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Variation and Association among Yield components and Quality Traits of Some Egyptian Bread Wheat Genotypes.

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ABSTRACT

Sixteen bread wheat genotypes were used to determine their potentiality for improving yield and quality traits. The wheat genotypes included five Egyptian improved cultivars (Misr1, Misr2, Sids1, Gemmeiza10 and Sakha93) and eleven Egyptian landraces.These landraces were obtained from The Egyptian National Gene Bank and were collected from different desert regions of Egypt. Two field experiments were carried out at the Agricultural Experiments and Research Station of CairoUniversity, Giza during 2013 to 2015 seasons.Grain yield and yield components as well as grain and flour quality traits were recorded. The quality traits included moisture % of grains, falling number, particle size index, wet& dry gluten%, flour extraction and total protein percentage. Principal component and cluster analyses were performed using the recorded characters.Cluster analysis classifiedgenotypes intofour groups for yield components. However for quality traits the investigated wheat genotypes were grouped into different three clusters and one ungrouped genotype (LR5). Group B is a grain yield promising clusterinvolved LR5 and LR 11 produced 8 tons/ hectare.Another two landraces (LR2&LR3) along to Sids1cultivarformedpromising quality group. LR5 recorded inferior performance for quality traits which splitted it as unpromising genotype for bread flour. LR11 was involved in proper cluster for quality traits, i.e A. The wheat genotypes members of Group B (promising quality group) exhibited variable degrees of grain yield potentiality which qualified them to enroll in wheat breeding programs.

principle component discriminated five components which accounting nearly 81 % of the total variation, The PC1 included Spike weight, number of grains, weight of 1000 grain, yield tonsperhectare, harvest index and falling numberwas accounted for 27.5 % of the total variability.The obtained results proved that landraces are of great benefit for breeding new cultivars possessed high quality and adaptation to newly reclaimed lands.

Keywords: landraces, Principles component,and Cluster analyses

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INTRODUCTION

Wheat (*Triticum aestivum* L.)is the most important cereal crop based on the end-product quality**(Zohary and Hopf2000)**. InEgypt, the limitation of agricultural acreage and improper storage conditions resulted in insufficient wheat production and inferior quality properties. Breeding forhigh-yieldingcultivars could achieve dramaticincreaseof grain yield production per unit land area **(Gomaa1999)**.On the other hands, wheat quality traits in most breeding programs are evaluated as a final performance due to their expensive costs and usually needslarge amount of grain **(Battenfield*et al* 2016).**

Several criteria used to determine wheat quality such hardness, soundness, gluten strength and protein content **(Tipples *et al* 1994)**. Protein content and some other grain quality traitssuch hardness of wheat were features in landracesthan current improved cultivars **(Keller *et al* 1991;Michalovand Dotlacil 1992).** The composition and component of protein in wheat flour are important trait determine the end-product quality **(Schofield and Booth 1983).**Gluten content and strength is denoted as a factor in assessment dough quality (**Xiao-lan*et al*2009)**. It is a plastic–elasticprotein fraction of wheat flour responsible for the physical properties of dough which is generally positively related to total protein content of flour **(Perten*et al* 1992 and Duska*et al* 2001).**

Thus proper statistical prediction models for end-use quality traits, may be allow breeding programs to cull unacceptable lines or segregations at early stages of improvement program. Cluster analyses are one of the appropriate tools for grouping the tested genotypes according to mean performance for several traits into intra homogeneous and inter distinct groups **(Abdossaheb*et al*2014)**. **Arab (2016**) determinedeleven quantitative and qualitative different traits affected on grain yield usingthirty twoEgyptian bread wheat accessions bypath analysis and principle component procedure.

In this investigation,sixteenEgyptian wheat genotypesincluding fivecultivars and eleven landraceswere evaluatedfor grain production and quality characters to explore their potentiality for improving grain yield and quality measurements.Multivariate statistical analyses such clustering andprinciple component wereconducted to elucidate thenature of interrelationship among the studied grain yield components and quality traits in addition to the grouping of genotypes in distinct groups.

