EFFECT OF MUTAGENS ON THE ASSOCIATIONS BETWEEN FIBER FINENESS AND SOME ECONOMIC CHARACTERS IN EGYPTIAN COTTON

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Abstract

The present work aimed at studying the effect of triethanolamine (TEA) 0.02% and dimethylsulphate (DMS) 0.025% from alkylating agents group as chemical mutagens on the correlation coefficients of some economic characters in the two Egyptian cotton varieties Menoufi and Giza 74, as well as the F_1 and F_2 populations of their hybrid. The experimentation work was carried out on M1 and M2 generations.

The results showed that positive phenotypic and genotypic correlations existed between fibre fineness and number of days to first flower in control plants. On the other hand, a negative genetic correlation was found between both traits in M1 induced by TEA and in M2 treated by DMS. Whereas, this genetic correlation was positive in M2 treated by TEA and in M1 induced by DMS. Positive genotypic correlations were found between fibre fineness and number of days to first open boll in control and in all mutant generations under study, except M2 treated by TEA where a negative genetic correlation was detected. The relationship between fibre fineness and boll weight in control showed positive phenotypic correlation, but negative genotypic correlation. After treatment by the two chemical mutagenes, positive genotypic correlations were found in all cases except in M1 treated by TEA, which showed negative genetic correlation. Positive genotypic correlations were found between fibre fineness and seed cotton yield per plant in M2 treated by the two chemical mutagens. On the other hand, negative genotypic correlations were found between both traits in M1 and control. Positive phenotypic and genotypic correlations were obtained between fibre fineness and lint percent treated by TEA in the two mutant generations, whereas, negative genotypic correlations were obtained between the two characters by DMS treatment in both mutant generations, as well as in control. After treatment with the two chemicals mutagens, positive phenotypic and genotypic correlations were found between fibre fineness and lint index in M1, while negative genotypic correlations were found between both traits in M2 as well as in control. Positive phenotypic and genotypic correlations were obtained between fibre fineness and seed index in control and M1 treated by TEA. In contrast, negative genotypic correlations between the two characters were found in the two mutant generations treated by DMS and the second mutant generation treated by TEA.

Introduction

The main objective of the present investigation was to study the correlation coefficients between fibre fineness and some economic characters after treatment by two alkylating chemical mutagens, i.e., triethanolamine (TEA) and dimethysulphate (DMS). The study aimed at breaking the relationship between fibre fineness and some other characters by chemical mutagens to help the breeders to select desirable combinations between traits. Many investigators studied the effect of some mutagens on the relationships between traits in cotton.

Fotiadis and Miller (1973) found small increase in the magnitudes of correlations between traits after treatment by gamma irradiation. Shroff and Srinivasachar (1977) found positive phenotypic and genotypic correlations between either seed index or lint index and maturity coefficients in M2 generation of Badnawar Indian cotton variety when treated with N-nitroso-N-methylurea (NMU) and ethylmethanosulphate (EMS). Guseniova (1978) found that the mutagen N- nitroso-N-ethylurea induced mutants in which undesirable correlations between quantitative and qualitative fibre characters were broken. El-Helow (1981) treated seedlings of some Egyptian cotton varieties with dimethylsulphate. She found positive phenotypic and genotypic correlation coefficients between boll weight and each of date of first open boll, lint percent, seed index, lint index and yield of seed cotton. Raafat (1982) reported different relationships between boll weight and some agronomic traits in Egyptian cotton germplasm treated by alkylating agents. Mahdy (1996) found that the DMS treatments significantly increased the correlation coefficients between the micronaire and both of date of first flower, number of fruiting branches, number of bolls per plant and plant height while, significantly decreased the micronaire and date of first boll.

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Materials and Methods

The two alkylating chemical mutagens: triethanolamine (TEA) 0.02% and dimethylsulphate (DMS) 0.025% were used to study their effect on the association between fibre fineness and some economic traits in two Egyptian cotton cultivars, i.e. Menoufi and Giza 74 (G. barbadense L.).

