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Study of Some Off-Types and Their Effect on Genetic Purity for Giza 94 under Commercial Scale

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Abstract

This study aims to study of some different off-types and the effect of the characteristics of these plants on genetic purity. Ten off types were collected from general cultivation and self-pollinated for them. Then those off types were crossed with the original variety to study the extent of the effect of genetic purity on those types. One of the most important findings in this study was that all the off-types gave higher values in plant height compared to the original variety Giza 94. The plant height ranged from 151- 202.8 cm Also, one of the most important trait that was affected was the (lint percentage), as most off types gave values less than original variety which ranged from 2929.99- 40.02.. Fiber color was affected, most of the off types were given a cream color, in contrast to the original type, which was white. The results also showed that the softness micronare of the fibers changed, as they became more coarse. This trait is very important in spinning and weaving operations. As for the fiber length character, the results showed that a small number of off types gave values that were lower than the original variety, and most of the hybrids gave values equal to or slightly longer than the original variety. In general most of off-types gave characteristics contrary to the original variety and these plants must be uprooting from seed production fields to maintenance the genetic purity of the variety under commercial scale.

Key words: *Off-types, Giza 94, deterioration*

Introduction

Extending the life of any Egyptian cotton variety in general agriculture is the goal of cotton breeders under Egyptian conditions because the varieties are characterized by high quality characteristics and also the need for spinning and weaving factories to continue in quantities and consistency in hair qualities, which enables benefit on a commercial scale. The emergence of different off types in varieties on the commercial scale is extremely dangerous, especially in the Giza 94 variety, which is grown in more than 75 percent of the area in Egypt. There are studies that studied the different types and their effect on the genetic purity of the Egyptian varieties Giza 70, Giza 80, 83, 88, and 86. In Egypt, yield and lint characteristics of cotton are considered the main properties in the cotton production and industry. The off-types are inferior cotton plants exist occasionally among commercial cotton varieties throughout the long period of their culture. **El-Shazly (1987) and Kamal *et al*, (1988)**, they found that the discolored cotton was associated with deterioration in fiber quality and lower yield components. **Abo-Arab *et al*, (2000)**, studied some Egyptian cotton varieties as well as their off-types (three off-types for each), they found that the results showed significant differences between the original parents and their derived off-types for fiber characters in both varieties, indicated that these changes appeared to be genetic alterations, one or more, mutant genes. **Hattab *et al*, (1962), AbdelBary and Bisher (1962)** classified and studied the off-type cotton plants according to the seed fuzz type. They estimated the percent of foreign seeds among standard type and recorded their traits. The lint discoloration of Egyptian cotton varieties were also studied, by several workers; **Al-Didi (1984)**. He found that the discolored cotton was associated with deterioration in fiber quality and lower yield components. **El-Okkia *et al*, (1990)** studied the variation between the standard type of Giza 70 its off-type (Giza 70 brown locks). They concluded that the Egyptian cotton varieties including off-type cotton locks would cause lack of color uniformity, depression of yield and quality, reduction of yarn strength and increment of waste in spinning processes. **Hemaida (2000)** studied the differences among the standard types of Giza 80 and Giza 83 with their off-type plants, using analysis of variance. He indicated that the off-type plants of Giza 80 gave considerably lower values for boll weight, lint percentage, seed index, lint index and fiber strength characters, while the discoloration type of Giza 83 exhibited later maturity and coarser fiber compared to the standard type. However, Univariate statistical techniques such as analysis of variance do not explain how accessions differ when all measured variables are considered jointly. However, by using the multivariate statistical technique, all variables are considered simultaneously in the differentiation of populations. This approach results in a more powerful comparison of populations than could be achieved with Univariate analysis. **Abdel Hafez *et al,* 2020** studied canonical discrimination analysis, a multivariate statistical technique, all independent variables (traits) are considered in the discrimination of populations (genotypes). In the last decades, some Egyptian varieties have showed a kind of changes in their homogeneity and uniformity and eventually some off types are spontaneously induced.

The main objectives of the present investigation were to study the effect yield and quality as affected by the existence of the off-type plants in the cotton variety Giza 94.

