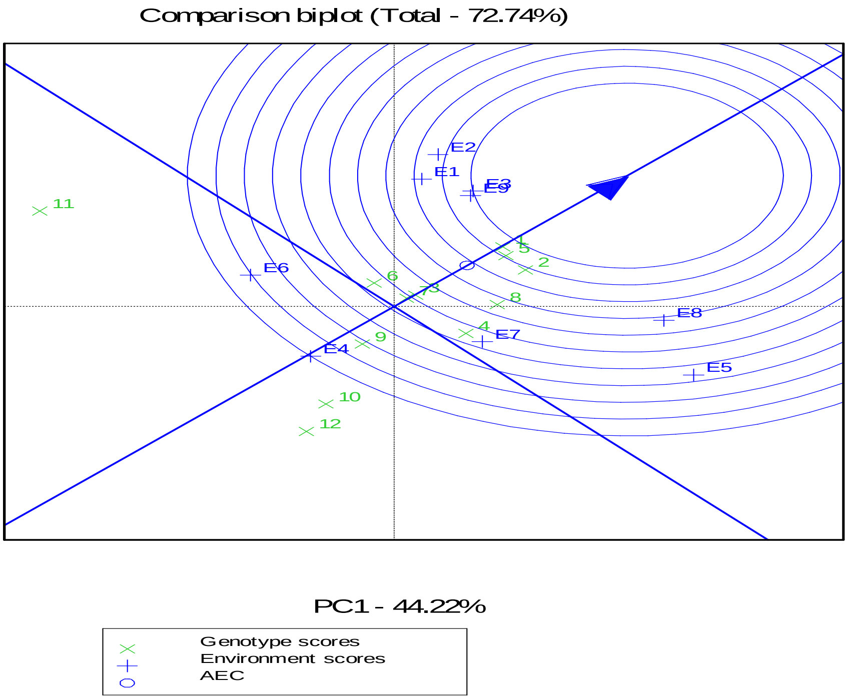


Fig (1). The" Mean vs. Stability" view of the GGE Biplot ranking for seed cotton yield of 12 genotypes across 3 environments in Middle andUpper Egypt over three seasons.

Ideal environment for seed cotton yield (SCY) and stability of the genotype has been shown in Fig (3). The environment located in the first concentric circle in Biplot termed as ideal environment and environments located close to the ideal present study, E3 (Sohage 2016) and E9 (Sohage 2018) are located in first concentric circle followed by E1 (Bani-Souf 2016) and E2 (El-Fayuom 2016) environments which are close to the ideal environments as desirable environments (Fig 3); therefore, it should be regarded as the most suitable to select widely adapted genotypes.



Fig(2) . Classification of the genotypes from the GGE Biplotof seed cotton yield (SCY) in different environments.



Fig(3) . Visualization of ideal environment using GGE Biplotfor seed cotton yield (SCY).

According to the Biplot analysis in Fig. (4), the corner genotypes that are the most responsive ones, can be visually determined. These corner genotypes were G1, G5, G2, G4, G8, G11 and G12. In this figure, locations are divided into six rays divide the Biplot into sectors. The first sector contains four environments, E1, E2, E3 and E9 with Genotypes G1, G5 and G2 as the most favorable. The second sector represents E8 and E5 with the genotype G8 and G4 as the most favorable. The two other corner genotypes G11 and G12 were the poorest yielding (Fig.4). They were located far away from all of test locations, reflecting the fact that they yielded poorly at each environment. The genotypes within the polygon nearer to plot origin (for example G3 and G7 for E1, E2, E3 and E9) are less responsive than vertex genotypes (Yan *et al* 2000)

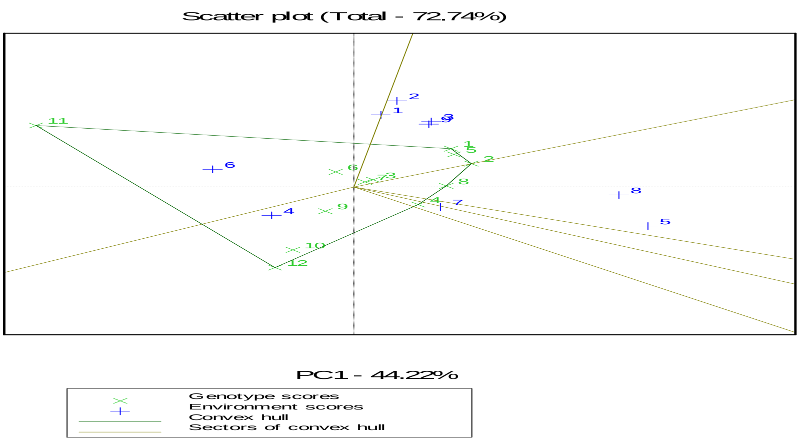


Fig.(4). GGE Biplot identification of winning genotypes and their related mega-environment.