The fieldwork continued for three successive seasons. Seeds of the two parental cultivars, their F1 and F2 populations were soaked for 24 hours before planting in the solution of mutagens. The genetic materials used in this study were:

(1) Untreated parents, their F1 and F2 generations (control).
(2) The two parents, their F1 and F2 generations which were treated with each of the two chemical mutagens (TEA and DMS) in third season (first mutant generation M1).
(3) The treated parents in second season, their F1, and F2 generations from the treated F1 in the same season (second mutant generation M2).

The plants were sown in randomly distributed rows spaced at 60 cm and in hills per row 50 cm apart. When the stand was assured, the plants were thinned to one plant per hill.

Phenotypic and genotypic correlation coefficients for fibre fineness (and maturity) expressed as micronaire reading and each of the date of the first flower, date of the first open boll, boll weight, seed cotton yield per plant, lint percent, seed and lint indices were estimated as outlined by Burton (1951).

Results and Discussion

Correlation Between Fibre Fineness and Date of First Flower

The phenotypic and genotypic correlation coefficients between the two traits in F2 generation, used as a control, were positive (Table 1). The first was highly significant and the latter was relatively high. These positive values of both phenotypic and genotypic correlation coefficients between fibre fineness and the number of days to first flower might indicate that breeders could select delayed flowering plants in untreated populations when high micronaire reading were desired and vice versa.

With regard to the relationship between both characters in the triethanolamine (TEA) treatment, results indicated that the phenotypic correlation ill both M1A and M2A had positive values similar to those in control. However the F2 values were significant in M1A but insignificant in M2A. On the other hand, the genotypic correlation was negative and high in M1A, indicating that delayed flowering was correlated with low micronaire reading. In contrast, the genotypic correlation in M2A was positive and relatively low.

In (DMS) treatment, the phenotypic correlation between both characters in the F2 population was positive and insignificant in M1, while it was positive and highly significant in M2. The genotypic correlation was positive and high in M1B but negative and low in M2B, indicating that delayed flowering was mostly correlated with high micronaire reading. However, such result of M1B was not in agreement with that obtained in M1A where the first was negative but the latter was positive. Such conclusion was in agreement with that reported by Mahdy (1996).

Correlation Between Fibre Fineness and Date of First Open Boll

The phenotypic correlation between both traits in untreated F2 generation used as control was positive and insignificant. On the other hand, the genotypic correlation in the control plants was positive and moderate. These results showed that high micronaire reading could be obtained by selecting the most delayed boll opening and vice-versa could outline high micronaire reading.

In triethanolamine (TEA) treatment, the phenotypic correlation in F2 was positive and insignificant in M1A but highly significant in M2A though it was low in its magnitude. Moreover, the genotypic correlation was positive and moderate in M1A but negative and low in M2A.

In dimethylsulphate (DMS) treatment, the phenotypic correlation of F2 generation was positive and insignificant in M1B, while it was positive and highly significant in M2B. The genotypic correlations were positive, and moderate in M1B but low in M2B. Therefore, one could select plants of early boll opening to get fine fibre and vice-versa, especially in M1B treatment.

To sum, the positive and high genetic correlation between micronaire reading and days to first flower and the positive and moderate estimate for the genetic association between micronaire reading and days to first open boll in M1B treatment, could give evidence that selection for genotypes earlier in maturity and lower in micronaire reading might be feasible in F2 population of the cross Menoufi x Giza 74 by treating the plants with dimethylsulphate. Similar finding were reported by Mahdy (1996).

Correlation Between Fibre Fineness and Boll Weight

The genotypic correlation in the control was negative with a value of −0.5653 (Table 1). This could indicate that in older to obtain heavy boll weight, the breeders have to select the plants which carry low micronaire reading and vice-versa.

In F2 population treated by TEA, the phenotypic correlations were positive and moderate in either M1A or M2A, while the genotypic correlation was high and positive in M1A treatment but low positive in M2B treatment.

With regard to the relationship between both characters in DMS treatment, the phenotypic correlation values were positive and highly significant in both M1B and M2B treatments. The genotypic correlations between the two characters were negative and low in M1B, but positive and high in M2B.

The positive and high values of genotypic correlations in M1A and M2B indicated that low micronaire reading, might be highly correlated with low boll weight and vice-versa, Such conclusion was in agreement with that reported by Fotiadis and Miller (1973).