Materials and Methods

The present study was carried at Agriculture Research Sakha Station, Agriculture Research Center, Egypt, during the 2021 to 2022 seasons. The original materials used in this study were (Giza 94 variety and their off-types). For studying the dangerous effect of the off-types on Egyptian cotton selfed seeds of the original parents (Giza 94) as well as their off-types. In 2020 season the off types were grown with original parent Giza 94 and crossed each genotype with original parent to produced F1 seed. In 2022 season, evolution the entries (Giza 94, ten off types and ten hybrids) was grown in a randomized complete block design evaluation experiment with three replications. Each experimental plot consisted of one row. Row length was 5 meter rows were 0.7 m apart. Plant spacing was approximately 0.3m between hills and hills were thinned at two plants hill^{-1}.

The studied traits were: Plant height cm (PH), Leave area cm^2 (LA), Boll weight g (BW), Seed cotton yield plant-1 g (SCYP), Seed index g (SI), Lint cotton yield plant^{-1} g (LCYP), Lint index g (LI), Lint percentage (L%), Fiber length mm (FL), Uniformity index percentage (UI%), Fiber strength g tex^{-1} (FS), Elongation mm (Elong) Micronaire reading (MIC), Reflectance degree percentage (RD%) and Yellowness (+B) and Short fiber cm (SF). Data were subjected to statistical analysis of variance by conducted according to Cochran and Cox (1957). The mean square of genotypes and replications for all studied traits were tested for significance according to the F-test. Canonical discriminate analysis was used for data analysis according to (Hair et al., (1987).The difference between centroid values of two groups is the D2 distance and is calculated as D2 (X1-X2), S-1 X1-X2) where, X1 and X2 are the estimated mean vectors in respective groups, and S-1 is the inverse of the pooled sample variance-covariance matrix (**Dillon and Goldstein, 1984**). All these computations were performed using Minitab and SPSS computer program. Cluster analysis was carried by the hierarchical cluster analysis procedure of the program **SPSS program (1995)**. This procedure, which use disjoint cluster analysis on the basisof words method and interval Euclidean distance, was applied to illustrate the relative genetic diversity and distance among the original parents with their spontaneous off-types.

Results and Discussion

Results in Tables 1 & 2 showed that the mean squares of genotypes (Giza 94) maintained cultivar (pure seeds) and its off-types were highly significant for growth, yield and its components and fiber traits. Mean squares for genotypes indicated that were difference between Giza 94 (pure) and its off-types. Thus, presence of these off-types within the cultivar in general cultivation is danger on purity. These results are agreement with those obtained are in harmony with El-**Mansy *et al,* (2000), Hemaida *et al,* (2000), Heba *et al,* (2012) and Abdel Hafez *et al,* (2020)**.

Results from the analysis of variance showed that there were significant differences between the genotypes, which mean the importance of studying the behavior of these traits between the genotypes.

Table 1. Mean squares of growth, yield and its components traits in Giza 94 cotton cultivar and its off-types

S.O.V.	PH	LA	BW	SCYP	SI	LCYP	LI	L%
Genotypes	1918**	1225.5**	0.766**	4380.6**	2.97**	661.2**	4.00**	**42.29****
Replication	**401**	**4469**	**0.157**	**24057**	**0.512**	**2999.5**	**0.1352**	**2.69**

** highly significant at 0.05 and 0.01

Table 2. Mean squares of fiber traits in Giza 94 cotton cultivar and its off-types.

S.O.V.	FL	UI%	FS	Elong	MIC	RD%	+B	SF
Genotypes	11.97**	25.02**	39.02**	8.98**	0.41**	129.5**	12.64**	**1.24****
Replication	0.45	1.35	6.62	0.41	0.03	1.02	0.31	**0.11**
Error	**0.67**	**2.67**	**1.81**	**0.28**	**0.07**	**2.43**	**0.22**	**0.38**