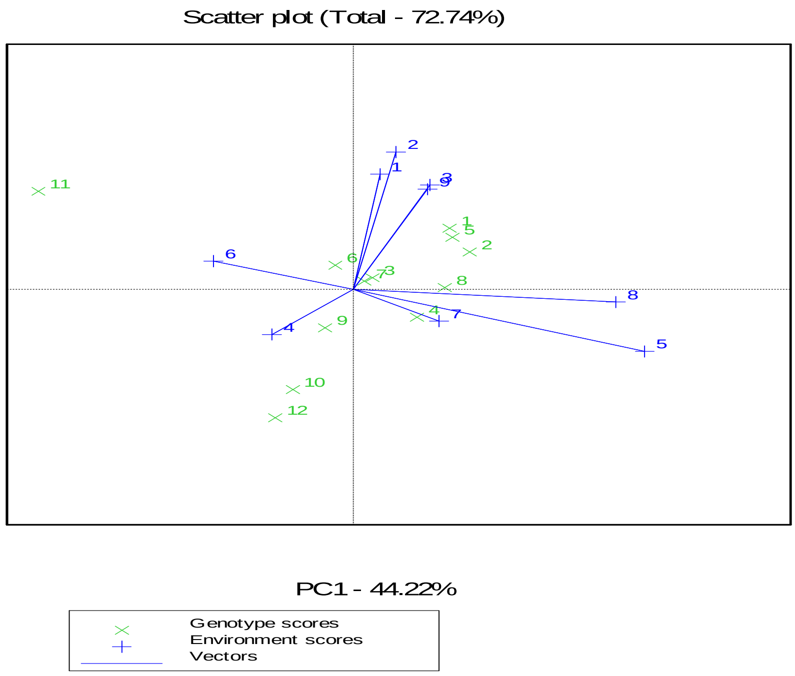


Fig.(5). GGE Biplot for the evaluation of the relationship among nine environments.

Figure (5) represents the evaluation and relationship among different environments over three seasons. Environmens having vector smaller angles are closely related. Positive correlations were found between E1 (Bani-Souif 2016), E2 (El-Fayuom 2016) and E3 (Sohage 2018) in a location as angle between them. On the other hand the genotypes groups G1, G2, G3, G5, G7 and G8 with the environments E3, E9 and E8 are close to each other in graph area represent the specific adaptation of genotypes to the environments and specific interactions were observed between them. The Results indicated that the environment effect is minimal in the variation of seed cotton yield.

Mean performance of the fiber quality for all cotton genotypes under different environments over seasons are presented in Table (3). Micronaire values (Mic) of all genotypes was ranged from 3.9 to 4.1 units with general mean of 4.0 units. The highest value for (Mic) was recorded by the genotypes G1, G3, G4, G8 and G9 which was (4.1 units). Lowest (Mic) value was recorded by the genotype G12 (3.9 units). The genotypes G5 and G2 recorded highest and lowest Upper half mean length (UHM), it was (30.9 and 29.2 mm), respectively. With respect to uniformity ratio (UR %) of 12 genotypes Table (4), ranged from 83.1 to 84.2% of the genotypes G1, G6, G7, G10, G11 and G12 exceeded the genotypes general means. General mean performance of maturity ratio for the genotypes was 0.92, on the other hand the highest and lowest value for maturity ratio was recorded in genotypes G1 (0.94), G5 (0.91) and G11 (0.91), respectively. Fiber strength (F.St gm/tex) Table (4), revealed that fiber strength (gm/tex) for the genotypes ranged from (36.5 to 38.0 gm/tex). The highest value and lowest value of fiber strength was recorded for the genotypes G3 and G7, it was (39.0 and 36.5 gm/tex).Yarn strength (Y.St) trait exhibited wide variation which ranged from (1840 to 1940) for the genotypes G7 and G11, respectively. The same genotypes recorded the highest and lowest values of yarn strength.

Table (3): Means of fiber quality of 12 Egyptian cotton genotypes at three environments over seasons

Code	Genotypes	Mic	UHM (mm)	UR %	Mature	F.St (gm/tex)	Y. St
G1	[(G91 × G90)] ×G85	4.1	29.9	84.1	0.94	37.8	1900
G2	[(G91 × G90)] × [G83 × (G75 × 5844)]	4.0	29.2	83.8	0.92	36.8	1915
G3	[(G91 × G90)] × [(G85 × G83)]	4.1	30.2	83.2	0.92	38.0	1905
G4	[(G91 × G90)] × [(G83 × G80) × G89]	4.1	30.3	83.3	0.93	37.4	1905
G5	[(G90 × Aust)] × [G83 × (G75 × 5844)]	4.0	30.9	83.5	0.91	37.7	1890
G6	[(G91 × G90)] × Karshink	4.0	30.6	84.1	0.92	37.1	1850
G7	[(G83 × G80)×Dandara]×[(G90 × Aust)]	4.0	30.0	84.2	0.92	36.5	1840
G8	[(G91 × G90)] × G80	4.1	30.4	83.8	0.93	37.6	1915
G9	(Giza 90 × CB 58)	4.1	29.9	83.1	0.93	36.5	1895
G10	[(G83 × G80) × G89] ×Aust	4.0	29.7	84.0	0.92	37.1	1870
G11	Giza 95	4.0	30.2	84.1	0.91	36.9	1940
G12	Giza 90	3.9	30.0	84.2	0.92	36.7	1915
	Means	4.0	30.1	83.8	0.92	37.2	1895

It's clear that the fiber quality of all cotton genotypes under study had a suitable fiber quality for Egyptian long staple cotton which grown in Middle and Upper Egypt.

Conclusion

Based on genotype environment interaction and GGE Biplot analysis, the genotypes G1 [(G91 × G90)] × G85, G5 [(G90 × Aust)] × [G83 × (G75 × 5844)] and G7 [(G83 × G80) × Dandara] × [(G90 × Aust)] were declared as best performers and ideal genotypes with respect to stability and producing maximum seed cotton yield in all environments. Therefore, the genotypes G1, G5 and G7 it could be used in breeding programs as promising material in future of breeding program to produce stable and high yielding cultivars.

