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GENETIC EFFECTIVENESS OF CLUSTERING ANALYSIS IN SELECTING PROMISING F_3 ROGENIES FOR BAKING QUALITY IN WHEAT

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ABSTRACT: Clustering analysis was employed to determine some promising F_3. Progenies derived from crossing between two introduced and two Egyptian wheat varieties, differing in their baking quality parameters. The clustering patterns of F_3 progenies in each one of the two obtained crosses showed four kinds of grouping at Euclidean distance lower than 7. The clustering patterns revealed that cluster II of the cross " Kauz-Star X Gemmeiza 7 " and cluster I of the cross " Opata-Rayon X Sids 7 " had the highest values for most studied baking quality characters and eventually having the eventual highest scores. Accordingly, both clusters were ranked firstly proving their superiority and consequently their readiness for selection .The means of the selected cluster of the cross " Kauz-Star X Gemmeiza 7 " surpassed both corresponding F_3 and Gemmeiza 7 means for most baking quality characters, which are reflected in actual genetic gains . This selected cluster could be taken in wheat breading program for its better baking quality attributes, proving the effectiveness of clustering procedure as a genetic tool in selection.

Key words: Clustering analysis, wheat, baking quality, selection, F_3 generation

INTRODUCTION

Clustering analysis is considered as a valuable approach in genetic studies. This assessment can provide useful information about the prediction of individual selection in segregating generations, based on the performance of their contributed characters in clustering patterns (Yau *et al.*, 1989; Hu *et al.*, 1990 and Mehta and Dhagat, 1992). Application of this approach can permit to identify and choose of superior clusters as well as superior individuals within each selected clusters. The more diverse individuals are the greater chance for improving the characters in view (Saadalla, 1994; Menshawy, 2000; Shuma 1994 and Abdel Sayyed *et al.*, 2006) The objective of this work is to employ clustering technique, as an efficient genetic tool, and to study its genetic effectiveness in determining possible promising F_3 individuals, desired from crossing two Egyptian wheat having better baking quality characters with two introduced ones.

MATERIALS AND METHODS

This work was carried out at Gemmeiza Res. Station, Agric. Res. Center, Ministry of Agriculture. Egypt.

The materials used in this study were wheat grains of F_3 generation derived from crossing of two Egyptian wheat varieties (Gemmeiza 7 and Sids 7) and two introduced lines (Kauz-Star and Opata-Rayon) . Grains of the four parents were sown in season 2005/2006, and crossed to obtain the F_1 grains of two crosses " Kauz-Star x Gemmeiza 7 " and " Opata-Rayon x Sids 7 " . In the next season 2006/2007, F_1 grains were sown to obtain the corresponding F_2 grains. In the season 2007/2008, F_2 grains were planted, along with their parental grains, in completely randomized experimental design with three replicates, to obtain F_3 grains. Fifteen F_2 plants were randomly chosen and their F_2 grains were taken for studying baking quality characters, besides the parental grains. Ash percentage, Protein percentage, non proteinous substance percentage, 1000-grans weight and sedimentation volume at 10 and 30 minutes were estimated according to Vida *et al.* (1998) and Emanuelson *et al.* (2003).

To study the clustering patterns among F_3 individuals, values of F_3 individuals for the studies baking quality characters are subjected to a multivariate analysis. This procedure used a disjoint cluster analysis on the basis of euclidean distances as outlined by Johnson and Wichern (1998). Clustering pattern of each F_3 generation was presented as dendrogram. This computations were performed using SPSS computer software (1995).

To determine the effectiveness of clustering for selecting promising individuals, clusters means of each F_3 families were estimated, scored and ranked for their phenotypic of the contributed baking quality characters. The highest cluster mean in each character gave the highest score and vice-versa. The mean rank over all characters in each cluster was calculated. The first ranked clusters were selected and compared with their corresponding F_3 mean or its Egyptian parental mean and actual genetic gains were also estimated.

RESULTS AND DISCUSSION

Performance of F_3 means of the studied wheat crosses for baking quality characters are illustrated in Figure 1 and these histograms which gave a clear picture of baking quality characteristics of the studied F_3 wheat generations , reflecting some sort of genetic variations and permitting to subject these early generations under selection. Matuz (1998) studied some baking quality characters in grains flour of F_2 and F_3 generations of four crosses between Hungarian and American wheat cultivars and detected genotypic variations. However, Flaete and Uhlen (2003) evaluated progenies of three wheat crosses for sedimentation volume and noticed genetic differences associated with baking quality.

The genetic relationships among F_3 individual of each studied wheat cross were summarized, aggregating individuals into phenotypic groups, in clustering patterns and presented in dendrograms as shown in Figure 2 and Figure 3 and the members of clusters of wheat crosses shown in Table 1.

