New Valley Journal of Agricultural Science
Published by Faculty of Agriculture, New Valley University, Egypt
DOI: 10.21608/nvjas.2022.174385.1112
Research Article Open Access

A New High Yielding and Long Staple Egyptian Cotton (*Gossypium barbadense* L.) Variety "Super Giza 94"

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Received: 12/11/2022
Revised: 26/12/2022
Accepted: 26/12/2022
Published: 26/12/2022

Abstract

The Egyptian long staple cotton variety "Super Giza 94" was developed by Cotton Research Institute CRI, Giza, Egypt, which belongs to ***Gossypium barbadense*** **L**. Super Giza 94 is a novel plant structure improved seed cotton yield, lint percentage and fiber quality traits. Super Giza 94 was developed through one-way hybridization of elite parental cotton genotypes accompanied by pedigree selection method to incorporate the excellent combinations of higher yield potential, early maturity and fiber quality traits with resistance to Fusarium wilt. The superior plant combinations were selected in F_2-F_6 generations entirely based on phenotypic plant traits and progeny yield potential in the field conditions. The selected strains were evaluated in multilocations yield trials over three years and six locations in a randomized complete block design with six replications. The results of these trials exhibited that the new variety surpassed the three commercial varieties of these locations in most yield traits. Super Giza 94 is characterized by early maturity with high yield potential, fluffy opening and easy to pick, strong resistance to Fusarium wilt disease, high lint percentage (40.2%) with improved fiber traits including fiber length (34.1mm), fiber strength (43.4 g/tex), micronaire reading (4.2), uniformity ratio (86.9%), yellowness +b (8.3), brightness Rd (79.8%) and white lint color. Super Giza 94 can solve maximum challenges of better cotton production in the area and fulfil industrial requirements. For that, recommended for general cultivation in the Delta region in the 2016 growing season.

Keywords: Egyptian cotton (*Gossypium barbadense* L.,), Long-staple, Yield, Multilocations yield trials, Production technology.

Introduction

Egypt is one of the main long and extra-long cotton producers in the world. All the Egyptian cotton varieties are belonging to *Gossypium barbadense* L. The Egyptian cotton breeding program is depending on artificial hybridization to produce new varieties since 1921. Since the introduction of long-staple cotton to Egypt and the active and efficient breeding program, nearly 98 cotton varieties have been developed and utilized in the main cotton production regions. All of these Egyptian cotton varieties are produced from artificial hybridization except one variety (Dandara) produced from field selection (**Al-Didi, 1972 and 1982**). Cotton yield per area unit has been doubled from the old varieties to the newest ones. The cotton breeders are working hard to putting effort and develop different cotton traits such as; morphological, physiological, quantitative yield components and fiber quality traits that directly or indirectly could increase cotton production per unit area (**Fehr, 1987** and **Sharma *et al*., 2021**). The Egyptian cotton breeding program uses the pedigree selection method to make an excellent combination of the most desirable traits to improve new cotton varieties, which enhances yield productivity per unit area. The main objective of this breeding program is to achieve desirable targets for farmers (high yield and early maturity), traders (high lint %), spinners (good fiber quality) and breeders (wide range of agro-climatic adaptability under different regions and resistance to pest and diseases). **El-Adly, *et al*., 2018** noticed that Giza 95 has an increasing percentage of 6.90% and 16.32% for seed cotton yield / F and lint yield / F higher than the previous commercial variety Giza 90. Also, **Abdelbary *et al*., 2021** reported that Giza 97 is developed by this program and produced 12.35 K/F, 13.93 K/F and 39.82% for seed cotton yield, lint yield and lint % traits, respectively. So, this program produces new cotton varieties with sustainable production of cotton yield for the domestic and export industry.

The main target of the Egyptian cotton breeding program is to release new varieties characterized by high-yield production coupled with high fiber quality. All of these traits are quantitative traits controlled by many genes and affected by environmental factors. So, the breeders used several biometrical analyses to analyze these traits and to understand genetic control and genetic behavior for the economically studied traits. Selection is used to select the best-performing genotypes and reduce environmental factors effects and increase fixed gene action (**Yan and Kang, 2003**). Selection changes the population's genetic structure to eliminate undesirable genes and maintain desirable genes, which is a result of the recombination between superior alleles from different loci. Also, estimate heritability to identify the amount of genetic variation transferred from one generation to the next one. Selection for high heritability traits helps the breeder to select the most superior plants to improve the genetic makeup of cotton plant (**Abdelmoghny, 2021, Abdelmoghny *et al*., 2021 and Gibely, 2021**).