Material and Methods

Ten Egyptian cotton genotypes and two cotton cultivars, Table (4) were grown in 2016, 2017 and 2018 seasons at three different locations represented Middle and Upper Egypt regions, i.e. Beni–soufe (E1), El-Fayoum (E2) and Sohag (E3). The experimental design in all locations was randomize complete block design with six replicates. Each experimental plot consisted of five rows, 4m long, 60 cm width and 30 cm between hills within a row. The hills were thinned to two plants. Cultural practices were applied as recommended for growing cotton. The middle three rows of each plot were hand harvested to determine seed cotton yield (SCY K/f).
Fifty open bolls were picked from the two outer rows per plot to determine fiber properties, i.e. yarn strength (Y.St unit), fiber uniformity ratio (UR %), Upper half mean length (UHM mm) and Micronaire reading (Mic). The lint cotton samples were tested at Cotton Technology Laboratory, Cotton Research Institute, ARC. High Volume Instrumentation (HVI) was used for determinations of fiber traits.

Table (4). Code and pedigree of 24 cotton genotypes, their parents and their origins.

Code	Genotypes
G1	[(G91 × G90)] ×G85
G2	[(G91 × G90)] × [G83 × (G75 × 5844)]
G3	[(G91 × G90)] × [(G85 × G83)]
G4	[(G91 × G90)] × [(G83 × G80) × G89]
G5	[(G90 × Aust)] × [G83 × (G75 × 5844)]
G6	[(G91 × G90)] × Karshink
G7	[(G83 × G80) × Dandara] × [(G90 × Aust)]
G8	[(G91 × G90)] × G80
G9	(Giza 90 × CB 58)
G10	[(G83 × G80) × G89] ×Aust
G11	Giza 95
G12	Giza 90

Seed cotton yield (SCY K/f) data for genotypes under study at different locations was analyzed using analysis of variance to determine the effects of environment (E), genotype (G) and their interaction (GE). Combined analysis of variance was computed for genotypes, locations, seasons and their interaction according to Snedecor and Cochran (1982) for each location.

GGE Biplot analysis (Yan, 2001) was used to interpret the genotype by environment interaction (GE) using Gen-stat14th ed. (Gen-Stat 2011). Only variables with significant effects of G and GE were appropriate for analysis using GGE Biplot (Blanche et al 2006).

Table (5): Mean effect of the interaction between cotton genotypes and environments over three seasons

Code	Genotypes	E1	E2	E3	Means
	2016				
G1	[(G91 × G90)] ×G85	11.68	10.38	8.58	10.21
G2	[(G91 × G90)] × [G83 × (G75 × 5844)]	11.37	10.04	8.78	10.06
G3	[(G91 × G90)] × [(G85 × G83)]	10.20	10.49	8.70	9.80
G4	[(G91 × G90)] × [(G83 × G80) × G89]	10.14	10.62	10.17	10.31
G5	[(G90 × Aust)] × [G83 × (G75 × 5844)]	11.10	10.29	9.61	10.33
G6	[(G91 × G90)] × Karshink	10.74	10.32	9.51	10.19
G7	[(G83×G80) × Dandara] × [(G90×Aust)]	10.83	11.83	9.93	10.86
G8	[(G91 × G90)] × G80	11.04	10.74	9.53	10.44
G9	(Giza 90 × CB 58)	10.78	11.23	9.91	10.64
G10	[(G83 × G80) × G89] ×Aust	9.98	12.23	9.85	10.69
G11	Giza 95	11.45	11.27	7.90	10.21
G12	Giza 90	8.96	10.75	8.13	9.28
	Grand Means	10.86	10.85	9.21	10,25
	2017				
G1	[(G91 × G90)] ×G85	8.40	13.02	12.40	11.27
G2	[(G91 × G90)] × [G83 × (G75 × 5844)]	7.55	13.96	12.73	11.41
G3	[(G91 × G90)] × [(G85 × G83)]	7.48	13.34	10.77	10.53
G4	[(G91 × G90)] × [(G83 × G80) × G89]	7.70	13.01	12.19	10.97
G5	[(G90 × Aust)] × [G83 × (G75 × 5844)]	8.22	13.61	12.19	11.34
G6	[(G91 × G90)] × Karshink	7.50	12.63	10.76	10.30
G7	[(G83×G80) × Dandara] × [(G90×Aust)]	7.19	12.78	10.79	10.25
G8	[(G91 × G90)] × G80	7.78	13.91	12.79	11.49
G9	(Giza 90 × CB 58)	7.50	14.69	12.26	11.48
G10	[(G83 × G80) × G89] ×Aust	5.66	13.12	10.38	9.72
G11	Giza 95	8.20	9.16	8.72	8.69
G12	Giza 90	5.85	12.57	11.24	9.89
	Grand Means	7.42	12.98	11.44	10.61
	2018				
G1	[(G91 × G90)] ×G85	8.66	8.41	10.19	9.09
G2	[(G91 × G90)] × [G83 × (G75 × 5844)]	9.14	9.17	10.07	9.46
G3	[(G91 × G90)] × [(G85 × G83)]	8.59	8.88	10.36	9.28
G4	[(G91 × G90)] × [(G83 × G80) × G89]	7.71	8.82	9.47	8.67
G5	[(G90 × Aust)] × [G83 × (G75 × 5844)]	9.62	9.56	9.79	9.66
G6	[(G91 × G90)] × Karshink	8.28	9.65	9.67	9.20
G7	[(G83×G80) × Dandara] × [(G90×Aust)]	9.10	9.47	9,89	9.49
G8	[(G91 × G90)] × G80	8.69	10.31	9.10	9.37
G9	(Giza 90 × CB 58)	8.62	10.22	8.88	9.24
G10	[(G83 × G80) × G89] ×Aust	7.70	9.33	8.79	8.61
G11	Giza 95	8.39	11.40	9.38	9.72
G12	Giza 90	6.63	9.23	7.87	7.91
	Grand Means	8.43	9.54	8.63	9.14