Correlation Between Fibre Fineness and Seed Cotton Yield

The phenotypic correlations between fibre fineness and seed cotton yield per plant were positive and insignificant in F2 populations either in control or any other treatment except in M1B where it reached the level of significance (Table 1). On the other hand, the genotypic correlations were negative and high in control, negative and moderate in both M1A and M1B, while it was positive in either M2A or M2B with a low value in the first but high in the latter.

However, the positive phenotypic and genotypic correlation between both characters in M2 either in A or B treatments, could indicate that fibre fineness of cotton plants might be highly associated with low seed cotton yield/plant and vice-versa.

Correlation Between Fibre Fineness and Lint Percent

The phenotypic correlation between fibre fineness and lint percent in the F2 generation of the control plants was positive and significant. However, the genotypic correlation between the two characters in the control plants had a high negative value, which could reveal that high lint percentage was highly correlated with low micronaire reading and vice-versa.

With regard to the relationship between both characters in the F2 generation in both TEA and DMS treatments, the phenotypic correlations were positive and highly significant in M1 and M2 generations. However, the genotypic correlation fluctuated from positive and high in TEA treatment to negative and low in DMS treatment.

Such previous results could give evidence that selection for plants with high lint percentage would exhibit high micronaire reading and vice-versa.

Correlation Between Fibre Fineness and Lint Index

Result showed that the phenotypic correlation between fibre fineness and lint index in the F2 generation for the control plants was positive and highly significant. The genotypic correlation between the two characters was high and negative. Such relationship might indicate that high lint index had considerable and negative micronaire reading.

In the second mutant generations for both treatments, the relationship between fibre fineness and lint index showed the same trend, In the first mutant generations, the phenotypic correlations were positive and highly significant for both treatment, on the other hand, the genotypic correlations were positive and high treatments.

Correlation between fibre fineness and seed index:

The phenotypic correlation between two traits of the F2 generation in control was positive and highly significant. In the two mutant generations for both treatments, the relationship between fibre fineness and seed index showed that same trend.

On the other hand, the genotypic correlation in the control plants was positive and high. In TEA treatment, the genotypic correlations was positive and high in M1A but negative and low in M2A. In DMS treatment, the genotypic correlations were negative and high in the two mutant generations. Therefore, breeders could select plants characterized by high seed index to obtain fibre with low micronaire reading, especially under M2 treated by DMS treatment.

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Table 1. Phenotypic and genotypic correlation coefficients between fibre fineness and some economic traits in control and triethanolamien treatment.

Population	No. of plants	Type of correl.	Date of 1st Flower	Date of 1st open	Boll wt.	Seed cotton yield
				Control		
Menoufi	32	Ph.	0.2938	0.0050	0.1947	0.2794
Giza 74	33	Ph.	0.5704**	0.9000**	0.6673**	0.1540
F1	56	Ph.	0.0783	0.2080	0.2621*	0.4660**
		Ph.	0.2433**	0.0435	0.1871*	0.0115
F2	148	G.	0.4857	0.4414	-0.5653	-2.8969
				M1A		
Menoufi	32	Ph.	0.6017	0.6750**	0.4643**	0.3772*
Giza 74	33	Ph.	0.2732	0.6946**	0.2634	0.0894
F1	77	Ph.	0.2958*	0.4902**	0.5125**	0.1584
		Ph.	0.2283*	0.0151	0.4537**	0.1275
F2	123	G.	-0.7829*	4.0969	1.0000	-0.3541
				M2A		
Menoufi	32	Ph.	0.4615**	0.6889**	0.4532*	0.0726
Giza 74	34	Ph.	0.3081**	0.3200*	0.5889**	0.1564
F1	64	Ph.	0.0600	0.1312	0.4218**	0.0758
		Ph.	0.0286	0.2473**	0.5261**	0.1161
F2	103	G.	0.1503	-0.2783	0.1004	0.0359