Genotype x environment interaction (GEI) is explaining both genetic potential of the genotypes and the interaction between genotypes with environment (climate, soil type, planting methods, and management technology) that affect genotype performance (**Shahzad *et al*., 2019)**. Characterizing genotype by environment interaction (GEI) is helpful to identify stable genotypes across diverse environments and the available knowledge about the nature and structure of GEI is important to the plant breeder for direct and indirect selections of potential genotypes for crop breeding program **(Zubair *et al*., 2020**). The indirect selection for the target traits requires multilocations yield trials, which needs suitable statistical stability methods to estimate the performance, adaptability and stability of genotypes. Also, the breeders need to minimize GEI for any crop production system (**Ail, 2017** and **Abdelmoghny *et al*., 2019 and 2020**). The plant breeders define stable genotype that shows the superior mean performance and stability yield across different environments or the genotype that has minimum interaction between genotype and environment (**Eberhart and Russell, 1966**).

Super Giza 94 is a new long-staple cotton variety characterized by high yield production, high lint %, early maturity and resistance to Fusarium wilt diseases and evaluated for sustainable high-yield potential under adverse climatic conditions in the Delta region during three growing seasons in 2006, 2007 and 2008. The Cotton Research Institute recommended Super Giza 94 for general cultivation in the Delta region in the growing season of 2016.

Materials and Methods

Super Giza 94 was derived from an artificial intra-specific hybridization between two ***Gossypium barbadense*** L., parents; the pure line R102 as female and the Egyptian cotton variety Super Giza 86 as male performed in 1999 at Giza Experimental Research Station, Cotton Research Institute, Agricultural Research Center, Giza, Egypt. The origin and characterization of the two parents are presented in **Table 1**. The following generations and pure lines were grown in Sakha Experimental Research Station, Kafr El-Sheikh, Agricultural Research Center, Egypt between 2000 and 2015. The seeds from the first filial generation (F_1) were obtained from this cross, which was sown in the field during the growing season of 2000. The selfed seeds of the F_1 plants were harvested, giving rise to seeds of the second filial generation (F_2). The selfed F_2 seeds were sown as individual plants to produce F_2 plants. Selection of the best plants started in F_2 depending on plant architecture, agronomic traits and fiber quality traits. Starting from F_3 to F_5 generation each selected plant consists of a bulk family derived from natural seeds and individual plants derived from selfed seeds. Field selection was done on based on visual evaluation for yield potential, plant height, and plant architecture and subsequently reselected in the laboratory based on yield potential and fiber properties determined with individual instruments for individual plants and high volume instruments (HVIs) for bulk families.

In 2005, eight progeny lines were selected for evaluation in the preliminary trial (LA) replicated trial in one location (Sakha experimental research station), based on visual evaluation of yield components performance and fiber properties. During three growing seasons from 2006 to 2008, the two progeny lines were selected to evaluate in the regional or advanced yield trial (LB) which was established in six locations; Kafr El-Sheikh, El-Beheira (E2), El-Mofiya, El-Dakahlia, El-Gharbiya and El-Sharquiya compared with the commercial varieties of these locations. These locations represented the most important cotton production area for long-staple cotton varieties in the Delta region. The experimental design of the two replicated trials (preliminary yield trial (LA) and multi-location yield trials (LB)) was a randomized complete block design (RCBD) with six replications in each location. Each entry was grown in a plot of five rows set of 4m in length, 70cm apart and the distance between plants within rows was 30cm, to become an experimental plot size was 14 m^2. General agronomic and cultural practices recommended for cotton crop production were adopted at each location during all the growing seasons. At harvest, fifty bolls were collected from the two outer rows to measure the average boll weight (BW) in grams. While, the three inner rows were harvested to estimate seed cotton yield (SCY) and lint yield (LY) which is expressed in Kantar/Faddan (Kantar of seed cotton yield =157.5 Kg, Kantar of lint yield = 50 Kg and Faddan=4200 m^2). Also, fiber quality characters were estimated at Fiber quality traits were estimated at Cotton Technology Laboratory, Cotton Research Institute, Agricultural Research Center, Giza, Egypt.

Based on the results of the multi-locations yield trial the breeders decide to isolate this promising cross. In 2009 the selfed seeds of sixty selected plants were sown in an isolated field at Sakha experimental station, Kafr El-Sheikh governorate. This field must be far 1 Km from other cotton fields from all directions to avoid cross-pollination. During the five from 2011 to 2015 growing seasons the variety yield trial was done in a randomized complete block design with six replications. The plot consists of five rows, 4m in length: 70cm distance between rows and 30cm within plants with the total experimental plot size being 14 m^2.

DNA Extraction

The DNA was extracted by using CTAB-based method from cotton (*Gossypium barbadense* L.,) leaves previously collected. The procedure was developed by **Doyle and Doyle**, **1987**. The leaves were collected and immediately stored at -80°C for further analysis. Ten polymorphic primers (OPM-18, OPM-08, OPM-01, OPH-19, OPH-13, OPQ-11, OPM-06, OPQ-05, OPD-11 and OPQ-07) were selected to amplify the genomic DNA. The fingerprints were examined under ultraviolet Trans-illuminator and photographed using Syne-Gene Documentation System.