E1 . Bani-Souf environment E2 . El-Fayuom environment E3 . Sohag environment

Table (6): Fiber quality means of 12 Egyptian cotton genotypes in three seasons at three locations.

Code	Genotypes	Mic	UHM	UR%	Mature	F.St (gm/tex)	Y.St
2016							
G1	[(G91 × G90)] ×G85	4.0	30.0	84.8	0.94	37.2	2060
G2	[(G91 × G90)] × [G83 × (G75 × 5844)]	3.8	28.7	83.4	0.93	36.1	1980
G3	[(G91 × G90)] × [(G85 × G83)]	3.8	29.9	82.5	0.91	38.0	2050
G4	[(G91 × G90)] × [(G83 × G80) × G89]	3.8	30.0	83.3	0.92	36.9	2070
G5	[(G90 × Aust)] × [G83 × (G75 × 5844)]	4.0	30.5	82.9	0.92	36.5	2040
G6	[(G91 × G90)] × Karshink	3.8	30.8	84.3	0.92	36.4	1900
G7	[(G83×G80) × Dandara] × [(G90×Aust)]	3.8	30.1	85.1	0.91	35.9	1920
G8	[(G91 × G90)] × G80	4.0	30.4	84.1	0.93	37.2	2125
G9	(Giza 90 × CB 58)	3.9	29.8	83.3	0.92	36.2	2035
G10	[(G83 × G80) × G89] ×Aust	3.8	30.0	84.1	0.90	36.1	2055
G11	Giza 95	3.9	30.5	84.9	0.92	36.9	2035
G12	Giza 90	3.8	30.0	84.2	0.92	35.1	2045
	Means	3.9	30.1	83.9	0.92	36.5	2025
2017							
G1	[(G91 × G90)] ×G85	4.1	29.1	83.4	0.93	37.0	1695
G2	[(G91 × G90)] × [G83 × (G75 × 5844)]	4.1	28.6	83.8	0.92	35.8	1855
G3	[(G91 × G90)] × [(G85 × G83)]	4.1	29.9	82.6	0.93	37.3	1775
G4	[(G91 × G90)] × [(G83 × G80) × G89]	4.0	29.8	82.1	0.92	35.7	1800
G5	[(G90 × Aust)] × [G83 × (G75 × 5844)]	3.9	31.2	83.3	0.90	37.3	1785
G6	[(G91 × G90)] × Karshink	4.1	30.1	83.7	0.94	35.8	1745
G7	[(G83×G80) × Dandara] × [(G90×Aust)]	3.9	29.2	83.5	0.90	35.0	1760
G8	[(G91 × G90)] × G80	4.0	30.4	83.0	0.92	36.5	1780
G9	(Giza 90 × CB 58)	4.0	28.9	83.0	0.92	35.8	1785
G10	[(G83 × G80) × G89] ×Aust	4.1	28.1	83.8	0.92	36.3	1695
G11	Giza 95	3.9	29.4	83.2	0.90	35.2	1935
G12	Giza 90	4.0	29.4	84.2	0.91	36.2	1820
	Means	4.0	29.5	83.3	0.92	36.2	1785
2018							
G1	[(G91 × G90)] ×G85	4.3	30.5	84.2	0.94	39.1	1947
G2	[(G91 × G90)] × [G83 × (G75 × 5844)]	4.2	30.4	84.2	0.92	38.5	1907
G3	[(G91 × G90)] × [(G85 × G83)]	4.3	30.9	84.4	0.92	38.6	1893
G4	[(G91 × G90)] × [(G83 × G80) × G89]	4.4	31.1	84.5	0.95	39.6	1840
G5	[(G90 × Aust)] × [G83 × (G75 × 5844)]	4.2	31.0	84.4	0.92	39.3	1847
G6	[(G91 × G90)] × Karshink	4.2	31.0	84.2	0.91	39.2	1900
G7	[(G83×G80) × Dandara] × [(G90×Aust)]	4.3	30.6	84.1	0.95	38.7	1833
G8	[(G91 × G90)] × G80	4.3	30.5	84.4	0.94	39.0	1847
G9	(Giza 90 × CB 58)	4.4	31.0	82.9	0.96	37.5	1860
G10	[(G83 × G80) × G89] ×Aust	4.2	31.1	84.2	0.93	39.0	1860
G11	Giza 95	4.2	30.6	84.1	0.91	38.7	1847
G12	Giza 90	4.0	30.5	84.1	0.94	38.7	1873
	Means	4.3	30.8	84.1	0.93	38.8	2940

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Fiber and yarn quality paramiters of Some Giza Egyptian Cotton Varieties

Suzan H. SANAD*, EL-ADLY H. [1], and M. A. NEGM

[1]Cotton Research Institute, Agri. Res. Center, Giza, Egypt
* souzan_ms@yahoo.com

Abstract

This study carried out in Cotton research Institute, to assess the quality of Giza 94, Giza 95 and Giza 96. The new promising Extra-long and Long Staple Egyptian cotton varieties. The goal of new variety introduction is to replace a current variety with one that shows significant improvement in particular areas, notably yield, fiber quality, resistance to relevant diseases or pests. From the breeding perspective, new varieties should always be "available". From traders and ginners point of view, new varieties should be higher quality and lint percentage than the existing varieties. From textile and commercial perspective, availability will depend on the probable profit potential of new varieties. Giza 94, Giza 95 and Giza 96 produced to meet these requirements.

