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GENETIC EFFECTIVENESS OF CLUSTERING ANALYSIS IN SELECTING SOME PROMISING BC_1 PLANTS IN COTTON

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ABSTRACT: Clustering analysis was employed to determine promising BC_1 plants, derived from interspecific crosses between two Egyptian and two American cottons, which outperform their Egyptian parents in yield. The clustering patterns of BC_1 plants in both "Giza 86 X Acala Maxxa" and "Giza 85 X Palala" crosses showed three and four kinds of groupings at dissimilarity Euclidian distance lower than 7, respectively. The clustering patterns revealed that cluster III of the cross "Giza 86 X Acala Maxxa" and clusters II and IV of the cross "Giza 85 X Palala" possessed the highest values for most studied yield characters and eventually having the highest scores comparing with the other clusters. Accordinely, both clusters were ranked firstly proving their superiority and consequently their readiness for selection.

The means of both selected cluster individuals surpassed both corresponding BC_1 and Giza parental means for studied yield characters. Such increments were significantly reflected in actual genetic gains. Examination of individuals of each selected cluster gave an opportunity to detect and select individual plants characterized by their high yield potentialities. Individual 13, from the first cross, and 19, from the second cross were the most promising individuals, and could be taken in cotton breeding program as selected plants from BC_1 generation derived from interspecific crosses.

Key words: Clustering analysis, cotton, interspecific crosses, BC_1 plants, selection.

INTRODUCTION

Clustering analysis is considered as an valuable approach in genetic studies. This assessment can provide useful information about the prediction of selected plants or families in segregating generations, based on performances of their contributed characters in clustering. Application of this approach can permit to identify and choose of superior clusters as well as superior plants or families within such selected clusters. The more diverse plants or families are the greater chance of improving the characters in view (Abd El-Sayyed *et al.*,1998; Khedr, 1998 and 2002; Gutierrez, 2002 and El-Mansy 2005).

The objectives of this work is to employ clustering technique as an efficient genetic tool and to study its genetic effectiveness to determine, as early as, possible promising BC_1 plants, derived from interspecific crosses between two Egyptian and two American cottons, that outperform their Egyptian parents in boll weight and yield.

MATERIALS AND METHODS

The plant materials used in the study were BC_1 generation of cotton derived from backcrossing interspecific F_1's between two Egyptian, *Gossypium barbadense* L., (Giza 86 and Giza 85) and two American, *Gossypium hirsutum* L., (Acala Maxxa and Palala) cottons, to their Egyptian parents. Both American parents were characterized by high boll weight, high yield / plant and moderate ginning percent comparing with the Egyptian parents which are characterized with good lint quality.

Selfed seeds of the four parents were sown in the season of 2002, and crosses were made to obtain two interspecific F_1's, "Giza 86 X Acala Maxxa" and "Giza 85 X Palala". In the next season, 2003, F_1 seeds along with their selfed Giza parental seeds were sown and backcrosses were done. In the third season, 2004, seeds of BC_1 generation along with their parental were planted in completely randomized experimental design with three replicates. Numbers of BC_1 plants are listed in Figures 2 and 3, respectively. At the end of the season individual plants of each parent or BC_1 generation were harvested and ginned.

Seed cotton yield per boll (SCY/B) and per plant (SCY/P) as well as lint yield per plant (LY/P) were estimated. Lint percent

(LP%) and lint yield per boll (LY/B) were calculated .

Ranges, 50% of values and means of BC_1 generation were computed, and expressed as boxpolts.