** highly significant at 0.05 and 0.01

Results in Table 3 for plant height exhibited that most of the off types were taller than the original variety Giza 94.The same trend was found in the plant height for all hybrids, and therefore the same risk for these plants on genetic purity. The previous results show the importance of uprooting these plants from the fields of seed producers to maintain homogeneity and thus produce seeds that are higher in genetic purity. Which reflects the importance of this trait and its danger to homogeneity in seed production fields? Therefore, it is one of the distinctive characteristics that makes it easy for seed producers to eradicate these plants from fields prepared for seed production in order to limit the deterioration of the Egyptian varieties during a transitional stage in those days until the replacement factor and increase of the replacement factor for pure seeds in place of those less homogeneous seeds. As well as ,leaf area trait the results showed that all off types were equally with original variety except for No. 2 and 3. On the other hand, most the hybrids gave values lower than the original variety. Similar results reported by Abdel Hafaz et al., 2020.

Regarding boll weight, the results showed that all genotypes were did not significant from original variety Giza 94, except for No. 2,6,10, the off-types give lower values than the original variety, for hybrids No. 16, and , 18 which gave high values compared with original variety Mean performance of Giza 94 , off types and hybrids for lint percentage , the results exhibited that the mean values of genotypes differences with a range of 29.94-35.51 and 34.14-40.02 for off types and hybrids respectively. The off types were lower than the original variety except for No. 7 and 8. While the hybrids gave moderate values compared with original variety. Same trend found for lint index. Generally the pervious results cleared that most the genotypes for the two traits gave values lower than the original variety .Similar results supported by **Abdel Hafaz *et al,* 2020 and Abdel Salam *et al,* and Ramadan 2015**. Similar results supported by **Abdel salam *et al,* 2010**. Lint percentage and lint index traits give an indication of deterioration, and attention must be paid to it and any slight change should be noted in the field of seed productions Purity.

Table 3. Mean performance for growth, yield and yield attributes in Giza 94 cotton cultivar and its off-types.

	Genotypes	PH	LA	BW	SCYP	SI	LCYP	LI	L%
1	**Giza 94 pure**	130.40	151.09	3.48	88.40	12.05	35.37	8.03	40.09
2	**T1**	200.80	162.82	3.28	48.08	11.02	15.87	5.39	32.77
3	**T2**	202.80	130.43	3.21	112.08	11.70	34.90	5.10	30.30
4	**T3**	185.20	130.79	3.31	66.48	11.69	21.31	5.48	31.85
5	**T4**	193.20	158.75	3.28	75.27	11.05	24.02	5.19	31.92
6	**T5**	184.00	160.48	3.19	64.51	11.74	21.64	5.94	33.60
7	**T6**	200.80	140.16	2.86	58.45	10.65	17.54	4.58	29.99
8	**T7**	162.80	150.77	3.40	120.28	10.72	45.42	6.60	38.10
9	**T8**	167.00	145.82	3.40	102.83	10.88	39.86	6.56	38.51
10	**T9**	174.60	168.66	3.07	103.26	10.73	37.23	6.24	36.69
11	**T10**	196.20	151.21	2.80	47.96	11.06	15.19	5.48	33.07
12	**T1 xG.94**	186.00	139.94	3.88	119.04	12.34	42.08	6.70	35.16
13	**T2 xG.94**	176.00	118.05	3.88	124.24	11.80	44.82	6.56	35.38
14	**T3 xG.94**	178.20	134.93	3.64	123.79	12.76	43.14	6.79	34.70
15	**T4 xG.94**	179.80	112.89	3.70	148.97	11.44	50.70	5.94	34.14
16	**T5 xG.94**	154.00	134.12	4.44	142.62	11.84	51.34	6.71	36.14
17	**T6 xG.94**	163.20	158.55	3.47	111.68	12.48	41.68	7.36	37.06
18	**T7 xG.94**	145.00	118.64	3.94	125.88	13.16	46.27	7.61	36.66
19	**T8 xG.94**	161.40	145.34	3.46	108.54	11.24	39.24	6.31	35.96
20	**T9 xG.94**	151.00	135.01	3.76	105.22	11.76	39.22	7.20	37.78
21	**T10xG.94**	171.80	124.40	3.30	107.08	10.02	42.88	6.67	40.02
	LSD at 0.05	**17.62**	**9.60**	**0.44**	**21.23**	**0.90**	**8.16**	**0.71**	**2.10**
	LSD at 0.01	**25.20**	**13.70**	**0.63**	**30.31**	**1.23**	**11.70**	**1.02**	**3.00**