Statistical analysis

The data of yield traits; boll weight, seed cotton yield and lint yield and fiber quality traits were recorded and statistically studied based on Analysis of Variance (ANOVA) using an R software program. The significance tests of the student t- test and Fisher F- test at the two appropriate probability levels p<0.01 and p<0.05 for the comparison with standards checks as described by **Gomez and Gomez, 1984.**

Results

Artificial hybridization between the pure line R102 and the commercial cotton variety Super Giza 86 was done at Giza experimental research station, Giza, Egypt during the growing season of 1999. After that, the hybrid seeds of $F_1$and the following generations were planted in the next seasons in the cotton breeding field at Sakha Experimental Research Station, Kafr El-Sheikh, Agricultural Research Center, Egypt during fifteen growing seasons from 2000 to 2015. The plant breeder must establish multi locations yield trials (LB) to evaluate the best cotton crosses across six locations (Kafr El-Sheikh (E1), El-Beheira (E2), El-Mofiya (E3), El-Dakahlia (E4), El-Gharbiya (E5) and El-Sharquiya (E6)) with six replication in each trail during three growing seasons (2006, 2007 and 2008), which represent cotton-growing area (Delta region) for long-staple category compared with the three commercial varieties of this category (Super Giza 86, Super Giza 85 and Super Giza 89). The results of these trials showed that mean performance for the two selected families had higher seed cotton (K/F) yield, lint yield (K/F) and lint % compared with the three commercial varieties of these locations at farmer's fields (**Table 2**). Also, the results of combined analysis of variance from the published data (**Abd El-Moghny and Max, 2015; Ali, 2017 and Abdelmoghny *et al.*, 2019 and 2020**) showed that the variance across locations and growing seasons showed highly significant differences (P < 0.01) differences between locations (E), growing seasons (Y) and among genotypes (G) for seed cotton yield (K/F), lint yield (K/F) and boll weight (BW). The interaction between G x E, Y x E and Y x G was significant for all yield studied traits. While fiber quality traits were belonging to the long-staple cotton category; fiber length was ranged from 31 to 35mm; fiber strength above 10.5 bressley index and more than 42 g/Tex. Also, the results from the recently completed studies of multilocations yield trails carried out by **Abd El-Moghny and Max, 2015; Ali, 2017 and Abdelmoghny *et al.*, 2019 and 2020** using phenotypic or genotypic stability analysis in the delta region showed that the new variety Super Giza 94 had high-yield performance coupled with good adaptability to the Delta region.

One important aim of the Egyptian cotton breeding program is to compare the new variety with the commercial varieties in farmer's fields under the farmer's complete control. After the two commercial varieties (Super Giza 85 and Super Giza 89) are out of general cultivation, the cotton breeder compares the new variety with the only remaining commercial variety (Super Giza 86). The comparison between the new cotton variety "Super Giza 94" with the commercial variety " Super Giza 86" during sixteen growing seasons from 2006 to 2021over six locations (Delta region) as shown in **Figures 1, 2 and 3** for seed cotton yield (K/F), lint yield (K/F) and lint %, respectively.

The Egyptian cotton breeder decided to isolate the new lines of new cotton variety "Super Giza 94" in an isolated field to produce breeder seeds. During five growing seasons from 2009 to 2015, the breeder evaluated twenty nuclei in a randomized complete block design (RCBD) with six replications as the variety yield trial with five rows in each plot (the plot size was 14 m^2). The target of this trial is to test the homogeneity and uniformity between these nuclei. During five growing seasons from 2011 to 2015 the breeder evaluated the nuclei of this new variety to estimate the variability between these nuclei for yield components and fiber quality traits. The phenotypic mean performance of the selected five nuclei during five growing seasons (from 2011 to 2015) was shown in **Figures 4, 5 and 6** for seed cotton yield (K/F), lint yield (K/F) and lint percentage (L %), respectively. The new cotton variety "Super Giza 94" is belonging to the long-staple cotton category, which characterized by fiber length (34.2 mm), uniformity index (87.0 %), micronaire value (4.3), fiber strength was (43.61 g/tex), yellowness or +b (8.4) and yarn strength (2464) as the average value during five growing seasons as presented in **Table 3**.

RAPD profiling for the new cotton variety "Super Giza 94" was used to reveal its genetic composure as shown in **Figure 7**. Ten RAPD primers OPM-18, OPM-08, OPM-01, OPH-19, OPH-13, OPQ-11, OPM-06, OPQ-05, OPD-11 and OPQ-07 were used to amplify the new variety. These ten primers were the best amplified with the new variety by giving different molecular weight bands. These results showed a strong association between ten primers along with the high genetic stability of the variety. This preliminary study suggested that the RAPD technique produces reliable results and needs more studies to construct a Phylogeny tree.