Giza 95 presented in Upper Egypt, Giza 94 presented in Delta Egypt, both of them belonging to Long-Staple category. While Giza 96 presented in North Delta as Extra-long staple variety. Long-Staple Egyptian cottons; the commercially grown Giza 90, and the newly introduced Giza 95 were spun into 40s and 50s counts. The commercially grown Giza 86, and the newly introduced Giza 94 were spun into 80s and 100s counts. The commercially grown Giza 92, and the newly introduced Giza 96 were spun into 100s and 120s counts. All the yarns were processed on Compact spinning system. Giza 95 found to be generally better to Giza 90 in single yarn strength, yarn unevenness, yarn neppiness and yarn hairiness. While Giza 94 with same fiber and yarn quality "in some characters" in compared with Giza 86. Giza 96 remarkable similar quality of Giza 92.

Keywords: Egypt, Cotton, Gossypium barbadense, fiber quality, varieties

Background

Egyptian cotton fibre quality must improve to remain competitive with other Extra Long and Long Staple producers due to increased demands for lightweight casual garments which require longer, stronger, and finer fibres. Improved cotton yields and fibre quality have continued to be realized through science-based plant breeding, particularly in Egypt and production systems with suitable climate and appropriate management inputs to maximize those improvements. The most significant challenge for cotton breeders has been to combine high yield with improved fiber quality, due to negative associations between yield and quality attributes in G. barbadense, El-Sayed, and Sanad, (2007).

Successful cotton improvement strategy must face both the quantity and year-to-year stability of fibre production to meet producer needs, while the enhancement of the magnitude and uniformity of certain fiber quality traits is needed for the technologically evolving yarn and textile industries. CRI is introduce new three cotton varieties in the last five years. As the new three varieties are clearly distinguished into three quality categories, they could be reviewed accordingly, ARC-CRI (2020).

Giza 96 (2015), Extra Long Staple variety. A cross between [(Giza 84 (Giza70 x Giza 51b)] X Stain PS62. In comparison with improved Giza 92 has a substantially higher fiber length (1.5 mm) and coarser fibers, but it has a slightly lower fiber strength (2 GPT). Giza 92 is highest cotton fibre strength between world cotton cultivars. Released to commercial production in 2015, it rose quickly to 909 hectares in 2015 comprising about 24 % of the ELS cultivated area, and by 2018 it reached its peak, when it covered 3820 hectares, i.e.51% of the ELS area. By year 2020, the total are of cotton production is reduced by almost 29%. In 2020 Giza 96 covered 1300 hectares and 31% of the total Extra Long staple cultivated area, "CATGO (2020) Figure 1.

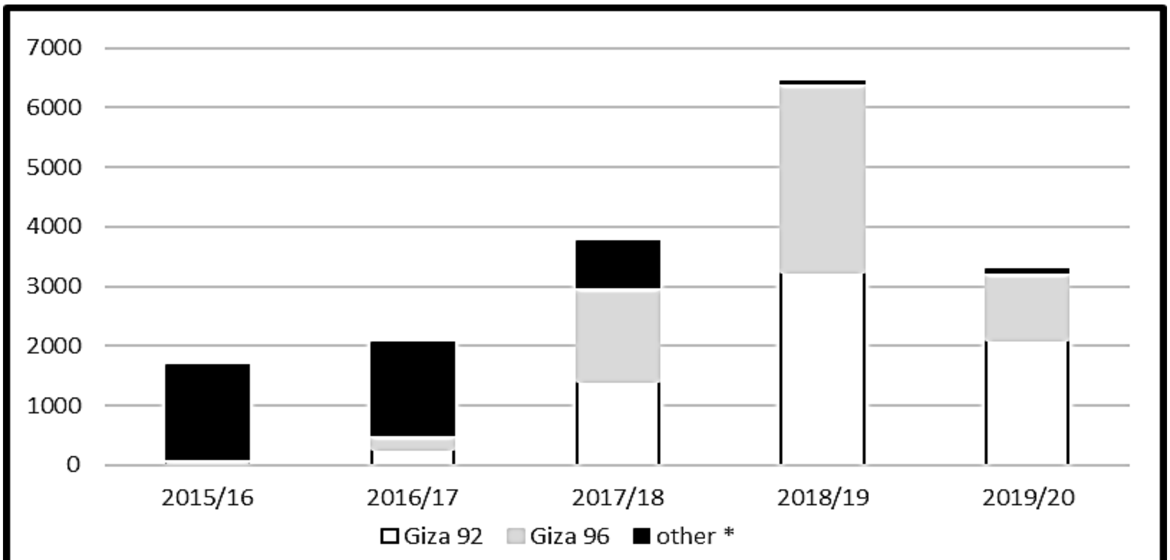

Figure 1. Area of cotton production /ha for ELS Cotton

Other; Extra Long Extra Fine, i.e., Giza 45, Giza 87 and Giza 93.

