YIELD AND QUALITY IMPROVEMENT TRENDS IN EGYPTIAN COTTONS

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Abstract

The objective of this paper is to study, with regard to cotton yield and quality, the improvement trends in the Egyptian cotton, and to know where we are and where we need to go in order to meet the requirements of both producers and spinners.

Established varieties as well as new promising crosses belonging the two categories of the Egyptian cotton were studied. These included:

1. Four varieties and two promising crosses belonging to the Extra Long Staple cottons category.
2. Three varieties and two promising crosses belonging to the Long Staple cottons category.

From the breeding perspective, new varieties should always be "available" as better substitutes for commercial varieties. From textile and commercial perspective, available substitute will depend on the probable profit potential of a new variety. It was observed that the strains of the crosses Giza 89 X Giza 86 and Giza 89 X Pima S6 almost significantly appeared to be the highest strains in seed cotton yield, 9.9 and 9.7 C/F respectively. They almost exceeded the yield of the commercial varieties belonging to the Long Staple category, Giza 85, Giza 86 and Giza 89. The promising cross G. 84(G. 74 X G. 68) is of much higher fiber strength which compensated for its relative shortness in fiber length having yarn of high level of strength. The promising crosses G. 84(G. 74 XG. 68) and G.77X Pima S6 were produced to meet the requirement of fine yarn producers and may therefore; replace Giza 70 and Giza 45 in commercial production.

INTRODUCTION

Improving cotton yield and quality through introducing new varieties is one of the most important objectives of the cotton research program carried out by the Cotton Research Institute (C.R.I.). 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 textile and commercial perspective, replacement will depend on the probable profit potential of a new variety.

Sadek and Abdel-Salam (1969) reported that the improvement of cotton relies mainly upon the cotton breeder, who, through a long process of hybridization and selection arrives at new varieties of superior quality to replace the old ageing ones.

Yield of field crops can be examined in terms of yield components (Baker, 1986). For cotton, these components are plants/acre, bolls/plant and boll size (grams/boll). The first two components are largely determined by management decisions and by environmental conditions. The last component, boll size, while it is also environmentally dependent, probably has the greatest chance of being improved through breeding. Further, boll size is divided into seed/boll and fiber/seed.

Abdel-Salam (1999) reported that the yield ability is clearly on the top of importance and priorities. The yield of a new strain should be higher than or at least competitive with that of varieties in commercial production. Also, the increase in yield should be obtained without sacrificing other essential characteristics, and should be consistently high year after year. May (2003) reported that a consequence of the technological revolution in yarn manufacture renewed emphasis on fiber property profiles that result in strong high quality yarns. In addition to incentives imposed by technological advance to enhance fiber quality, the cotton marketing system began in the year 2000 to impose price premiums and discounts for fiber length uniformity index, an indirect measure of short fiber content.

A successful cotton improvement strategy must face both the quantity and year-to-year stability of fiber 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 assessing the quality of the varieties and the promising hybrids in their fiber and yarn properties to give the industry guidance or identifying its highest priority fiber quality needs. We want to be sure that we can continue to supply the advanced industry, especially in fine yarns sector, with the quality of fibers that are needed in cotton's markets at home and abroad.

The objective of this paper is to study, with regard to cotton yield and quality, our position at present and the prospective one for the improvement trends in the Egyptian cotton, in other words, where we are? and where we need to go? in order for both producers and spinners efforts to be profitable.

MATERIALS AND METHODS

Established varieties as well as new promising crosses belonging to the two categories of the Egyptian cotton were used. These included:

1. Four varieties and two promising crosses belonging to the Extra Long Staple cottons category.
2. Three varieties and two promising crosses belonging to the Long Staple cottons category.

The promising selected strains of certain crosses are examined in advanced strain test of trial B, in order to be compared with the cultivated varieties. It should be noted that trial B is carried out at different locations at Delta region, each single trial grown in a randomized complete block design with six replications in each of two years, depending on cotton category (Table.1), to study the interaction of the genotypes under different environments. This program is continued until a satisfactory genetic stability is achieved. Comparisons among the new promising crosses and the commercial varieties were included in seasons 2005 and 2006 for yield components and in 2006 for fiber and yarn quality.

In this investigation the following characters were considered;

1. Seed cotton yield (Cantar/Feddan) S.C.Y./ C/F (One cantar = 157.5 Kg of seed cotton.
2. lint cotton yield L.Y./ (C/F). (One cantar = 50 Kg of lint cotton.
3. Boll weight (B.W), the average weight, in grams of 50 sound opened boll.
4. Lint percent %.(L.%).
5. Earliness index (E): expressed as percent yield at first pick relative to total seed cotton yield.
6. Fiber properties tests were carried out by HVI spectrum and micromat instrument.