Seed cotton yield, the results exhibited that the most genotypes gave lower than values compared with original variety especially the hybrids off-types No. 1, 3, 5, 6, and 10 while, No. 2, and 7, were higher than off-types G 94. As well as, the most hybrids gave higher than values compared with G.94i.e, No, 12, 14, 15, 16 17 and 18. While the hybrids No. 19, 20, and 21, did not differ significant with G. 94. The previous results indicated that the dominant action controls this trait which led to the emergence of hybrid vigor for all hybrids compared to the original variety G.94.These results were obtained by **Hemaida *et al,* 2006 and Abdel Hafez *et al,* 2020** which reported showing. More vigorous in growth compared to correspondent Giza 86 and Giza 88.

As for seed index the results showed that there are genetically differences between the genotypes and the values ranged from 10.2 to 13.16 gm for the off-types and hybrids respectively. The most off types gave lower values compared with the original variety studying the natural characters of cotton fibers is an important matter for the textile industry and the basis for the development of the industry. Any difference in the fibers, whether in length, strength, color, or uniformity ration, is extremely important from a financial, economic, and technical perspective.

Results in Table 4, of the staple length study showed that most of the genotypes were significantly lower than the original variety, except for numbers 1, 7 and 8. Meanwhile, all hybrids were equal to the original variety, significantly except for No.21. These differences are supported by researchers and others agree with them. Regarding the strength of the staple, the results showed that there are significant differences between the original variety and the different off types and hybrids under study. Also, same off types were lower than the original variety for example i.e., No. 2, 4, 6 and 10. While the most hybrid were equal with the original variety except for No., 15.

Results in Table 4 for uniformity ratio UN exabited that, most the genotypes gave values equal with original variety where values ranged from 87.16 to 90.5 for off-types and hybrids. While there are number of genotypes gave values lower than the original variety which are, 3, 4, 9, 10, 14 and 21 where the values ranged from 80.6-84.58. Uniformity ratio trait is one of the important traits in relation to it affect the efficiency of yarn in the textile industry. With reference to the elongation trait, the most of entries gave higher values than the original variety whither for the off-types and the hybrids under this study.

As well as, micronare reading trait, the results showed that all the off types and the hybrids gave values ranged from 4.4 to 5.5, except for No. 18, which gave a value equal to the original variety. Which means that all the different entries were coarser than the original variety, and this character is one of the most dangerous characteristics in the textile industry? The same results were obtained by a number of studies, which concluded that most of the off types were coarser fiber. The same results were obtained **by Hamida (2008), Abo Arab et al, (2000) and Abdel Hafez *et al,* (2020)**.

The color of the fibers in cotton is considered extremely important for the textile industry, as it affects the consistency of the appearance of the fabric with other characteristics. The result is that all the different types gave a cream color to the fibers, except for numbers 7, 8, and 9, which gave the same color as the original variety Giza 94. As for the hybrids, they took the same color as the second father, and the hybrids, 17, 18, 19 and 20 gave the same color as the original variety Giza 94. Short fiber (SFC) in cotton traits in the spinning and weaving processes, as it affects the rate of loss, the efficiency of the spinning and weaving processes and the characteristics of the final product. Results cleared that the most entries were equal with the original variety Giza 94. The previous results show that there is a correspondence between fiber length, fiber strength and color fiber for example, the off-types and hybrids with a high staple length correspond to high fiber strength and have a white color similar to the original variety Giza 94. In general, the results also exhibited the three is hybrid vigor in the two traits. The results showed this trend for the most hybrids. Studying the divergence and differences on the basis of all the traits under study is important for cotton breeders to determine the extent of relatedness between the genotypes. Using discernment analysis, the genetic divergence of the variety, the off-types and the hybrids. The results showed that the lint percentage was the most distinguishing trait, as well as the plant height compared to the rest of the traits. The results showed that the most important traits were the ability to distinguish between genotypes, lint index, lint percentage, plant height, staple length, and fiber color. The second axis was yield and leaf area. These results were supported by **Abdelsalam (2010), Hemieda (2008) and Abdel Hafez *et al,* (2020)**.