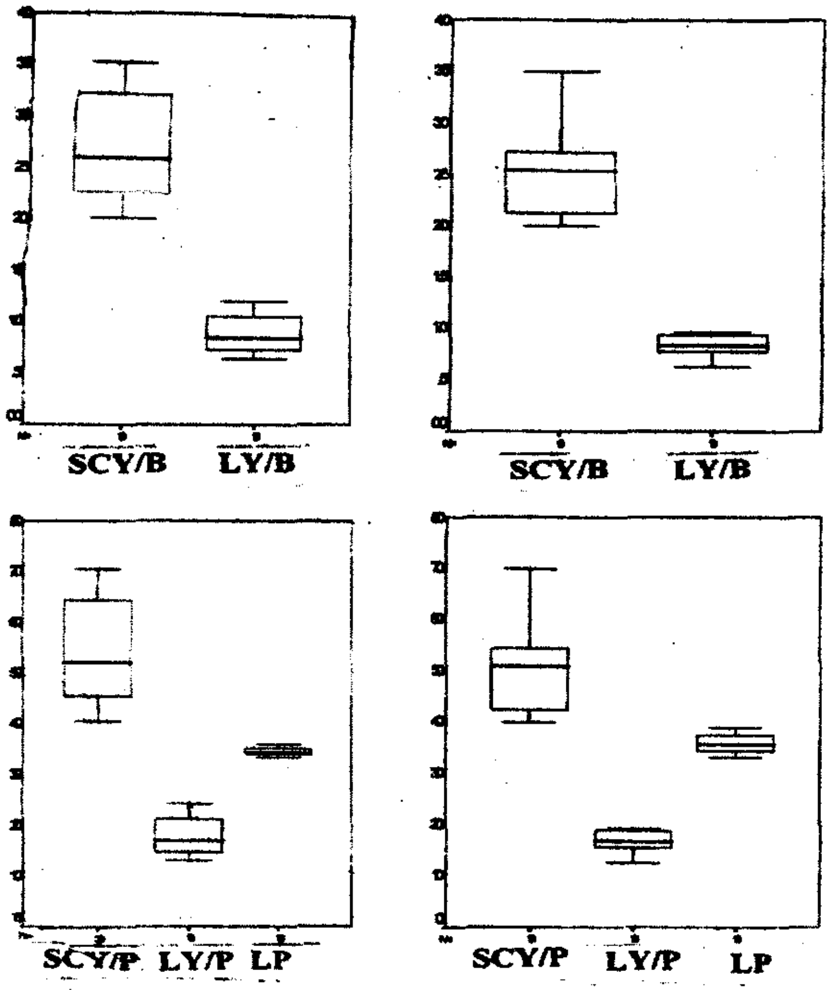
To study the clustering pattern among BC_1 plants and its effect on prediction of selection, values of BC_1 plants for the studied yield characters were subjected to a multivariate analysis in each BC_1 generation. This procedure used a method performing a disjoint cluster analysis on the basis of Euclidean distances as outlined by Johnson and Wichern (1998) and Mohammadi and Prasanna (2003). Clustering pattern of each BC_1 is presented as dendrogram. These computation are performed using SPSS computer software (1995).

To determine the effectiveness of clustering for selecting promising plants, clusters mean of each BC_1, were estimated, scored and ranked for their phenotypic values of the contributed characters. The highest cluster mean in each yield character gave the highest score and vice versa. The mean rank over all characters in each cluster was calculated. The first ranked clusters were compared with their corresponding BC_1 mean or Giza parental mean and actual genetic gains were estimated. Also, the individuals of selected cluster were compared with their Giza parental values.

RESULTS AND DISCUSSION

Performances of BC_1 plants of both crosses for boll and plant seed cotton yield, lint yield per boll and per plant and lint percentage are illustrated in Fig. 1. The Figures showed boxpolts diagram for each studied character exhibiting the ranges, 50% of values and means. These diagrams gave clear picture of yield characteristic in both BC_1 populations, reflecting wide genetic variations and permitting to subject these early generations under selection. Sharma (1994), Martin and Geraldi (2002) and Bernardo (2003) reported that early generation selection of self–pollinated crops is expected to be effective, but in practice it might be ineffective owing to the large no genetic effects.

The genetic relationships among BC_1 plants were summarized using clustering analysis to aggregate plants into phenotypic groups. The dendrograms of BC_1 populations of both studied crosses were



Giza 85 X Palala **Giza 86 X Acala Maxxa**

Fig. 1 : Performance of BC_1 plants derived from the interspecific cotton crosses for the studied yield characters , showing ranges , 50% of values and means

illustrated in Figures 2 and 3, respectively.