The cotton samples used were of approximately 50 Kg of ginned lint, in order to perform both fiber and spinning tests. A standard spinning preparation procedure and modern machinery in the pilot spinning mill, Cotton Research Institute, were used to produce conventional combed yarns as shown in Table 1. Yarn quality test used for this study is Lea Count Strength Product (LCSP = lb X Ne), measured by using the Good-Brand Lea Tester. Yarn tenacity (cN/Tex) and elongation at break (%) were measured on a Statimat ME with 120 breaks per sample. Yarn evenness (CV%), value was measured on Uster Tester 3 (the measurement length was 400 m.). Fiber and yarns were tested according to ASTM (1984).

Table 1. Processing outline.

Cotton category	Long Staple cottons	Extra Long Staple cottons	
		Extra Long Staple	Extra long Extra Fine
Commercial varieties	Giza 85, Giza 86 and Giza 89	Giza 70 and Giza 88	Giza 45 and Giza 87
Promising crosses	G.89 X G. 86 and G. 89 X Pima S6	G.84 X(G.74XG. 68)	G. 77 X Pima S6
Samples processing	Compact Bale Opener; compact Opener, Chute feed and "DK-780" carding machine; Marzoli "Duomax draw-frame, Lw 1 lap winder, CM 500 comber, Duomax draw-frame, High-speed frame "PCX 16-A, RST1 Ring spinning system".		
Spindle speed	14000 rpm		
Yarn count (Ne)	80	140	
Twist multiplier	3.6		

RESULTS AND DISCUSSION

1. Long Staple Cotton category

1.1. Yield and yield components

In order to eliminate the bias to any given year and/or location and to obtain more accurate results, the combined analysis of studied yield components for two years and average of five locations are given in Table 2.

It was observed that the strains of the crosses Giza 89 X Giza 86 and Giza 89 X Pima S6 almost significantly appeared to be the highest strains in seed cotton yield, 9.9 and 9.7 C/F respectively. They almost exceeded the yield of the commercial varieties belong the same category, Giza 85, Giza 86 and Giza 89. The results of lint cotton yield obtained from trial B indicated that the two crosses Giza 89 X Giza 86 and Giza 89 X Pima S_6 were promising and possibly could give high productive yield. Lint percent recorded that the strains of the two crosses, Giza 89 X Giza 86 and Giza 89 X Pima S_6 have insignificant differences compared with the control commercial varieties. The heavy boll weight is one of the main components of high seed cotton yield. Therefore, selecting for heavy boll weight strains could help the cotton breeder to improve yield. The mean weight of 50 bolls obtained from trial B was in the same level of the control varieties. The results of mean performance from combined data showed that the promising cross Giza 89 X Pima S6 was the earliest one for earliness index with the mean of 71.8%. On the other hand, Giza 86 cotton variety was the latest.

1.2. Fiber and yarn properties

Much breeding effort has been directed towards enhancing cotton fiber length to promote ring spinning performance. Breeding for fiber length has focused on increasing the length of the longest fibers in a sample of fiber, typically measured by High Volume Instrument as the Upper Half Mean length. 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., 33.5 mm. Figure 2 demonstrates the relation between fiber length and fiber strength and shows that G 86, G.89XG.86 and G.89 appear to be improved in both fiber strength and fiber length over the standard variety.

Table 2. Mean performance of the yield, boll weight and earliness of Long Staple genotypes.

Genotype	S.C.Y. (C/F)			L.Y. (C/F)			Lint %			B.W.			Earliness %		
	2005	2006	Comb.	2005	2006	Comb.	2005	2006	Comb	2005	2006	Comb.	2005	2006	Comb.
G. 85	7.3	10.2	8.8	8.8	12.5	10.6	38.3	38.8	38.5	150	142	146	67	54	61
G. 86	7.3	9.9	8.6	8.7	12.2	10.5	38.0	39.2	38.6	148	148	148	69	51	53
G. 89	7.5	9.6	8.5	8.7	11.3	10.0	36.9	37.4	37.1	146	142	144	69	52	61
G. 89XPima S_6	9.2	10.3	9.7	11.0	12.5	11.7	38.2	38.6	38.4	142	138	140	81	62	72
G. 89XG. 86	9.4	10.4	9.9	11.1	12.4	11.8	37.5	37.6	37.6	151	149	150	72	54	63
L.S.D at 0.05%	0.66	0.78	0.71	0.78	0.94	0.86	1.64	1.21	1.81	5.33	3.02	3.48	3.78	4.11	3.91

*Comb. = Combined

Table 3. Fiber and yarn properties for Long Staple cottons spun at 80s.