Discussions

The Egyptian cotton breeding program used the pedigree selection method depending on intra-specific hybridization to produce new cotton varieties since 1921. The Egyptian cotton breeders succeed to produce about 98 cotton varieties until now using only *G. barbadense* genotypes. In the 2002 growing season the first segregating generation (F_2) was sown and the breeders select the most transgressive plants from a large number of F_2 plants, which exceed their parents in most of the studied yield and fiber quality traits. These selected plants formed the bulked families of the later generations. **Abdelmoghny *et al*., 2021**, reported that the transgressive plants had a higher level of adaptation than their parents. During the segregating generations (from F_3 to F_5) selection was done based on two levels; the first level was between families to select the most superior families then the second level was done within the selected families (between families) to select the superior plants within each family (**Abdelmoghny, 2016, 2021 and Gibely, 2021**). Starting from F_5 generation or advanced generations the selected strains or lines were evaluated through two trials; preliminary yield trial (LA) then the selected lines from this trail will be evaluated in the multi-location yield trials (LB). Selection during these trails depends on selecting the superior families or lines which exceed the commercial cotton varieties of these regions in both yield and fiber quality traits. These results agreed with **Baloch, *et al*., 2018; Abdelmoghny, 2021 and Gibely, 2021** reported that selection between families is better than selection within families and selection for high heritability traits is a good indicator to select the best families and the most promising plants within each family in different cotton crosses.

The results of multi-locations yield trials (LB) indicated that the selected families or lines have a highly good range of agro-climatic adaptability in different ecological zones and early maturing. This is important because it leads to a reduction in the crop life cycle, and thus the number of irrigations and insect infestation. So, the cotton breeder can decide to isolate these selected families to create a new cotton variety for these ecological zones characterized by high yield productivity, long-staple fiber quality, early maturity and high water use efficiency.

All these results help the cotton breeder decide to replace Super Giza 86 with Super Giza 94 at these ecological zones (Delta region). These results indicated that Super Giza 94 can solve the maximum challenges of better cotton production in the area and fulfill all industrial requisitions. Super Giza 94 is achieving desirable targets for farmers (high yield and early maturity), traders (high lint %), spinners (long-staple cotton category) and breeders (wide range of agro-climatic adaptability under different ecological zones). **Abd El-Moghny and Max, 2015; Ali, 2017** and **Abdelmoghny *et al*., 2019** and **2020** used different phenotypic or genotypic stability methods to evaluate different Egyptian cotton genotypes in multi-locations yield trials under different locations and showed that the new variety "Super Giza 94" had high stability coupled with yield superiority across the studied genotypes.

The results showed that the new cotton variety Super Giza 94 yielded out higher than Super Giza 86 for yield and its components traits during sixteen growing seasons from 2006 to 2011. The increasing percentage was 13.79%, 10.89% and 3.33% for seed cotton yield (K/F), lint cotton yield (K/F) and lint %, respectively. Also, Super Giza 94 is characterized by early maturity about 15 to 20 days than Super Giza 86 from planting to harvesting. The new variety has high water use efficiency by decreased irrigation compared with super Giza 86. While, fiber quality traits lies within the long-staple cotton category that characterized by fiber length ranged from 31-35mm, micronaire value ranged from 3.6-4.6 and had fiber strength more than 42 g/tex. So, the Egyptian cotton breeder's successes to increase yield periodicity, maturity and maintain the fiber quality traits for this category.

Finally, the cotton breeder decided to isolate the new cotton variety in the isolated field with only the cultivation of selfed seeds for sixty families as individual plants at Sakha Experimental Research Station as the isolated field (distance was 1.0 Km far from other cotton fields from all directions to avoid cross-pollination) to produced the breeder seeds. The results of the variety yield trail through five growing seasons (from 2011 to 2015) indicated that these nuclei were uniform, homogenous and had high genetic similarity coupled with high yield and stability. These results indicated that the new variety had high stability and very low GEI. One main target of the Egyptian cotton breeding program through this stage is to maintain the uniformity of plant height, lint colour and seed fuzz by eliminating any off-type plants from the breeding field. So, the breeders select the best nuclei based on the superiority of their yield and fiber quality traits higher than the overall mean and mix to create breeder seed then multiplication to increase seed quantity for general cultivation.