MATERIALS AND METHODS

Plant material and experimental procedures

Table.1. Code, origin and sources of studied sixteen wheat genotypes.

Genotype	Code	Origin and some features
Misr1	M.1	Released in 2009 for newly reclaimed lands in Northern Egypt, resistant to stem rust.
Misr2	M.2	Released in 2010 for newly reclaimed lands in Northern Egypt, resistant to stem rust.
Seds1	S.1	Releasedin 1996 for Middle and Upper Egypt, tolerant of high temperature, sensitive to leaf rust.
Gemmeiza10	G.10	Released in 2004 for middle Nile Delta of Egypt, resistant for stem and leaf rusts.
Sakha 93	S.93	Released in 1999for salt affected soils of North Nile Delta ,resistant to yellow rust.
A.#14139	LR1	Adndan (Aswan).
A. #14147	LR2	El Noba (South Aswan).
A.#14169	LR3	EL Kaser(New Valley).
A. #14171	LR4	Beer Srag(New Valley).
A.#14194	LR5	EL Kaser (New Valley).
A.#14210	LR6	Beer Srag (New Valley).
A.#14234	LR7	Tushki (Western South-Egypt).
A.#13714	LR8	EL Dakhla (New Valley).
A.#11209	LR9	West ElZook (Sohag).
A. #12321	LR10	North Sinai.
A.# 14201	LR11	Northern West Coast.

Sixteen wheat genotypes were evaluated in two field trials during 2013/2014 and, 2014/2015 seasons at the Agricultural Experiments and Research Station, Faculty of Agriculture, Cairo University, Giza, Egypt. The genotypes included five improved cultivars obtained from Agriculture Research Center (ARC)and Egyptian eleven landraces (LR). These land accessions were kindly provided by the Egyptian National Gene Bank (NGB), Giza. Their originallocations are six locations of desert regions (Table 1). The trials were conducted as a randomized complete block design (RCBD) with four replicates. The experimental plot consisted of 10 rows, each was 2 m long and spaced 20 cm with 4 m^2 area of the experimental plot. Yield and quality traits were studied using spike samples takenrandomlyfrom guarded plantsof the central rows per each experimental plot; whereas the grain yield of all plants were considered for determination grain yields per plot excluding borders. All cultural practices were adopted according the recommendations of wheat production in Giza.

Data collectionand studiedtraits

At complete maturity, yield and its components were studied by using five randomly guarded plant samples taken from central rows of each plot. The studied individual characters included plant height, cm (**PLHT)**, number of tillers per plant **(TILL)**, spike length **(SPKL)**, spike weight **(SPKwt)**, number of spikelets per spike **(SPIKLT**), number of grains/spike **(GRAINS)** and 1000-grainweight**(S.I).** The grain yield/plot was transferred to yield /hectare, in tons **(GYH)** In addition to Harvest index (**HI %)**as the percentage of grain yield to biological yield.

The studied quality traits prepared into duplicate samples and carried out as completely randomized design (CRD).Such traits were determined in Chemical and Cereal Technology Laboratory, Food science Department, Faculty of Agriculture, Cairo University.Moisture percentage (**MOST %**) were recorded from samples, each consisted of 200 g per plot of harvested grains. Extraction rate or flour percentage **(EXT %)** are referring to milling characteristicsas the relative of flour (g) according to 1kg sample of cleaned grains with 14 % moisture. Particle size index**(PSI %)** according to **AACC (2000)** method No. 55-30 methodology indicated for hardness.**(PROT %)**based on Kjeldahl method. Falling number/alpha amylase activity per second (**FN sec.)** was determined by "Falling No.1600" according to **AACC (2000**) method No. 02-06. Gluto-matic traits involved wet gluten **(WGL %)** and Dry Gluten **(DGL %)**were recorded by forming dough refer to **AACC (2000)** No. 38-12.02.