The clustering patterns of F_3 individuals of the studied wheat crosses showed four kinds of groups, for each cross, at dissimilarity point equal six euclidean distance.

Considering the F_3 cross "Kauz-Star x Gemmeiza 7", four clusters contained 5, 4, 3 and 3 members, respectively Figure 2. The largest cluster was cluster I which showed the widest divergence than the others. Clusters means and scores of the contributed baking quality characters showed that cluster II exhibited the highest values, showing the highest score compared with the other clusters Table 2. Interestingly, cluster II had the highest estimate of protein percentage and consequently the lowest estimate of non-proteinous substance percentage compared with all other clusters in all studied wheat crosses.

Regarding the F_3 cross" Opata-Rayon x Sids 7 ", the four clusters consisted of 6, 5, 3 and 1 members respectively. Clusters I and III were widely divergent than clusters II and IV Figure 3 ,clusters means and scores of the contributed characters showed that cluster I exhibited the highest values for most baking quality attributes followed by cluster III. However, both clusters II and IV were the lowest in this consideration.

It is worthily to note that, cluster III had the highest estimates of sedimentation volume at 10 and 30 minutes as well as the heavier grains weight over all clusters in the two crosses.

To detect the superior clusters, the clusters scores were ranked for their phenotypic values of the contributed characters towards clustering and mean rank over all characters was determined. Cluster II of the cross " Kauz-Star x Gemmeiza 7 " and cluster I of the cross " Opata-Rayon x Sids 7 " had the highest mean scores and ranked firstly , showing their superiority and consequently were choused and selected as shown in Table 2 .

The selected clusters means and the averages of their corresponding F3 and the Egyptian parents, in order to compare them, are given in Table 3. It is clear that means of most baking quality characters in selected cluster of the cross " Kauz-Star x Gemmeiza 7 " increased significantly than those of F3 means except non-proteinous substance which decreased significantly . This trend was also observed in the comparisons with the better baking parent "Gemmeiza 7". However, the selected cluster of the cross " Opata-Rayon x Sids 7 " increased significantly than F3 means only in sedimentation values but decreased significantly than its Egyptian parent in protein, protein/non-protein rate and sedimentation value .

Comparisons were reflected in significant, positive or negative, actual genetic gains as illustrated in Table 3. The actual gains detected in selected cluster of the " Kauz-Star x Gemmeiza 7 " were more than those of the cross" Opata-Rayon x Sids 7" consequently this cluster could be taken in wheat breeding program as selected one having selected individuals, derived from F3 generation, exceeding their " Gemmeiza 7" in baking quality values .

Therefore, this conclusion might reflects the effectiveness of clustering procedure in detecting the best clusters in baking quality. The wheat breeders could safely select and take the desirable clusters and could certainly eliminate the undesirable ones. Likewise, applying clustering procedure might justify the selection response in the advanced wheat generations.

Clustering analysis in relation to selection in wheat breeding appeared to be a new approach. Menshawy (2000) employed clustering method to detect and select some wheat clusters characterized by their earlier in heading and maturity and having better grain yield comparing with either F3 means or the earlier parent.

Table 1. Members of clusters of wheat crosses

cluster	No. of members	F_3 plants members
	(Kauz-Star X Gemmeiza 7)	
I	5	12 , 8 , 10 , 15 , 1
II	4	13 , 11 , 6 , 5
III	3	4 , 14 , 3
IV	3	9 , 7 , 2
	(Opata-Rayon X Sids 7)	
I	6	7 , 12 , 14 , 13 , 6 , 5
II	5	3 , 2 , 8 , 9 , 1
III	3	15 , 10 , 4
IV	1	11

Table 2. Clusters means and scores for the contributed baking quality characters toward clustering Pattern of F_3 progenies of wheat crosses

Cluster No.	ash (%)		protein (%)		Non protein (%)		protein / Non protein		1000-grain weight		Sedimentation Volume (ml) 10 min.		Sedimentation Volume (ml) 30 min.		Mean rank
	X	Rank	X	Rank	X	Rank	X	Rank	X	Rank	X	Rank	X	Rank	
(Kauz-Star X Gemmeiza 7)															
I	1.322	1	13.710	3	84.967	3	16.151	3	7.388	3	41.000	1	37.400	1	2.142
II	1.374	3	14.432	4	84.244	4	17.071	4	7.282	2	47.000	3	42.750	3	3.285
III	1.425	4	12.184	1	86.389	1	14.108	1	7.123	1	48.000	4	44.000	4	2.285
IV	1.367	2	12.342	2	86.289	2	14.307	2	7.426	4	44.330	2	40.000	2	2.285
(Opata-Rayon X Sids 7)															
I	1.370	2	12.833	4	86.076	4	14.913	4	7.535	1	50.833	4	46.660	3	3.142
II	1.374	3	11.969	1	86.638	2	13.821	1	7.658	2	46.600	3	42.600	2	2.000
III	1.345	1	12.693	3	86.904	1	14.606	3	7.866	4	49.000	2	49.000	4	2.571
IV	1.415	4	12.381	2	86.232	3	14.357	2	7.660	3	39.000	1	39.000	1	2.285

Table 3. Selected clusters means , their F3 and their corresponding Egyptian parental means for baking quality characters toward clustering patterns .