The clustering pattern of BC_1 plants of both interspecific cotton crosses "Giza 86 X Acala Maxxa" and "Giza 85 X Palala" showed three and four kinds of grouping at dissimilarity low than 7 Euclidian distance, respectively.

Regarding the BC_1 of the cross "Giza 86 X Acala Maxxa", the three clusters consisted of 8,8 and 3 members, respectively. Cluster I was widely divergent than cluster II (Fig. 2). Clusters mean and scores of the contributed characters showed that cluster III exhibited the highest values for all studied yield attributes, followed by cluster I. However, cluster II was the least in this consideration (Table 1).

Concerning the BC_1 of the cross "Giza 85 X Palala", the four clusters composed of 10, 6, 2 and 1 plants, respectively (Fig. 3). The largest cluster was cluster I which showed the widest divergence than cluster IV, that consisted of only one individual forming a unique cluster by itself. Clusters mean in Table 1 revealed that cluster IV possessed the highest estimates of most of studied yield characters as compared with the other clusters, and eventually having the highest scores, followed by cluster II. It is worthily to note that cluster IV had the highest lint percentage over all clusters of both crosses, besides its better yield performance. In this regard, Abd El-Sayyed *et al.*, (1998) classified some *barbadense* genotypes into three major clusters. However, Khedr (2002) reported that clustering patterns of the twenty families of each backcross of three cotton crosses presented five kinds of clusters. While El-Mansy (2005) classified F_3 populations of cotton into three clusters.

To detect the superior clusters, the clusters scores were ranked for their phenotypic values of the contributed characters towards clustering and the mean rank over all characters was also determined (Table 1) .

Accordingly, cluster III of cross "Giza 86 X Acala Maxxa" and clusters II and IV of cross "Giza 85 X Palala" had the highest scores and ranked firstly, showing their superiority and consequently chosed and selected. The selected cluster means and the averages of their corresponding BC_1 and Giza parental means are given in Table 2. It is clear that means of selected clusters

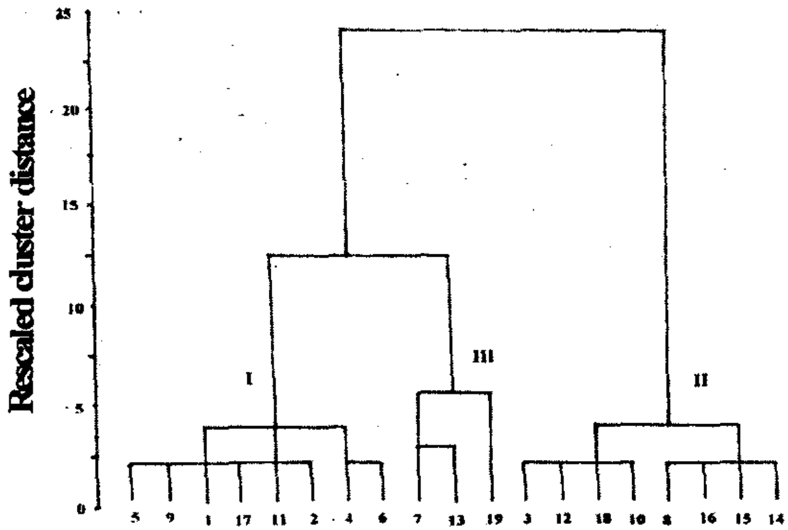


Fig. 2: Dendrogram presentation for clustering BC1 plants of the cotton cross Giza 86 X Acala Maxxa