	Commercial varieties			Promising crosses		L.S.D at 0.05% level
Material	G. 85	G. 89	G. 86	G. 89 X Pima S6	G. 89 X G. 86	
Fiber Propertie						
UHM. (mm)	30.5	31.5	33.2	31.2	33.0	1.31
U.I. (%)	86.8	86.5	88.0	86.3	87.4	1.9
Short Fiber Index	7.5	6.5	6.6	7.00	7.00	1.33
Strength (g/tex)	40.8	41.5	44.5	40.0	44.5	2.15
Elongation (%)	6.6	7.0	6.5	7.0	6.6	0.16
Yellowness (+b)	8.4	8.0	8.7	8.8	8.7	0.09
Brightness (Rd%)	75.6	77.0	76.0	74.5	73.8	2.01
Micronaire	3.8	4.3	4.5	4.3	4.1	0.55
Fineness (mtex)	144	162	168	160	155	6.21
Maturity ratio	0.93	0.95	0.98	0.95	0.96	0.02
Maturity	84	86	89	86	87	2.31
Yarn Properties						
LCSP	2800	2730	2900	2700	3010	90.22
Single yarn strength	17.50	16.90	18.00	16.80	18.50	1.63
Yarn evenness (c.v.%)	17.44	17.82	17.26	18.00	17.17	1.15

Figure 1 indicates that in 2005 and 2006 seasons, the four tested cottons beside Giza 85 are distributed as follows:

- The promising cross Giza 89 X Giza 86 was positioned in level (A) meaning that it is of higher yield and quality than the standard compared variety.
- Giza 86, the commercial cotton variety was positioned in level (B) meaning that it is of high quality and lower yield.
- The promising cross Giza. 89X Pima S6 was positioned in level (C) i.e., with low quality and high yield.
- Giza 89, positioned in level (D) i.e., low yield and quality.

- Undoubtedly, the old commercially grown variety G.85 was used as standard for comparison with the tested cottons and promising crosses and appears to be the reasonable choice between groups (A) and (B) with regard to its yield and quality. The data illustrates that the promising cross G.89XG.86 future by increase in both yield and quality by about 13% than G. 85, practically. The negative relation between yield and quality does not exist.

Therefore, the following points were taken into consideration in setting up the quality levels of the new promising crosses:

1. Yarn strength is to be given the first priority (higher durability of clothes); Giza 89X Giza 86 that exceeded existed varieties by 13% is to be listed in level (A), Figure 2. Also, the spinning properties of Giza 89 X Giza 86 showed significantly better combed Ne 80's LCSP, yarn tenacity and yarn evenness.
2. Micronaire reading obtained of G.89 X G.86 was less than that of Giza 86, preferably equal or somewhat higher than that of Giza 89 and Giza 85.
3. Fiber length of level "A" Giza 89X Giza 86 and Giza 86 were similar and somewhat higher than that of Giza 89.

Improvement was directed towards higher yarn strength through higher fiber strength rather than length or fineness. Other fiber properties also exhibited the same levels of the standard varieties.

2. Extra Long Staple Cotton category

2.1. Yield and yield components

Comparative studies were held between the crosses G.77X Pima S6 and G. 84 (G.74 x G. 68) and the commercial varieties; G. 45, G. 87, G. 70, and G. 88 for seed cotton yield, lint yield, boll weight and earliness index. In Extra Fine Extra Long staple category, it is perceived from Table 4, that G. 45 and G. 87 cotton varieties recede significantly in seed cotton yield and lint yield (C/F) than the promising cross G.77X Pima s_6 with 56 % and 22% C/F respectively. In Extra Long Staple category, the promising cross G. 84 (G.74 x G. 68) surpassed G. 70 in seed cotton yield and lint yield by about 18%, while it is receded insignificantly in both seed cotton yield and lint yield than G. 88 cotton variety.

The earliness index results showed that the promising cross G. 84 (G.74 x G. 68) was earlier than the commercial varieties.