Character	Ash (%)	Protein (%)	Non protein (%)	protein / Non protein	1000-grain weight	Sedimentation Volume (ml)	
						10 min.	30 min.
(Kauz-Star X Gemmeiza 7)							
Selected cluster	1.374	14.432	84.244	17.071	7.282	47.000	42.750
F3 mean	1.365	13.310	85.323	15.619	7.310	44.660	40.660
Gemmeiza 7	1.270	11.413	87.316	13.071	8.070	36.000	33.000
(Opata-Rayon X Sids 7)							
Selected cluster	1.370	12.833	86.076	14.913	7.535	50.833	46.660
F3 mean	1.369	12.487	86.439	14.451	7.650	49.600	45.000
Sids 7	1.348	14.089	84.443	16.686	8.770	53.000	47.660

Table 4. Actual Gains in the selected cluster of each cross for the contributed baking quality characters toward clustering patterns .

Cluster No.	Selecting strategy	Ash (%)	Protein (%)	Non protein (%)	protein / Non protein	1000-grain weight	Sedimentation Volume (ml)	
							10 min.	10 min.
				(Kauz-Star X Gemmeiza 7)				
II	over F_3 mean	0.009	1.122*	-1.079*	1.452*	-0.028	2.340*	2.090*
	over Gem. 7	0.104*	3.019*	-3.072*	4.000*	-0.788	11.000*	9.750*
				(Opata-Rayon X Sids 7)				
I	over F_3 mean	0.001	0.346	-0.363	0.462	-0.115	1.233*	1.660*
	over Sids 7	0.022	-1.256*	1.633*	-1.773*	-1.235	-2.167*	-1.000

* significant at 5%

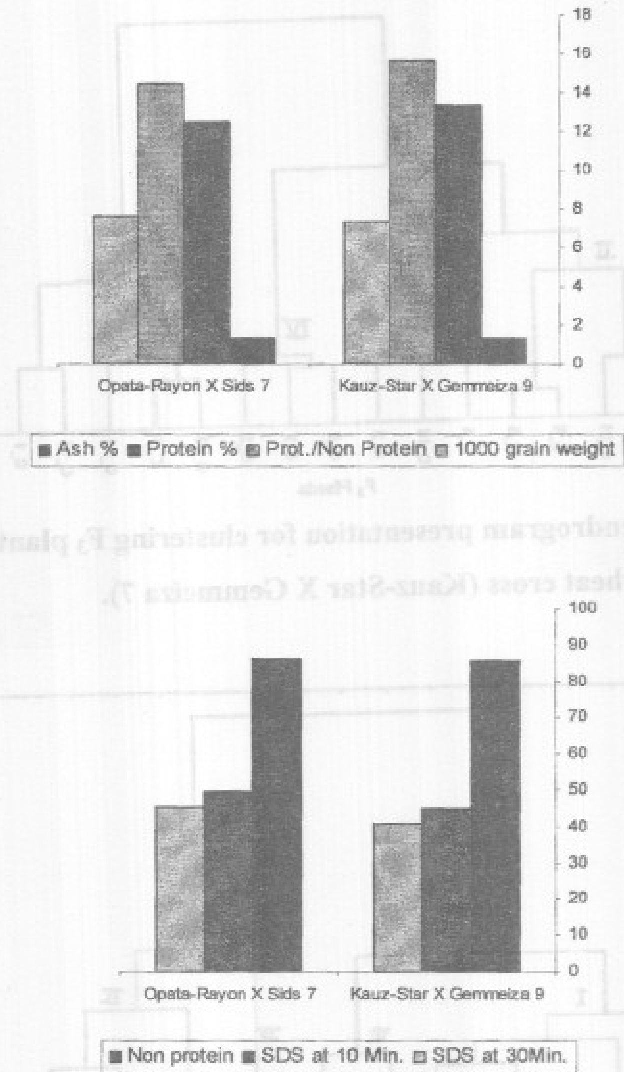

Figure 1. Performance means of F_3 generations of the studied wheat crosses for the studied baking quality characters .