To get the maximum yield potential of the new cotton variety Super Giza 94, the farmers should follow the production technology suggested by Cotton Research Institute (CRI). Firstly, 2-3 deep plow followed with a cultivator and one-time rotavator soil preparation to cut hard pan, loosen and pulverize for good root development and conservation of soil. Fertilizer application must be complete before the crop starts the flowering stage. The efficiency of the new variety " Super Giza 94" for input response to competitive yield, the fertilizer level 75Kg N/F, 150Kg P_2O/F, 60 Kg K_2O/F doses was found significant and six or seven number of irrigations are enough to get maximum yield in limited water availability systems depends on the intensity of weather conditions. The first irrigation is given after 21 days from the sowing date then irrigation is repeated every 12-15 days intervals depending on heat temperature and soil structure. Irrigation will stop starting of September month depending on the sowing date. Weeds control by 3 to 4 hoeing as recommended. Plant protection is concerned with using standard and recommended practices suggested by the Ministry of Agriculture and Land Reclamation, Egypt every growing season.

Conclusions

Super Giza 94 is a highly promising Egyptian long staple cotton variety, with high yield potential of 12.425 K/F, 14.689 K/F and 40.213% for seed cotton yield, lint yield and lint percentage (L%), respectively with white lint color and resistance to Fusarium wilt diseases. The new variety is approved and recommended for commercial release and general cultivation in the Delta region. Also, Super Giza 94 is characterized by the erect main stem, large leaf size with deep lobes, medium or long sympodial branches and nodes of the first fruiting branch ranging from 6-7. The new variety Super Giza 94 was registered by the variety registration committee after two successful years of DUS tests. Then, maintaining plant breeder rights was done by Plant Variety Protection Committee, Ministry of Agriculture and Land Reclamation, Egypt under certificate number 307 using rules of the International Union for the Protection of New Varieties of Plants (UPOV).

Abbreviation

SCY = seed cotton yield
LY = lint yield
BW = boll weight
L% = lint percentage
FL = fiber length
FS = fiber strength
MIC = micronaire value
+b = yellowness
Rd = brightness

Acknowledgment

The cotton breeders of this new variety are thankful to all the members of the Cotton Research Institute for their support and help to release the new variety. Also, many thanks are extended to the Cotton and Fiber Crops Diseases Department, Plant Pathology Research Institute, Agricultural Research Center, Giza, Egypt. The genotypes evaluated in this assay were part of the Cotton Screening Program for Fusarium wilt resistance.

Authors' contributions

These authors contributed equally to this work.

Competing interests

The authors declare that they have no competing interests.

Table 1: Pedigree, origin and characterization of the two parents.

Parents Characterization	R102	Super Giza 86
Origin	Unknown	Egypt
Pedigree	Unknown	Giza 75 x Giza 81
Boll weight	3.5g	2.9-3.2g
Lint percentage %	41.5%	38-39%
Fiber length	32.8mm	33.2mm
Fiber fineness	4.0	4.4
Fiber strength	11.4	10.8
Maturity	Early	Late

Table 2: Mean performance of the selected two families of Super Giza 94 over six locations during three growing seasons from 2006 to 2008 compared with the three commercial varieties of these locations.

Families	SCY K/F	LY K/F	L%	BW g	EI %	MIC	FL mm	FS g/tex	+b	YS	UI %
					2006						
F_5 657/04	11.01	13.82	39.90	145	53.9	3.7	34	38.5	9.4	2474	87.7
F_5 659/04	11.24	14.26	40.31	153	57.5	3.4	33.6	39.2	9.4	2511	86.2
Super Giza 89	9.63	11.32	37.40	142	52.1	4.3	32.6	40.6	8.2	2465	87.9
Super Giza 86	9.87	12.21	38.27	148	51.1	4.1	32.5	43	9	2582	87.9
Super Giza 85	10.21	12.47	38.85	142	54	3.8	30.3	38.1	8.9	2176	86.9
Mean	10.39	12.82	38.95	146	53.72	3.86	32.6	39.88	8.98	2441.6	87.32
SE	0.315	0.539	0.53	2.074	1.093	0.157	0.643	0.888	0.22	69.523	0.335
LSD at 0.01	0.826	0.987		3.136							
LSD at 0.05	1.086	1.297		4.122							
					2007						
F_6 647/05	13.12	16.03	38.82	158	73.2	4.2	33.8	41.4	9.1	2588	89.3
F_6 650/05	12.41	15.41	39.35	158	74.8	4.2	33.8	41.5	8.5	2637	89
Super Giza 89	11.02	12.6	36.22	148	72.5	4.3	31.8	42.5	7.6	2496	88.4
Super Giza 86	10.92	13.21	38.37	160	66.2	4.5	33.2	45.6	8.6	2712	89
Super Giza 85	11.03	12.97	37.26	157	69.5	4.1	30.7	40.8	8.5	2357	88
Mean	11.7	14.04	38	156.2	71.24	4.26	32.66	42.36	8.46	2558	88.74
SE	0.449	0.698	0.563	2.107	1.525	0.068	0.611	0.855	0.242	61.279	0.236
LSD at 0.01	1.033	1.227		4.464							
LSD at 0.05	1.358	1.613		5.867							
					2008						
F_7 660/06	11.49	14.32	39.42	154	71.8	4.1	32.2	40	8	2354	87.1
F_7 666/06	10.96	13.61	39.49	145	73.7	3.8	33.3	40.1	8	2448	87.3
Super Giza 89	9.76	11.31	36.68	141	57.7	4.2	32.1	40.5	7.6	2329	87.1
Super Giza 86	9.9	12.18	38.92	151	60.4	4.2	31.8	39.5	8	2280	85.9
Super Giza 85	8.7	11.53	37.62	146	66.5	4	30.3	41.2	7.9	2342	86.5
Mean	10.16	12.59	38.43	147.4	66.02	4.06	31.94	40.26	7.9	2350.6	86.78
SE	0.488	0.59	0.551	2.293	3.11	0.075	0.482	0.284	0.077	27.407	0.258
LSD at 0.01	0.834	1.004		4.098							
LSD at 0.05	1.096	1.319		5.386							