Statistical analyses

Both obtained data ofyield components and quality traits were subjected to regular analysis of variance of RCBD and CRD,respectively,using MSTAT-C software and Duncan's multiple range tests at 0.05 level. Combined analysis over two seasons was carried out after test the homogeneity of error mean squares. Cluster analysis using squared Euclidian distance between group averages method**(Kumar *et al* 2009)** was carried out**.** Additionally**,** principle component analysis had explained the contribution of each trait to variancesand processed via SPSS V. 18 - SPAW software package program.

RESULTS AND DISCUSSIONS

Wheat genotypes included recommend five varieties and eleven landraces varied highly significantly for all studied traits either in two seasons or combined over seasons. Such observed variations among the studied wheat genotype arean indicationof the presence of genetic among the investigated improved varieties from one side and along to landraces.These results proved that the desert regions possess raw wealth of wheat landraces that may contribute positively to wheat breeding program(**Abdullah and Mohammad 2014)**.

Cluster analyses of investigated wheat genotypes for performance of yield components and quality traits combined over both seasons are depicted in Figs. 1&2, respectively.Genotypes were clustered into four groups (A, B, C and D) for yield components at 5% level of significance (Fig. 1). Cluster A included eightgenotypes: M.1, S.1, LR3, LR4, LR6, LR8,LR9 and LR10. Each group B and group C involved two genotypes:LR5, LR11 and M.2, LR7, respectively.The last group (D) comprised the remainder genotypes i.e. G.10, S.93, LR1 and LR 2. Group B, which comprise LR5 and LR11 (collected from New Valley and Northern West Coast, respectively) seemed performedbetter rather than other groups in spite they involved improved wheat varieties. These two LRs possessed highest plants that bearhighest number heaviest grainsthat reflected in reliable grain yield.This superior performance of group B seems the reason of splitting from intermediate Cluster, i.e A. On the other hand Group D was splitted from intermediate Group C due to relative inferior performance forprevious components in spite of that group D possess heavier grains.

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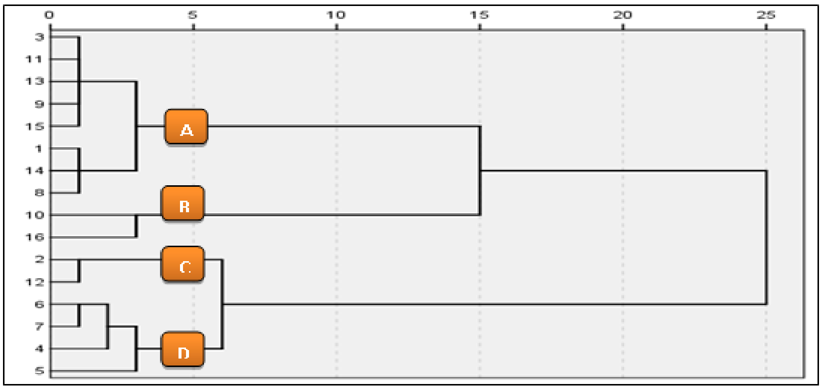
Figure 1: Dendogram illustrated thegrouping of the 16 wheat genotypes forgrain yield components by elucidean method group averages.



#1:M.1, #2:M.2, #3:S.1, #.4: G.10, #5:S.93, #6 to #16: LR1 to LR11, respectively

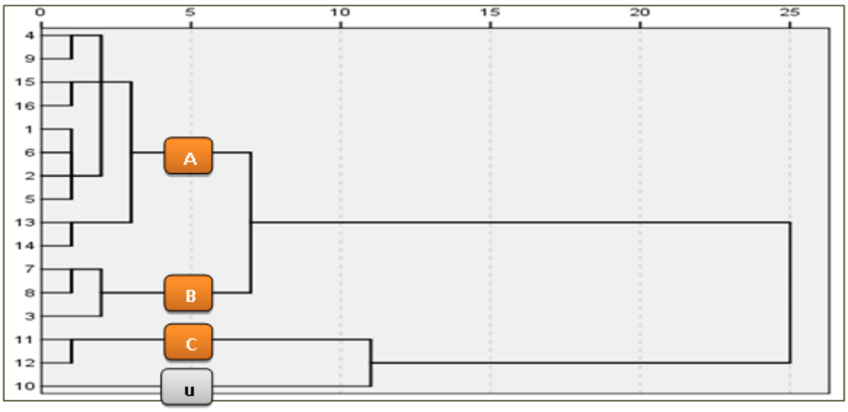
Table 2. Mean performance of formed wheat groupsfor studied grain yield components combined over 2013/014 and 2014/015 seasons