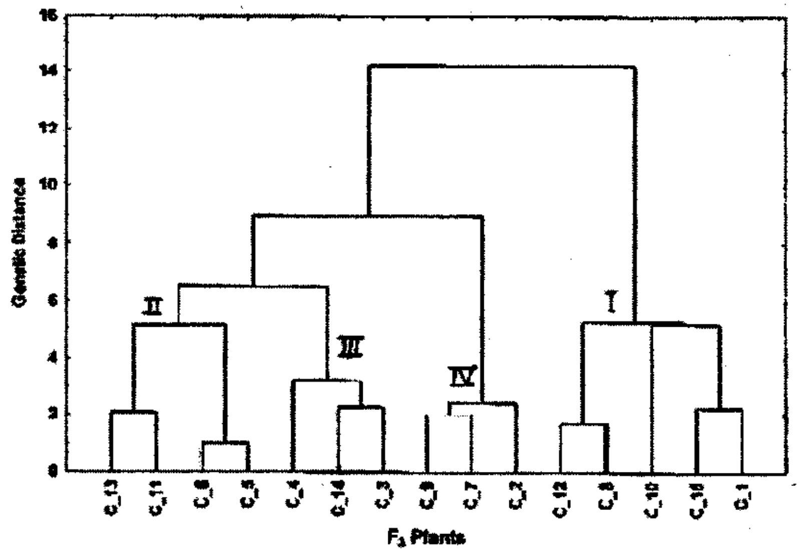

Figure 2. Dendrogram presentation for clustering F_3 plants of the wheat cross (Kauz-Star X Gemmeiza 7).

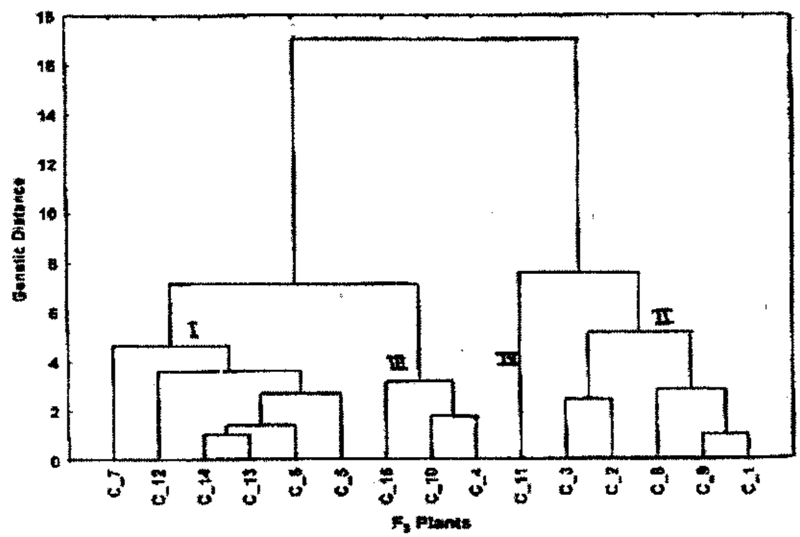

Figure 3. Dendrogram presentation for clustering F_3 plants of the wheat cross (Opata-Rayon X Sids 7)

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الفاعلية الوراثية لتحليل المجاميع في انتخاب أنسال الجيل الثالث المبشرة لجودة الخبيز في القمح

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تم استخدام طريقة تحليل المجاميع في تحديد بعض أنسال الجيل الثالث المبشرة القادمة من التهجين بين اثنين من السلالات المستوردة واثنين من الأصناف المحلية والتي تختلف في مقاييس جودة الخبيز ،ووجد أن حزم المجاميع لانسال الجيل الثالث في كل واحد من الهجينين المتحصل عليهم أظهرت أربعة أنواع من المجاميع بمقدار اقل من سبعة . وأوضحت حزم المجاميع أن المجموعة II في الهجين " Kauz-Star X Gemmeiza 7 " والمجموعة I في الهجين " Opata-Rayon X Sids 7 " استحوذتا على أعلى القيم لمعظم صفات جودة الخبيز المدروسة وبالتالي أعلى الدرجات . و تبعا لذلك نجد أن كلتا المجموعتين استحوذتا على المرتبة الأولى لإثبات تفوقهم وبالتالي إمكانية الانتخاب لهم . ووجد أن متوسطات المجموعة المنتخبة للهجين " Kauz-Star X Gemmeiza 7 " تفوق بالتطابق على كل من متوسطات الجيل الثالث و الصنف Gemmeiza 7 لمعظم صفات جودة الخبيز والتي تنعكس على المكاسب الفعلية الوراثية . وهذه المجموعة المنتخبة لابد أن تأخذ في الاعتبار في برامج تربية القمح لتحسين جودة الخبيز وهذا يثبت فعالية استخدام طريقة المجاميع كأداة وراثية في الانتخاب .