2. 2. Fiber and yarn properties of ELS cotton category

The old commercially grown variety G.70 was used as a standard for comparison with the other cottons of the category and promising crosses and appears to be the reasonable choice between groups (A) and (B) with regard to its yield and quality. Figure 3 illustrates that the promising cross G.84 X (G. 74 X G. 68) exceeds Giza 70 in both yield by about 14% and quality by about 4%. When this cross was compared with the averages of the two standard varieties, it was found that:

1. The commercially grown varieties Giza 70 and Giza 88 are of comparable fiber length, but Giza 88 is of somewhat finer and stronger staple and stronger yarns, Table 5.
2. The promising cross G. 84(G. 74 X G. 68) is of much higher fiber strength which compensated for its relative shortness and resulted in having yarn of high level of strength.
3. In addition to the priorities, yarn manufacturers have asked for higher fiber strength. Enhancement of fiber strength through introgression from triple hybrid "G. 84(G. 74 X G. 68)" has been successful through Long-term advanced breeding efforts.
4. From the breeding perspective, new varieties should always be "available". From textile and commercial perspective, availability will depend on the probable profit potential of a new variety. The promising cross G. 84(G. 74 X G. 68) was produced to meet these requirements and may replace Giza 70

2.3. Fiber and yarn properties of Extra Long and Extra fine cotton category

Giza 45 is well known as world top quality cotton, and Giza 87 was introduced and launched for commercial growing because it has advantages in yield potential over Giza 45.

Table 4. Mean performance of the yield, boll weight and earliness of Extra Long Staple genotypes.

Genotype	S.C.Y. (C/F)			L.Y. (C/F)			Lint %			B. W.			Earliness %		
	2005	2006	Com.	2005	2006	Comb.	2005	2006	Com.	2005	2006	Com.	2005	2006	Comb.
G. 45	4.4	7.3	5.85	4.6	7.8	6.2	33.3	34.7	34.0	147	143	145	55	59	57
G. 87	6.3	8.7	7.5	6.4	9.4	7.9	32.7	35.5	34.1	147	142	144	60	57	59
G. 77X Pima S6	8.2	10.1	9.15	8.9	11.3	10.1	34.6	36.4	35.5	150	144	147	70	58	64
G. 70	6.6	8.4	7.5	7.3	9.9	8.6	34.8	37.7	36.2	150	147	148	65	52	59
G. 88	8.4	10.0	9.2	9.7	12.0	10.8	36.6	38.8	37.7	155	143	149	66	55	61
G. 84X(G. 74 X G. 68)	8.0	9.8	8.9	8.9	11.4	10.1	35.4	38.7	37	152	140	146	69	67	68
L.S.D at 0.05%	1.33	1.26	1.11	2.12	1.88	1.97	1.15	1.31	1.21	3.45	2.54	2.34	5.54	3.66	3.43

Table 5. Fiber and yarn properties for Extra Long Staple cottons spun at 140s.

	Commercial varieties				Promising crosses		L.S.D at 0.05% level
Material	G.45	G.70	G.87	G.88	G.77 X Pima S_6	G. 84(G. 74 X G. 68)	
Fiber parameters							
UHM. (mm)	35.6	35.5	35.8	35.5	36.5	33.9	0.57
U.I. (%)	88.8	87.0	88.0	87.7	89.2	87.5	1.33
Short Fiber Index	5.8	5.4	5.7	5.6	5.7	6.2	0.90
Strength (g/tex)	43.5	45.0	45.5	46.5	46.5	49.0	2.31
Elongation (%)	5.8	6.4	5.9	6.2	6.5	6.3	0.14
Yellowness (+b)	8.9	9.5	9.3	11.5	11.4	8.7	3.15
Brightness(Rd%)	74.1	73.0	73.2	66.1	66.3	74.4	4.22
Micronaire	3.1	4.0	3.2	3.8	3.0	3.6	0.21
Fineness (mtex)	118	146	115	138	108	134	12.1
Maturity ratio	0.87	0.92	0.90	0.93	0.92	0.93	0.08
Maturity	82	85	83	84	83	84	3.61
Yarn Properties							
LCSP	3240	2950	3295	3090	3225	3065	71.75
Single yarn strength	22.84	18.80	23.13	20.81	22.82	20.77	2.43
Yarn evenness (c.v%)	18.96	20.44	18.84	20.69	18.90	18.38	1.21

The old commercially grown variety G.45 was used as a standard for comparison between the cottons of the category and promising crosses and appears to be the reasonable choice between groups (A) and (B) regarding to its yield and quality. Figure 4 illustrated that the promising cross G.77 X Pima S6 exceeds Giza 45 in yield by about 62%, and by 35% in case of Giza 87, wile the level of Lea count strength was the same for the three varieties under study.