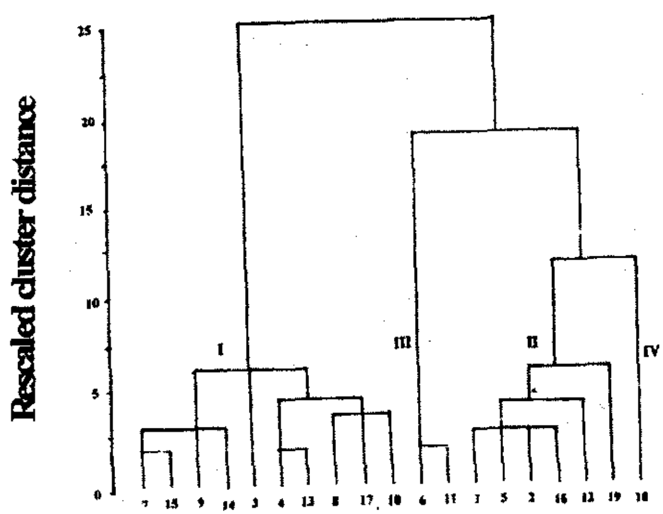


Fig. 3: Dendrogram presentation for clustering BC1 plants of the cotton cross Giza 85 X PALALA

Table 1: Cluster means and scores for the contributed characters toward clustering patterns of BC_1 generation of interspecific crosses

Cluster No.	SCY / B gm		LY / B gm		SCY / P gm		LY / P gm		LP %		Mean Score
	$\bar{X}$	Score	$\bar{X}$	Score	$\bar{X}$	Score	$\bar{X}$	Score	$\bar{X}$	Score	
Giza 86 X Acala Maxxa											
I	2.643	2	0.873	2	52.850	2	17.454	2	35.114	1	1.8
II	2.113	1	0.736	1	42.250	1	14.719	1	36.136	2	1.2
III	3.300	3	1.210	3	66.000	3	23.980	3	36.573	3	3.0
Giza 85 X Palala											
I	2.295	1	0.735	1	45.900	1	14.707	1	34.465	1	1.0
II	3.372	4	1.090	3	67.433	4	21.795	3	34.638	2	3.2
III	2.915	2	0.969	2	58.300	2	19.375	2	35.200	3	2.2
IV	3.190	3	1.210	4	63.800	3	24.200	4	38.020	4	3.6

Table 2: Selected clusters mean, their BC_1 and their corresponding Giza parental means for the contributed characters toward clustering patterns

Genotypes	SCY / B gm	LY/ B gm	SCY / P gm	LY / P gm	LP %
			Giza 86 X Acala Maxxa		
Selected cluster III	3.300	1.210	66.000	23.980	37.110
BC1 means	2.523	0.868	50.463	17.333	35.859
Giza 86	2.536	0.897	50.517	17.724	36.170
			Giza 85 X Palala		
Selected cluster II	3.372	1.090	67.433	24.200	34.638
„ „ **IV**	3.190	1.210	63.800	21.795	38.020
BC1 means	2.747	0.897	54.947	17.936	34.784
Giza 85	2.180	0.767	43.600	15.337	36.420

Table 3 : Actual genetic gain in the selected clusters of each cross for the contributed characters toward clustering patterns

Cluster No.	Selecting strategy	SCY / B gm	LY / B gm	SCY / P gm	LY / P gm	LP %
			Giza 86 X Acala Maxxa			
III	Over BC1 mean	0.777*	0.342*	15.537*	6.647*	1.251*
	Over Giza parent	0.764*	0.313*	15.483*	6.256*	0.933*
			Giza 85 X Palala			
II	Over BC1 mean	0.625*	0.193*	12.486*	3.859*	- 0.146
	Over Giza parent	1.192*	0.323*	23.833*	6.458*	- 1.785*
IV	Over BC1 mean	0.443*	0.313*	08.853*	6.264*	3.236*
	Over Giza parent	1.010*	0.443*	20.200*	8.863*	1.597

* Significant at 0.05

surpassed both BC_1 and Giza parental means in all studied yield characters.

Such increments were significantly reflected in actual genetic gains as illustrated in Table 3. The actual gains detected in selected clusters of the cross "Giza 85 X Palala" were more than those of the cross "Giza 86 X Acala Maxxa". Goda (2001) and Al-Ameer (2004) obtained high values of expected genetic gains for yield characters among selected lines of cotton in dictating that phenotypic expression of these characters were indicative of their genetic behavior and selection would be highly effective.