Group	No. genotypes	PLHT	Till	SPKL	SPkwt	SPIKLT	Grains	SI	GYH	H.I
A	8	106.2	3.2	8.9	2.6	18.9	39.3	44.6	7.2	26.7
B	2	126.0	3.2	8.3	2.7	19.4	42.8	45.5	8.0	25.8
C	2	112.7	3.5	9.5	2.5	19.6	42.6	41.8	6.8	30.1
D	4	89.4	3.0	9.5	2.7	18.9	41.6	45.4	6.1	31.7

Land races from similar Geographic sites of collection didn't perform similarlyor grouped in the same cluster, in spite of four LRs from New Valley are in Group A with other ones.Alsothe improved cultivars for yield component, distributed among the various clusters.

The results of cluster analysis for studied quality traits (Fig. 2), Illustrate that the investigated wheat genotypes are classified into three groups (A, B and C) and one ungrouped genotype (LR5).Group A involved ten genotypes G.10 , LR4, LR10 , LR11 , M.1 , LR1 , M.2 , S.93 , LR8 and LR 9. with Recorded averages of PSI % , EXT % , WGL % , DGL % , PRO %, MOST % and FN values 84.5 , 74.8, 38 , 16.9 , 11.4 , 10.7 % and 338.4 sec. respectively. This group may be promising for extraction%, wet gluten%, protein% and moisture % of flour.

Figure 2:Dendogramof clustering the 16 wheat genotypes due to quality traits byelucidean method between group averages



#1:M.1, #2:M.2, #3:S.1, #.4: G.10, #5:S.93, #6 to #16: LR1 to LR11, respectively

Table 3: The means of yield quality traits classify into 3 groups and one ungroup according to cluster analysis of 16 wheat genotypes

Group	No. genotypes	PSI%	EXT%	WGL%	DGL%	PROT%	MOST%	FN sec
A	10	84.5	74.8	38.0	16.9	11.4	10.7	338.4
B	3	88.7	70.7	34.1	18.0	11.5	10.3	351.0
C	2	88.5	72.4	38.6	19.5	11.6	10.5	276.3
Ungrouped	(LR5)	89.5	64.3	39.5	13.0	9.4	9.9	285

However, another group (B) included 3 genotypes LR2, LR3 and sids1 which recorded the first rank of PSI with 88.7%, and FN calculated at 351 sec.Falling number (FN) per seconds classified into two major groups depended on the activity of enzyme alpha amylase, the value of 350 seconds or longer pointed to a low enzyme activity and very sound wheat quality. As the amount of enzyme activity increases, the falling number decreases. FN below 200 seconds is an indication high levels of enzyme activity as reported by**Carl (2006)**.Accordingly wheat genotypes of Group Bmay be considered the highest quality ones.

The last group is C that constructed in two landraces coded LR6 and LR7 with averages 88.5,72.4,36.8 , 19.5 , 11.8 , 10.5 % and 276 sec, in the same order.

LR5 recorded inferior performance for quality traits as least EXT%, DGL%, PROT%, MOST% andFN which splitted it as unpromising genotype for bread flour. LR11sharing LR5 for being as promising genotypes for grain yield components but the first one involved in proper cluster for quality traits, i.e A. The wheat genotypes members of Group B (promising quality group) exhibited variable degrees of grain yield potentiality which qualified them to enroll in wheat breeding programs.

In order to further assess differences between investigated wheat genotypes obtained by cluster analysis genetic and molecular characterization confirmed the above mentioned findings **(EL-Kadi *el al* 2017)**.