The level of fiber length of Giza 45, Giza 87 and the promising cross G.77 XPS_6 is quite appropriate for this ELS category of cottons, and, thus there is no need to select for longer and finer staple.

Micronaire reading of the promising cross did not appear to be higher than that of Giza 45 and Giza 87 especially it is known that the low micronaire is associated with increase in neppiness.

A slight increase in yarn strength in the vicinity of 5%, over the average of the two standard varieties would be advantageous, and he promising Cross G.77 X Pima S_6 is of the same level of quality with the cultivar variety which makes selection for higher quality more difficult.

The promising cross Giza77X Pima S_6 was produced to meet these requirements and may replace Giza 45.

Abdel-Salam, M. E.

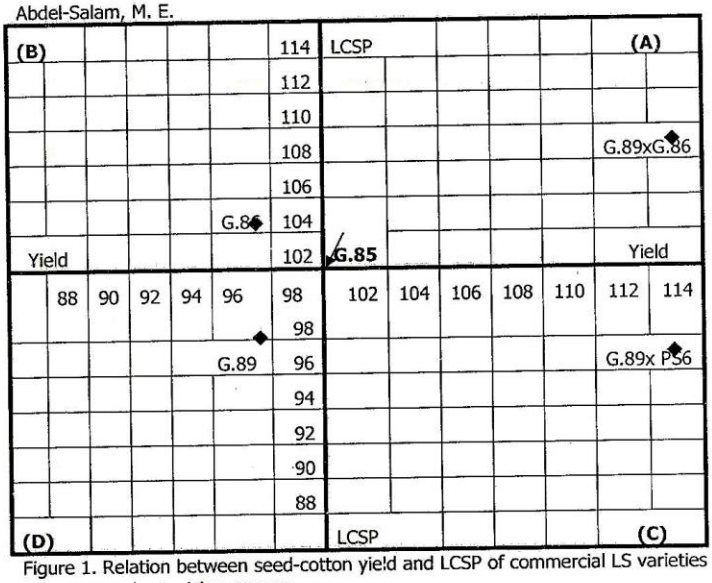

Figure 1. Relation between seed-cotton yield and LCSP of commercial LS varieties and promising crosses.

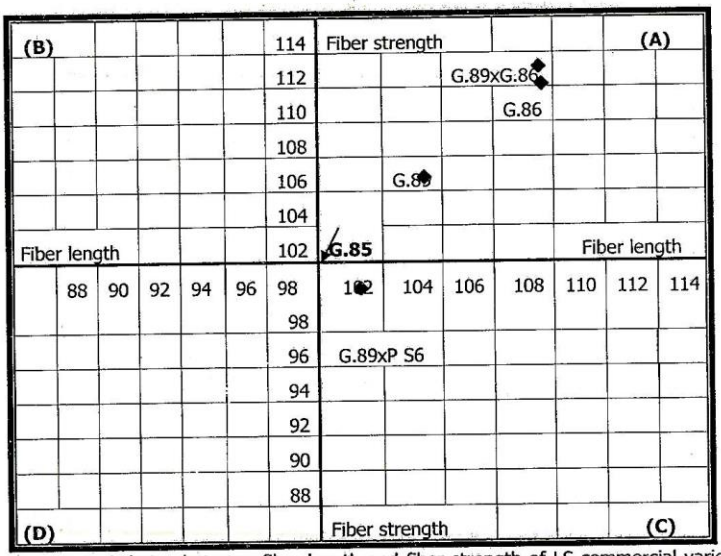

Figure 2. Relation between fiber length and fiber strength of LS commercial varieties and promising crosses.

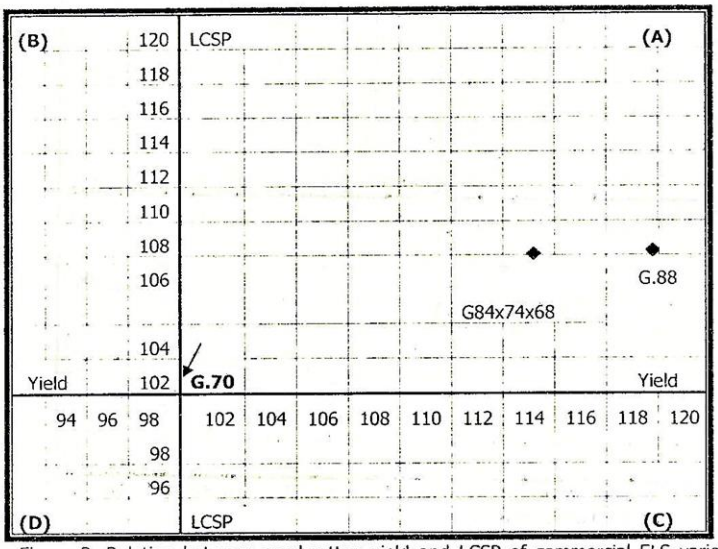

Figure 3. Relation between seed-cotton yield and LCSP of commercial ELS varieties and promising crosses.