The results in Table 5 and Figure 1 showed that there are three off types that gave the lowest values of non-similarity to the original variety, and their numbers are 7, 8, and 9, and the values are 48.9, 44, and 57.3, respectively. The previous results in Tables 3 and 4, these off types gave values relatively close to the original variety in staple traits. Hence the importance of using divergence and milt variety in studies appears, as it depends on evaluating genetic groups on the basis of all the traits under study, and estimating the importance of traits in their relative contributions to the total variation.In addition to the importance of studying genetic divergence between genotypes and the relative contributions of traits to overall variation. Studies on similarities and differences in the groups under study demonstrate the importance of isolating and uprooting these types from the fields of seed producers to preserve the genetic purity of the varieties. At the same time, estimating distinctive and reliable traits, such as The characteristic of plant height, lint percentage, and the seed value of seeds help in detecting any change, even slight, to maintain the genetic purity of varieties below the commercial level.

Table 4. Mean performance for fiber traits in Giza 94 cotton cultivar and its off-types.

	Genotypes	FL	UI%	FS	Elong	MIC	RD%	+B	SF
1	**Giza 94 pure**	33.72	88.22	39.74	5.98	4.06	74.66	8.82	5.42
2	**T1**	33.68	90.06	38.48	6.30	4.78+	69.42	10.68	5.38
3	**T2**	32.50	89.12	32.48-	9.54	4.78	65.44	11.46	5.88
4	**T3**	32.53	85.68	38.88	7.80	5.50	61.56	12.50	5.94
5	**T4**	31.42	85.30	37.20	7.32	4.78	66.82	11.70	6.18
6	**T5**	33.98	88.16	39.18	6.76	4.77	71.76	9.58	5.76
7	**T6**	32.36	87.06	32.94	9.82	4.72	66.20	12.06	5.02
8	**T7**	33.62	87.16	38.46	5.74	4.56	74.02	9.04	5.64
9	**T8**	34.16	88.46	41.48	6.58+	4.54	74.04	8.10	5.46
10	**T9**	32.72	85.90	39.72	6.92	4.62	71.56	8.82	6.14
11	**T10**	29.06	84.58	36.00	8.12	4.42	65.00	11.76	6.46
12	**T1 xG.94**	35.30	88.60	41.40	7.00	4.50	70.80	9.70	5.40
13	**T2 xG.94**	34.00	88.90	38.00	6.80	4.50	67.40-	11.00	5.40
14	**T3 xG.94**	33.05	80.60	39.60	7.80	4.70	56.00	13.40	6.40
15	**T4 xG.94**	32.00	86.90	32.20	10.70	4.70	65.60	11.70	6.10
16	**T5 xG.94**	33.20	88.30	39.10	7.50	4.70	69.00	10.90	5.40
17	**T6 xG.94**	34.30	88.30	41.30	6.90	4.70	74.80	9.00	5.40
18	**T7 xG.94**	35.70	90.50	40.30	6.00	4.10	74.90	9.10	5.40
19	**T8 xG.94**	34.70	88.00	40.60	5.80	4.40	75.00	8.20	5.40
20	**T9 xG.94**	34.80	88.10	40.50	6.70	4.50	73.20	8.10	4.50
21	**T10xG.94**	31.12	84.60	38.60	6.30	4.50	64.70	11.40	6.50
	LSD at 0.05	**0.90**	**1.72**	**1.41**	**0.60**	**0.30**	**1.64**	**0.50**	**0.70**
	LSD at 0.01	**1.23**	**2.50**	**2.02**	**0.80**	**0.40**	**2.34**	**0.70**	**0.92**

Table 5 . Dissimilarity matrix among the 21 genotypes based on morphological traits