Population	No. of	Type of	Lint %	Lint index	Seed index
				Control	
Menoufi	32	Ph.	0.7121**	0.4949**	0.1294
Giza 74	33	Ph.	0.6600**	0.7585**	0.8482**
F1	56	Ph.	0.3424*	0.4865**	0.5994**
		Ph.	0.2236*	0.4624**	0.4386**
F2	148	G.	-0.8789	-0.6206	0.9360
				M1A	
Menoufi	32	Ph.	0.4808**	0.6354**	0.5620**
Giza 74	33	Ph.	0.3890*	-0.1281	0.1615
F1	77	Ph.	0.3442**	0.5745**	0.6355**
		Ph.	0.5715**	0.4526**	0.4904**
F2	123	G.	3.8800	0.8168	1.0778
				M2A	
Menoufi	32	Ph.	0.3811**	0.4850**	0.5525**
Giza 74	34	Ph.	0.8578**	0.7194**	0.5988**
F1	64	Ph.	0.1621	0.4111**	0.4379**
		Ph.	0.4170**	0.6560**	0.5390**
F2	103	G.	0.8602	-0.8160	-0.1692

*, ** Significant a 0.05 and 0.01 levels, respectively.
A = triethanolamine treatment.
M1 = First mutant generation.
M2 = Second mutant generation.
Ph. = Phenotypic correlation.
G = Genotypic correlation.

Table 2. Phenotypic and genotypic correlation coefficients between fibre fineness and some economic traits in control and dimethylsulphate treatment.

Population	No. of plants	Type of corr.	Date of 1st Flower	Date of 1st open	Boll wt.	Seed cotton yield
				Control		
Menoufi	32	Ph.	0.2928	0.0050	0.1947	0.2794
Giza 74	33	Ph.	0.5704**	0.9000**	0.6673**	0.1540
F1	56	Ph.	0.0783	0.2080	0.2621*	0.4660**
		Ph.	0.2433**	0.0435	0.1871*	0.0115
F2	148	G.	0.4857	0.4414	-0.5653	-2.8969
				M1B		
Menoufi	18	Ph.	0.1673	-0.0922	0.7416**	0.2728
Giza 74	24	Ph.	0.4663*	0.3840*	0.5495**	0.0264
F1	57	Ph.	0.2528*	0.0874	0.5655**	0.1758
		Ph.	0.0380	0.0063	0.5794**	0.4069*
F2	134	G.	0.7371	0.3967	-0.1363	-0.4207
				M2B		
Menoufi	16	Ph.	0.4392*	0.0527	0.9818**	0.2189
Giza 74	19	Ph.	0.1411	2.5556**	0.7701**	0.1936
F1	53	Ph.	0.2641*	0.7186**	0.6184**	0.1894
		Ph.	0.3142**	0.5074**	0.3873**	0.0399
F2	78	G.	-0.1043	0.1538	0.5851	1.6411

Population	No. of	Type of	Lint %	Lint index	Seed index
				Control	
Menoufi	32	Ph.	0.7121**	0.4949**	0.1294
Giza 74	33	Ph.	0.6600**	0.7585**	0.8482**
F1	56	Ph.	0.3424*	0.4865**	0.5994**
		Ph.	0.2236*	0.4624**	0.4386**
F2	148	G.	-0.8789	-0.6206	0.9360
				M1B	
Menoufi	18	Ph.	0.9380**	0.6230**	0.9137**
Giza 74	24	Ph.	0.5650**	0.5774**	0.6611**
F1	57	Ph.	0.2579	0.4352**	0.4904**
		Ph.	0.2830**	0.8505**	0.4851**
F2	134	G.	-0.2930	3.1804	-0.6923
				M2B	
Menoufi	16	Ph.	0.8224**	0.7035**	0.6423**
Giza 74	19	Ph.	0.5051*	0.8787**	0.3234**
F1	53	Ph.	0.3890**	0.6020**	0.8421**
		Ph.	0.4021**	0.4884**	0.5063**
F2	78	G.	-0.1707	-1.3955	-2.5742

*, ** Significant a 0.05 and 0.01 levels, respectively.
B = dimethylsulphate treatment.
M1 = First mutant generation.
M2 = Second mutant generation.
Ph. = Phenotypic correlation.
G = Genotypic correlation.