Giza 94 (2016), Long Staple Delta cotton variety. A cross between Strain 10229 and Giza 86. It proved to be one of the most successful Egyptian cotton varieties. Giza 94 is of white lint and of the same fiber length as Giza 86 and high ginning outturn "GOT is 39.36%", consequently surpassed Giza 86 in cultivated are. Launched into commercial production in 2016, its acreage grew rapidly to 64538 hectares in 2020, about 64% of total cotton cultivated areas. Its acreage reached a peak in 2019 of 82532 hectares 58% of the total cotton cultivated area, (Figure 2).

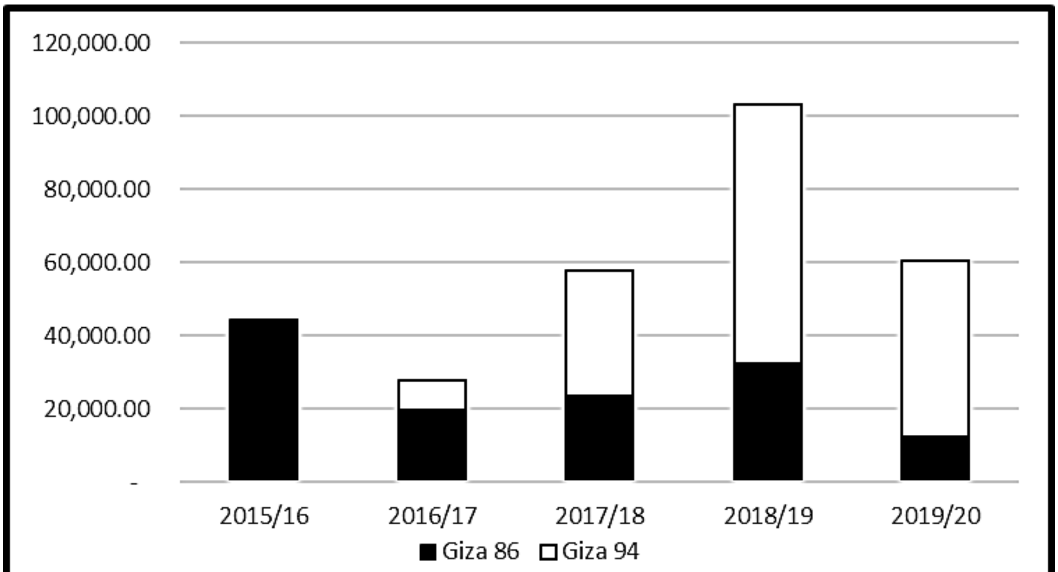

Figure 2. Delat Long Staple Cotton Production

Giza 95 (2015), Upper Egypt Long Staple varieties. A cross between [(Giza 83 (Giza75 x Strain 5844)] X Giza 80. Released for commercial production in 2015, when it was grown in about 1916 hectares, its acreage was increased in the following years to 11800 thousand hectares, (Figure 3). However, its yield potential is the higher than Giza 90, its main merit is its earliness.

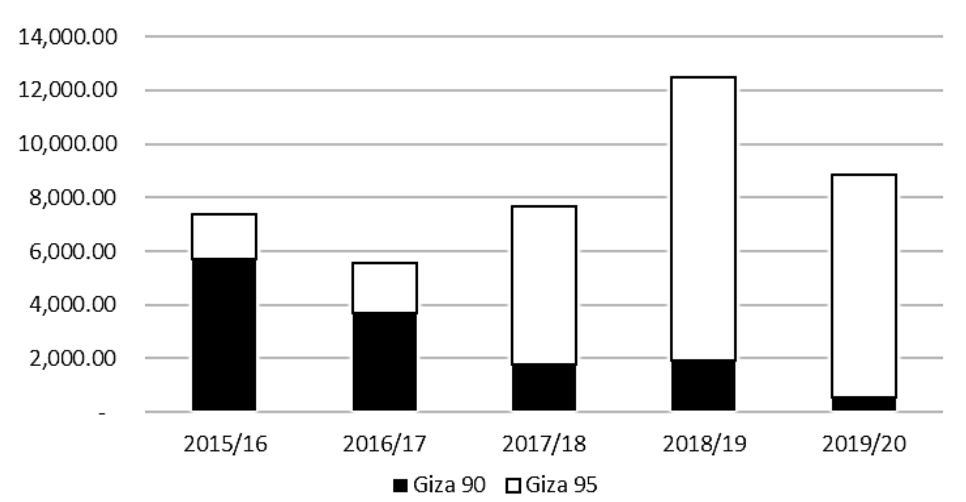

Figure 3. Upper Egypt cotton production

CRI is assessing the quality of the new varieties in their fibre and yarn properties to give the industry guidance or identifying its highest priority fibre quality needs.

In this study, the quality properties of the new commercial varieties Giza 96, Giza 94 and Giza 95 were compared with those of the established commercial varieties, Giza 92, Giza 86 and Giza 90 cotton varieties from the standpoint of quality level.

Table 1. Processing outline.

Cotton category	Upper Egypt Lon Staple cotton	Delta Long staple	Extra Long Staple
Commercial variety	Giza 90	Giza 86	Giza 92
New variety	Giza 95	Giza 94	Giza 96
Spinning process	Blowroom, Carding, Drawing, Combing, Drawing, Roving, Compact Spinning and winding		
Yarn count (Ne)	40 Ne and 50 Ne	80 Ne and 100 Ne	100 Ne and 120 Ne
Twist multiplier		4.2	

Table 2. Fibre quality properties of Egyptian cotton varieties under study.