Examination of individuals of each selected cluster gave an opportunity to detect and select some individual plants characterized by their higher yield potentialities. These individuals and their values for the contributed yield characters towards clustering are presented in Table 4. Data revealed that all individuals of the selected clusters, which are significantly exceeded their Giza parental values, were promising plants. individual 13, of the cross "Giza 86 X Acala Maxxa", and 19, of the cross "Giza 85 X Palala" appeared to be the most promising individuals. Consequently, these individuals could be taken, all or some in cotton breeding program as selected plants derived from BC_1 generation. Stable progenies were derived from interspecific hybrids of *G. hirsutum* and *G. barbadense* exhibiting wide range of combination of parental morphological and characteristics and fiber quality (Cantrell and Davis, 1993). However, Tatineni *et al.,* (1996) obtained limited interspecific introgressions derived from hybridization between *G. hirsutum* and *G. barbadense.*

Therefore, these conclusions might reflect the effectiveness of clustering procedure in detecting the more yielding clusters. The cotton breeders could safely select the desirable clusters and could certainly eliminate the undesirable ones. These findings might also suggest that clustering pattern of BC_1 generation seemed to be effective rather than other segregating generations. Likewise, applying clustering procedure might justify the selection response in advanced generations.

Clustering analysis in relation to selection in cotton breeding appeared to be a new approach. Examination the literature revealed that such an approach did not

Table 4 : Values of members of each selected cluster and their Giza parental means in each cross for the contributed characters in clusters pattern

Selected cluster	Member code	SCY/B gm	LY/B gm	SCY/P gm	LY/P gm	LP %
		Giza 86 X Acalca Maxxa				
III	7	3.36	1.20	67.2	23.33	36.10
	13	3.50	1.26	70.0	25.20	36.87
	19	3.04	1.17	60.8	23.41	38.36
Mean		3.30	1.21	66.0	23.98	37.11
Giza 86		2.53	0.89	50.5	17.72	36.17
		Giza 85 X Palala				
II	1	3.19	1.019	63.8	20.40	34.43
	2	3.42	1.080	68.4	21.60	34.19
	5	3.25	1.076	65.0	21.53	35.13
	12	3.52	1.107	70.4	22.15	34.12
	16	3.33	1.048	66.6	20.96	34.12
	19	3.52	1.210	70.4	24.13	35.84
IV	18	3.19	1.210	63.8	24.20	38.02
Mean		3.35	1.107	66.9	22.14	35.12
Giza 85		2.18	0.767	43.6	15.34	36.42

receive more breeder's attentions. Khedr (2002) employed this approach in selection of some promising families derived for triple test cross in cotton for earliness. However, El-Mansy (2005) applied this analysis among F_3 populations of cotton.

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الفاعلية الوراثية لتحليل المجموعات في انتخاب بعض نباتات الجيل الرجعى الأول في القطن

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تم استخدام طريقة تحليل المجموعات في انتخاب بعض النباتات المبشرة في الجيل الرجعى الأول، والناتجة من التهجين النوعي بين اثنان من أصناف القطن المصري مع اثنان من القطن الأمريكي. وأظهر تحليل المجموعات **clustering analysis** أن الهجين الأول **Giza 86 X Acala Maxxa** يضم ثلاث مجموعات في حين أظهر الهجين الثاني **Giza 85 X Palala** أربع مجموعات وذلك تحت معامل عدم تشابه أقل من 7 **Euclidean distance**. وأظهرت النتائج أن المجموعة الثالثة في الهجين الأول بينما المجموعتين الثانية والرابعة في الهجين الثاني الأعلى قيما بالنسبة لمعظم صفات المحصول وحصلت على أعلى تقدير، مقارنة بباقي المجموعات.

وكان متوسط المجموعات المنتخبة أعلى من متوسط الأبوين المصريين والجيل الرجعى الأول في صفات المحصول. وتم انتخاب أفضل النباتات الفردية من المجموعات المنتخبة، فكان النبات رقم ١٣ في الهجين الأول والنبات رقم ١٩ في الهجين الثاني أكثر النباتات المبشرة والتي ينصح باستخدامها في برنامج تربية القطن.