Table 3: Phenotypic mean performance for fiber quality traits for the selected five nuclei of Super Giza 94 during five growing seasons

Nuclei	Fiber length mm	Uniformity Index %	Fiber strength g/tex	Micronaire reading	Maturity %	Rd %	Yellowness +b	Yearn strength
				2011				
1	33.5	86.3	44.5	4.8	0.9	80.9	8.1	2520
2	33.7	86.8	43.5	4.4	0.9	80.3	8.4	2485
3	33.8	87.2	43.5	4.5	1.0	87.9	8.2	2435
4	35.0	87.3	43.3	4.5	1.0	80.6	8.3	2420
5	33.2	86.3	43.5	4.5	1.0	79.3	8.5	2390
				2012				
1	35.0	86.7	43.5	4.6	1.0	76.6	8.3	2440
2	35.0	86.1	43.6	4.5	1.0	80.0	8.4	2460
3	35.0	86.8	44.0	4.3	0.9	80.7	8.0	2610
4	35.0	86.4	43.0	4.5	1.0	79.3	8.6	2350
5	33.5	86.6	43.1	4.6	0.9	78.6	8.6	2415
				2013				
1	34.3	86.0	43.2	4.5	1.0	79.9	8.3	2520
2	33.4	87.4	43.1	4.6	0.9	79.5	8.7	2450
3	33.6	88.0	43.2	4.8	1.0	79..3	8.2	2325
4	34.0	86.2	43.0	4.6	1.0	79.0	8.3	2395
5	34.3	87.1	44.0	4.6	0.9	78.3	8.2	2455
				2014				
1	34.5	88.7	44.0	4.5	1.0	78.7	8.1	2570
2	34.5	86.7	44.0	4.5	1.0	76.8	8.7	2385
3	33.9	87.8	44.0	4.3	0.9	78.6	8.3	2540
4	34.3	87.7	44.0	4.6	0.9	79.6	8.3	2415
5	33.7	87.5	43.0	4.3	1.0	78.6	8.7	2445
				2015				
1	33.5	86.3	44.5	4.8	0.9	80.9	8.1	2520
2	35.0	86.7	43.5	4.6	1.0	76.6	8.3	2440
3	34.3	86.0	43.2	4.5	1.0	79.9	8.3	2520
4	34.5	88.7	44.0	4.5	1.0	78.7	8.1	2570
5	33.9	87.8	44.0	4.3	0.9	78.6	8.3	2540
Mean	34.18	87.00	43.61	4.53	0.95	79.50	8.33	2464.60
SE	0.119	0.158	0.092	0.029	0.002	0.435	0.040	14.520

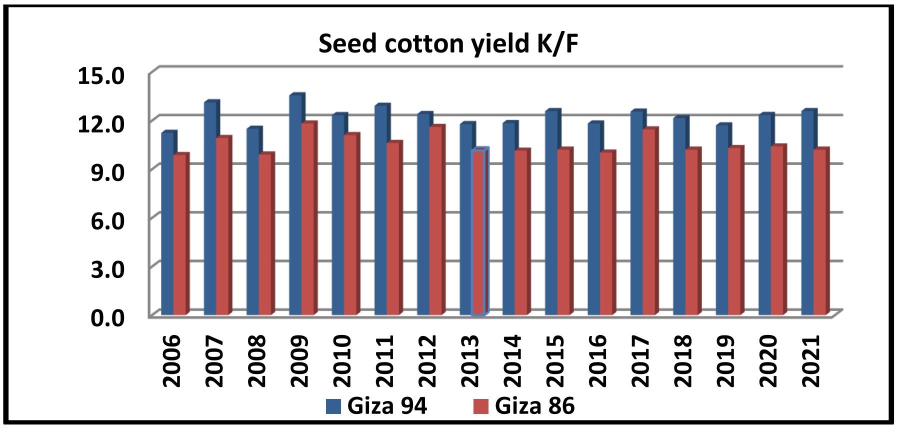

Figure 1: Comparison between Super Giza 94 and the commercial variety Super Giza 86 during sixteen growing seasons over five locations for seed cotton yield K/F.