Cotton Varieties	Fiber length Parameters		Fibre Tenacity		Micronaire	Maturity Ratio	Value of color attributes	
	UHM (mm)	Uniformity %	Strength (G/Tex)	Elongation %			Brightness Rd %	Yellowness (+b)
Giza 92	33.7	86.5	46.1	6.3	3.7	0.93	77.7	7.9
Giza 96	35.2	86.4	44.8	6.4	4.0	0.93	75.7	8.3
Giza 86	33.3	86.7	44.0	7.3	4.3	0.95	75.9	7.9
Giza 94	34.1	86.5	43.7	7.4	4.3	0.94	72.3	7.6
Giza 90	29.3	85.3	36.0	7.2	4.3	0.92	62.8	11.3
Giza 95	30.1	85.7	36.9	7.1	4.2	0.93	67.4	11.8

Results and Discussion

Upper Egypt Long Staple Cotton category

Fiber and yarn properties

Much breeding effort directed towards enhancing cotton fiber length to promote ring-spinning performance. Breeding for fiber quality has focused on increasing the length and strength, typically measured by High Volume Instrument. Egyptian cotton breeders have been very successful for increasing the Upper Half Mean Length and length uniformity and reached the maximum fiber length limit in the LS cotton category, i.e., 30.1 mm for Giza 95. Table 2 demonstrates the relation between fiber length and fiber strength in commercial and new cotton varieties.

Yarn quality

From the data presented in Table 3, it is possible to summarize the differences between the two varieties in the following points:

Regarding to compact ring spinning, ring spinning is the only system that offers a real challenge to Open End spinning for coarser and medium yarn count up to 40 Ne and it offers successful processing of cotton at significantly higher quality than Open End spinning.

Regarding to ring spinning system, single yarn strength of Giza 95 is similarly higher than that for Giza 90. Giza 95 yarns are generally more even than those of Giza 90. As a result, the coefficient of variation of single yarn tenacity is generally lower for Giza 95 than it is for Giza 90, or in other words, Giza 95 yarns are of more regular strength, a property that undoubtedly, lead to higher weaving efficiency when using Giza 90 yarns. The Results show that, with increasing twist, yarn tensile properties increased in an approximately linear over the range of twist multiplier considered.

Raw material represents the largest item among operating costs for Egyptian spinning mills. Assuming, raw material represents, on average, 65 % of spinners' estimated operating costs, the minimum yarn count should be spun from Upper Egypt cottons is 50's. Below this count, the spinning mill will achieve lose. Generally, production of coarse or fine yarn counts from specific cotton depends on the demand and costumer desire.

Table 3. Compact Yarn properties, of 40 Ne and 50 Ne spun from Giza 95 and Giza 90.

	Giza 95	Giza 90	Giza 95	Giza 90	L.S.D. at 0.05 Level
	40 Ne		50 Ne		
Count	39.6	39.4	50.7	50.9	
C.V. count	0.8	0.8	3.4	1.2	2.45
Tpi	26.0	25.8	29.6	29.4	4.06
C.V. Tpi	3.2	4.5	1.9	4.0	2.22
TM	4.2	4.1	4.2	4.1	0.08
Strength	22.4	22.5	22.9	24.0	1.46
C.V. Strength	6.6	7.9	7.4	9.8	1.05
Elon.	6.3	6.0	5.9	5.5	0.65
CVm	11.0	11.7	13.3	13.0	2.11
Hairiness	2.8	2.7	2.9	3.0	0.25
Thin places	1	1	2	4	2.77
Thik places	6	12	18	25	15.95
Neps	17	23	22	28	8.84

Delta Long Staple Cotton category

Giza 86, the commercial variety is of staple length about 33 mm. While, Giza 94 is of staple length to the upper limit defining the Long-Staple cottons (Table 2), or in other words the lower limit defining the Extra-Long Staple cottons, thus they are really a bridge between these two groups, their staple length is about 33 mm. The fiber tensile properties, Micronaire reading and colour attribute are of similar trend of both varieties; since Giza 86 is one of Giza 94 parents.

Generally, as fiber length, fineness and strength are the most important factors in determining the spinning limit, and as the two cottons Giza 86 and Giza 94 are equal fiber length and strength, thus both commercial varieties are expected to be more suitable for finer counts.

Table 4 presents the tenacity and yarn imperfections of yarns in the function of linear densities of the yarns formed. With the decrease in linear density of the yarn, the tenacity of the yarn slightly increase.

Table 4. Compact yarn properties of 80 Ne and 100 Ne spun from Giza 86 and Giza 94.

	Giza 94	Giza 86	Giza94	Giza 86	L.S.D. at
	80s		100s		0.05 level
Count	80.5	80.9	101.0	99.0	
C.V. count	2.0	2.4	2.2	1.3	0.94
Tpi	37.5	37.9	43.0	42.0	5.52
C.V. Tpi	2.4	2.9	2.6	2.0	0.74
TM	4.2	4.3	4.3	4.2	0.09
Strength	25.3	26.7	26.7	26.6	1.31
C.V. Strength	8.6	9.6	8.6	8.5	1.02
Elon.	5.3	5.2	5.2	4.4	0.82
CVm	11.2	12.1	12.0	12.5	1.07
Hairiness	2.1	2.2	2.2	2.1	0.11
Thin places	8	4	12	11	7.04
Thik places	23	33	19	25	11.54
Neps	18	23	23	22	4.67

For the Long Staple cotton variety Giza 86 and Giza 94, single yarn strength of the compact yarn with a nominal linear density of 80 Ne compact spun yarn are 25.5 g/tex and 26.7G/tex.