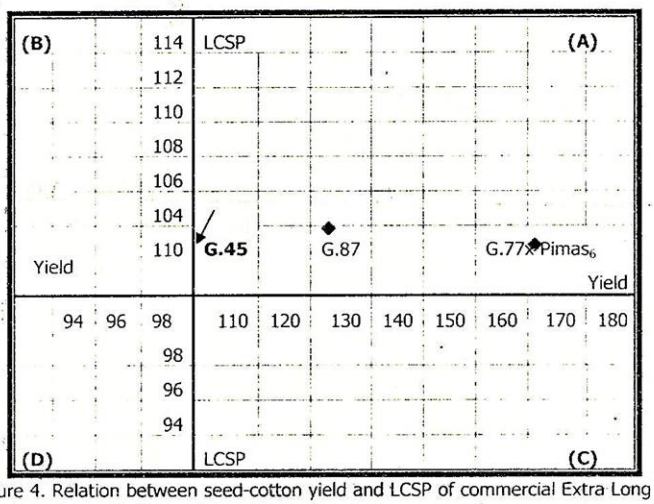

Figure 4. Relation between seed-cotton yield and LCSP of commercial Extra Long Extra fine varieties and promising crosses.

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إتجاهات تحسين المحصول والجودة فى القطن المصرى

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إتجاهات التحسين فى القطن المصرى هى الأساس فى هذه الدراسة مع الأخذ فى الاعتبار الصفات المحصولية وخواص الجودة ، أين نحن الآن؟ وماذا نعد للمستقبل لكل من منتجى القطن وغزالى القطن المصرى؟

استخدمت فى هذه الدراسة الأصناف التجارية المنزرعة و الهجن المبشرة والتى تمثل طبقتى الأقطان الفائقة الطول والطويلة المنزرعة فى الوجه البحرى وهى:

- أربعة أصناف وهجينان مبشران يمثلون طبقة الأقطان الفائقة الطول " جيزة ٤٥ ، جيزة ٧٠ ، جيزة ٨٧، جيزة ٨٨ و الهجين جيزة ٧٧ × بيما س٦ ، والهجين جيزة ٨٤×(جيزة ٧٤×جيزة ٦٨).
- ثلاثة أصناف وهجينان مبشران يمثلون الأقطان الطويلة المنزرعة بالوجه البحرى " جيزة ٨٥، جيزة ٨٦، جيزة ٨٩، والهجين المبشر جيزة ٨٩×جيزة ٨٦ و الهجين المبشر جيزة ٨٩ × بيما س ٦.

من منظور مربى القطن، فإن الاصناف الجديدة التى تتميز بالمحصول والجودة العالية يجب أن تكون متوفرة دائما ، أما من المنظور التجارى لصناعة الغزل والنسيج فإن إحلال صنف جديد محل صنف اخر يعتمد على مدى تحقيقه ربحية أعلى وتوافقه لمتطلبات الصناعة.

وقد أظهرت النتائج أن الهجين المبشر جيزة ٨٩ × جيزة ٨٦ و الهجين المبشر جيزة ٨٩× بيما س٦ تفوقا من الناحية المحصولية على الأصناف التجارية المنزرعة من نفس طبقة أقطان طويلة التيلة وجه بحرى. أما الهجين المبشر جيزة ٨٤ ×(جيزة ٧٤ × جيزة ٦٨) فهو يتميز بمتانة التيلة العالية والتى تعوض النقص فى الطول مما يؤدى الى إنتاج خيوط عالية المتانة.

هذا، وقد أنتج كلاً من الهجين المبشر جيزة ٧٧ × بيما س٦ و الهجين المبشر جيزة ٨٤ × (جيزة ٧٤ × جيزة ٦٨) ليقابلا متطلبات المزارع بالنسبة للمحصول وصناعة الغزل والنسيج فى الجودة وليحلا محل الصنفين جيزة ٤٥ وجيزة ٧٠ .