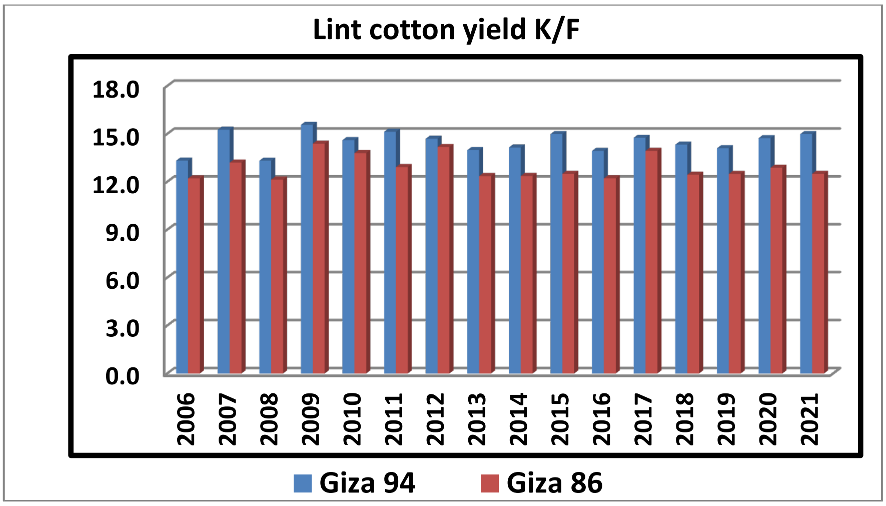

Figure 2: Comparison between super Giza 94 and the commercial variety super Giza 86 during sixteen growing seasons over five locations for lint cotton yield K/F.

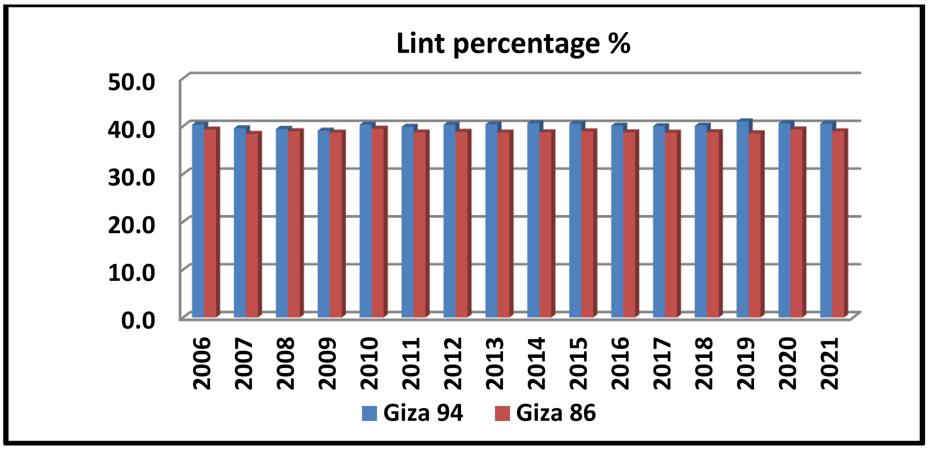

Figure 3: Comparison between Super Giza 94 and the commercial variety Super Giza 86 during sixteen growing seasons over five locations for lint percentage (L %).

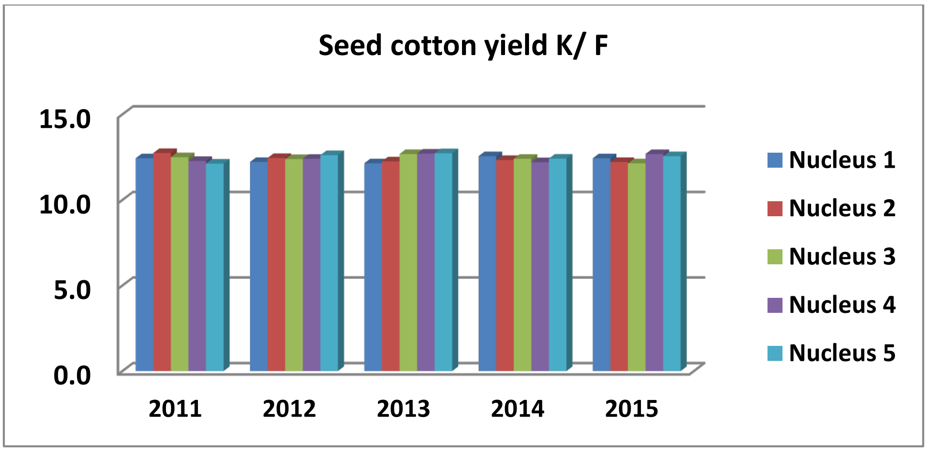

Figure 4: Selected five nuclei of Super Giza 94 during five growing seasons for seed cotton yield K/F.