The cost of Delta Long-Staple raw cotton purchased represents between 40% and 45% of the total selling costs of 100% cotton combed yarn count 80 Ne and 100 Ne, respectively. However, the main competitiveness of the Egyptian Delta Long-Staple cotton is only in combed yarn fine counts “more than 70’s” to achieve revenue with 5% Uster quality level, (Uster Statistics 2018).

Extra Long Staple Cotton category

Because of the importance of staple length, or in fact the length properties, in assessing the quality of the Extra-Long Staple cottons, it is useful to compare in some details the length properties of these two varieties, i.e. Giza 92 and Giza 96. Table 2 shows the fiber properties of the two ELS cotton varieties. The UHM of Giza 96 is around 35.1 mm. while, Giza 92 is shorter and still can’t reach the length of ELS category.

Giza 92 is of much higher fiber strength which compensated for its shortness and resulted in its having a higher level of yarn strength. In addition to the priorities, yarn manufacturers have asked for higher fiber strength. Enhancement of fiber strength through introgression from Giza 92 has been successful through Long-term advanced breeding efforts.

Table 5 shows yarn properties of the two cottons grown in north Delta. It is apparent that the mean value of tensile strength of Giza 92 is somewhat higher than that for the Giza 96. Single yarn strength of Giza 92 is substantially higher than Giza 96. This increase in strength is attributed partially to its higher fiber strength and fiber length uniformity. But the most effective factor is, undoubtedly, its substantially higher fiber strength. However, the Giza 92 could be regarded as comparable to Giza 96 and to be grown commercially so as to suffice the requirements of as exporting and local mills as possible.

Table 5. Compact Yarn properties, of 100Ne and 120 Ne spun from Giza 96 and Giza 92.

	Giza 96	Giza 92	Giza 96	Giza92	L.S.D. at 0.05 level
	100s		120s		
Count	98.4	101.1	123.2	122.0	
C.V. count	2.4	3.6	2.3	1.7	1.56
Tpi	42.7	38.2	48.8	48.4	9.94
C.V. Tpi	1.7	2.6	1.0	0.4	1.86
TM	4.2	3.8	4.4	4.4	0.58
Strength	27.3	27.5	27.7	27.8	0.29
C.V. Strength	4.8	6.4	7.8	8.6	3.27
Elon.	5.9	4.4	4.6	4.6	1.36
CVm	11.5	12.3	11.5	11.4	0.82
Hairiness	1.9	1.8	1.9	1.9	0.10
Thin places	12	15	14	21	7.59
Thik places	22	24	23	27	4.23
Neps	22	23	26	26	4.04

The yarns spun on the compact spinning system are characterized by higher tenacity, higher elongation at break, smaller mass irregularity measured at short segments, and lower hairiness in comparison with yarns spun on the conventional ring spinning frame. As the Extra Long-Staple are used extensively in combed and fine spinning it is apparent that for combed 120s yarns; both Giza 96 and Giza 92 are of equal strength, However, it should be kept in mind that spinning these cottons at such very high counts (120s) is almost common in India.

Materials and Methods

The present study carried out in Egyyarn spinning Company, to assess the quality of new commercial varieties Giza 96, Giza 94 and Giza 95 in compared with those of the established commercial varieties, Giza 92, Giza 86 and Giza 90 cotton varieties. Two tons of each cotton variety taken and possessed into spinning line to produce winding cones. Fiber yarn properties were determined at the Egyyarn Spinning Laboratories, Egypt. All the Egyptian cotton varieties under study used to produce Compact combed yarns as shown in Table 6.

Fiber characteristics: The cotton fiber properties such as, fiber length, fiber uniformity, fiber strength, fiber elongation, fiber micronaire, fiber maturity, fiber reflectance fiber yellowness were evaluated as per standard, ASTM Committee, 1997a as shown in Table 7.

Yarn preparation: After evaluation of the physical characteristics of the raw material, each cotton lots opened and processed in spinning line. The counts for the yarn samples collected according to Table 1. The yarn samples thus, prepared were tested according to the standard methods as recommended by ASTM Committee (1997b).

Yarn Strength and elongation: yarn Strength and elongation were measured with Statimat ME-Textechno-Germany, (10 bobbins per sample and ten breaks per bobbin).

Yarn imperfections: This involved measuring the mass variation, yarn hairiness, thin and thick places and number of neps, per 1000 meters of the yarn using USTER 4. This was determined by measuring the capacity occurring as the yarn pass through the condenser and record in terms of total number of neps, thick places and thin places. 10 bobbins per sample and 1000m per bobbin of yarn on the USTER 4 equipment in accordance with the procedures of ASTM standards (ASTM Committee, 1997b as specified by American Society for Testing and Materials (ASTM) Standard D1425/D1425M.16.

Yarn count: Yarn count determined by the Lea Count Method according to ASTM standard (ASTM Committee, 1997c) on Uster Autosorter.

Yarn twist: The yarn twist was measured using the opposite twist method on the digital twist tester. In this way, the random error of mean value was less than 2%.

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