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1		87.6	60.2	49.8	31.2	52.5	89.5	73.4	72.2	58.9	85.0	80.9	98.6	108.4	129.6	117.3	80.6	111.5	80.9	103.8	102.7
2			57.5	50.9	70.6	60.0	63.1	66.9	59.5	75.5	90.9	52.0	50.6	38.4	51.5	70.7	68.1	84.8	68.4	93.0	62.1
3				35.1	41.4	25.5	74.4	74.6	73.3	59.4	77.5	74.0	78.9	68.7	95.7	91.5	74.3	92.0	68.4	107.0	87.4
4					30.8	30.2	67.3	65.1	49.7	47.0	75.8	65.6	77.2	64.4	93.7	90.6	63.3	97.5	66.4	98.0	79.7
5						41.0	66.4	59.2	55.8	57.6	63.7	66.0	82.8	84.9	109.5	93.5	60.6	90.6	57.2	94.7	89.2
6							87.5	83.4	76.0	43.8	91.3	82.8	90.2	78.4	105.6	107.3	85.9	108.4	81.2	112.1	90.4
7								36.8	45.4	103.6	48.9	32.4	45.7	60.3	68.3	31.7	18.2	44.6	25.6	78.5	77.0
8									34.8	87.7	44.0	29.4	40.9	74.7	79.2	59.2	30.0	53.8	38.1	49.7	59.7
9										73.9	57.3	44.5	56.7	63.9	79.6	69.8	37.1	78.7	53.6	63.3	59.4
10											97.3	95.9	99.9	92.4	117.3	124.9	98.0	125.1	99.3	100.2	80.0
11												65.5	70.7	86.9	100.1	67.4	44.6	56.9	43.5	68.3	81.3
12													30.7	64.1	64.2	48.7	34.3	52.8	38.4	69.1	65.9
13														56.7	44.6	46.8	50.7	50.2	53.2	62.3	51.1
14															42.0	59.5	68.3	81.6	70.2	97.8	65.7
15																54.9	78.4	75.5	80.3	93.3	65.1
16																	46.6	38.8	45.5	89.0	83.4
17																		55.4	33.8	75.0	78.7
18																			37.9	76.6	82.4
19																				76.7	77.9
20																					46.9
21																					

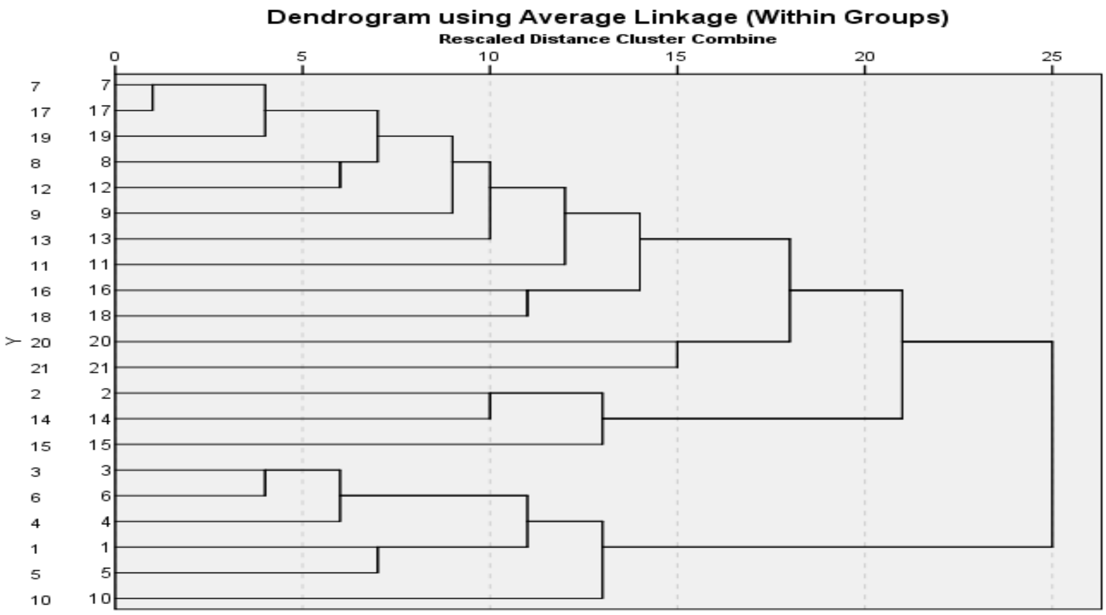

Figure 1.dendrogram presentation of 21 cotton parental and hybrids

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