Principle component analysis

Principal component analysis (PCA) reflects the importance of the largest contributor to the total variation at each axis of differentiation. The eigenvalues are often used to determine how many factors to retain. The sum of the eigenvalues is usually equal to the number of variables **(Fujikoshi *et al.* 2010).**

The coefficients defining the five principal components of these data are given in Table 4. The coefficients are scaled, so that they present correlations between the observed variables and derived components. The five principal components including PC1 to PC5, which are extracted from the original data and had latent roots greater than one according to scree plot , which accounting nearly 81 % of the total variation (Fig 3). These results suggest that these principal component scores might be used to summarize the original 16 variables in any further analysis of the data.

The first factor included **SPKwt**, **GRAINS**, **SI,GYH,HI and FN** sec. which accounted for 27.5 % of the total variability. The suggested name for this factor was Yield. Furthermore, factor 2, 3, 4 and 5 with 24.2, 12.8, 9.3 and 6.8 obtained high amount of variability among all studied factors, respectively. Thus, suggested name for factor 2, 3, 4 and 5 werehard grain, length, gluten and Spikes, respectively.

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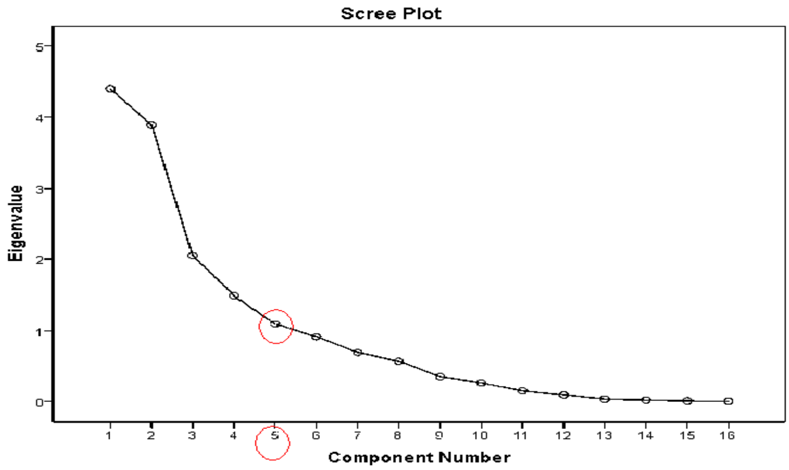
Table 4: Component Matrix for studied traits of 16 wheat genotypes

Traits	Component				
	1	2	3	4	5
PLHT	-.153	-.251	.340	-.585	.601
TILL	.203	-.191	.751	.185	.027
SPKL	-.021	.220	-.724	.298	.136
SPKwt	.874	.042	-.140	.028	.405
SPKLT	.239	-.071	.020	-.020	.878
GRAINS	.607	-.063	-.427	.087	.550
SI	.839	.126	.170	.194	.039
YTON	.652	-.300	-.216	-.505	.183
HI	.517	.243	-.470	.467	.146
PSI	.016	-.793	.084	-.445	.006
EXT	.030	.791	.160	.252	-.339
WGL	-.725	.345	.015	.328	-.091
DGL	-.127	.190	.059	.926	-.010
PROT	-.239	.257	.762	.063	.136
MOST	.065	.789	-.440	-.056	.057
FNsec.	.666	.337	.099	-.205	-.306
Factor Var. %	27.5	24.2	12.8	9.3	6.8
Cummulativevar . %	27.5	51.8	64.4	73.9	80.8

Studied traits variation discrimination could be effective by the multivariate analyses via principle component which proved these studies of traits variation among different genotypes.

Figure 3: Scree plot showing eigenvalues in response to number of components for the estimated traits of means 16 wheat genotypes



CONCLUSION

Results of the present study indicated thatEgyptian wheat land races exhibited encourage variation and performance for grain yield components and quality traits compared to improved cultivars.Cluster analysis of eleven landraces along to five improved cultivars for yield components elucidated that some land races are promising for eithergrain yield components or quality traits. The analysis of variances between groups hardly explains the nature of variation.However, multivariate analysis via principle component overcomes these obstacles by distinguishing the studied traits into 5 components that play important roles for wheat performance. The obtained variation and genetic studies of HM-Glutin sub units in the present collection proved that they may use in wheat breeding programs.

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