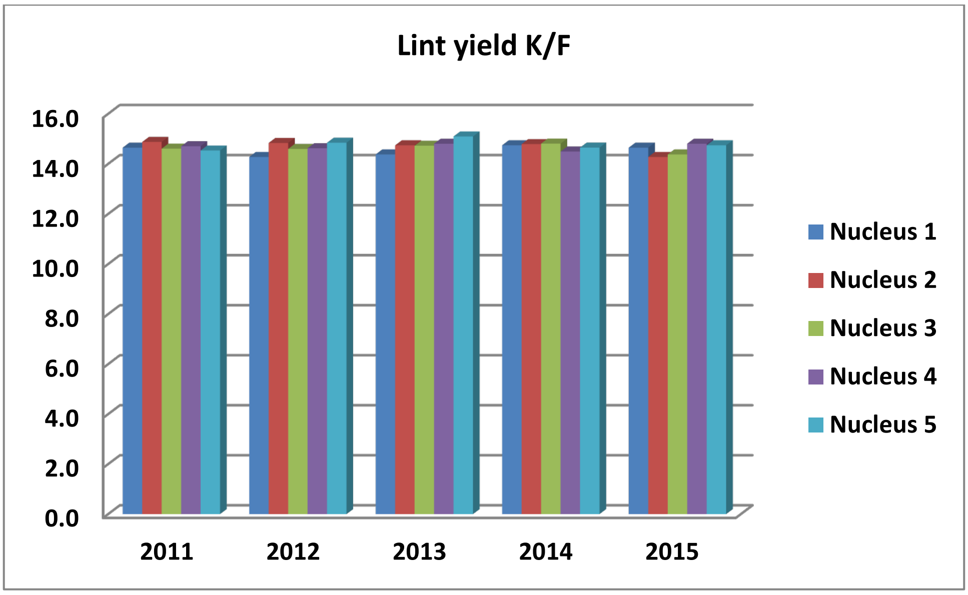

Figure 5: Selected five nuclei of Super Giza 94 during five growing seasons for lint yield K/F.

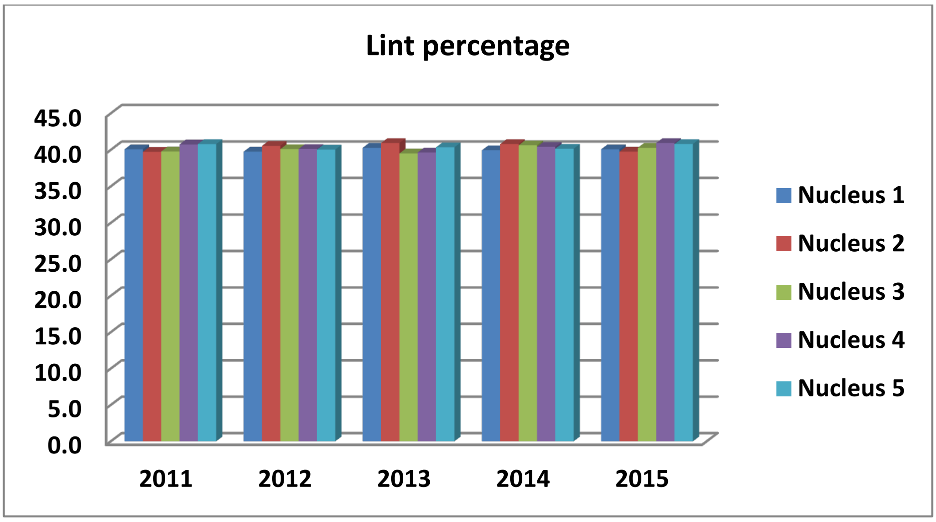

Figure 6: Selected five nuclei of Super Giza 94 during five growing seasons for lint percentage.

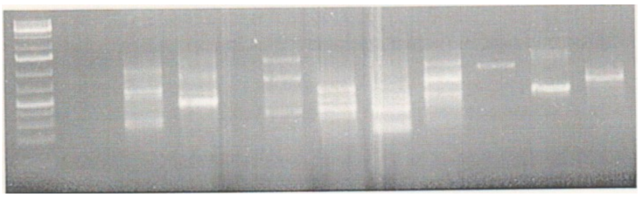

Figure 7: Amplification profile of new cotton variety "Super Giza 94" with ten primers.

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