Efficiency of Mass Selection on Improving some Important Characters of Onion (*Allium cepa*,L.)

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ABSTRACT

Field experiments were conducted in order to estimate the magnitude of variability and to study effect of one cycle of mass selection on some important characters of "Beheri" cultivar of onion, as well as calculate the phenotypic correlation coefficients among all possible pairs of the studied characters. In this respect, this work was carried out at the Experimental Station Farm (at Abies), Faculty of Agriculture, Alex. Univ., during the consecutive years from 2003 till 2006.

The obtained results illustrated, generally, that the estimated coefficients of variability and ranges for the vegetative characters; i.e., number of leaves per plant, leaves length, plant fresh weight, leaves fresh weight, leaves dry matter content; and bulb characters; i.e., fresh weight, dry matter content, diameter, length, shape index, total soluble solids, single - center, and external doubling, in a large population of "Beheri" cultivar, reflected high and enough variability, for the possibilities of conducting successful and efficient selection to produce improved cultivar with better performances than the original population. The results indicated, generally, that the variability magnitudes within the studied characters were decreased as a result of practicing the mass selection method. Also, the obtained results demonstrated, generally, that the first cycle of mass selection population reflected high efficiency for improving all studied characters, but with different rates, comparing with the original population. The estimated values of the correlation coefficients among the various pairs of characters showed that all detected relationships (78 relationships) appeared to be desirable for the objectives of the selection in the present study. Likewise, the estimated correlation coefficients were found to be either significant or highly significant with positive or negative trends.

INTRODUCTION

Onion (*Allium cepa*, L.) is out-crossing diploid, 2n=2x=16, vegetable crop belonging to the family Alliaceae (Havey, 1993). It is one of the most important crops worldwide for its unique flavor or its ability to enhance the flavor for other foods (Randle *et al.*, 1998). Moreover, it has a high nutritive value, wide range of health attributes such as antibiotic effects, anticarcinogenic, and a reduce effect of blood cholesterol level (Lawson and Hughes, 1991; Block, 1992, Dorant *et al.*, 1993). So, onion is used in the form of fresh, frozen, dehydrated bulbs, and green bunching.

In Egypt, onion is an important crop for export as well as for local consumption. In the last two decades, export decreased considerably to Europe due to many factors concerning the bulbs quality. In addition, a relatively low productivity level and deterioration in the quality characters of some local cultivars such as "Beheri " cultivar, which showed also a great amount of variability among the individual plants of the commercial grown population. It is important to investigate the magnitudes of variability among onion genotypes for traits of economic importance is very necessary to plan effective breeding programs. Since, the wide range of variability available in opens an immense scope to design the identification of superior genotypes.

Onion populations are usually maintained by open-pollination, and considerable phenotypic variations exists for size, shape, and yield and its component characters (Randle, 1992-a ,b and c). In this respect, several investigators estimated the magnitudes of variability among onion genotypes for some economic and important traits such as Bajaj *et al.* (1980 and 1990), Shalaby *et al.* (1991), Gamie *et al.* (1995), Hayder *et al.* (2007),Ananthan and Moorthy (2007). These authors concluded that wide ranges of variability's were estimated among the studied characters of the different genotypes of onion allowing for selection of desirable traits, which would be effective for onion improvement programs. Accordingly, it was thought to start a breeding program for onion depending on mass selection method, in which individual plants with desirable traits are chosen and bulked together to grow for the following generation. The choice of the plants is based on phenotypic selection; that is, on the appearance of the plant and its particular traits that can be identified. The selected plants are harvested, generally, without control of pollination, and are bulked without benefit of progeny testing. Although selection is based on the phenotype, its purpose is to obtain a greater frequency of superior genotypes within the population. The effectiveness of mass selection is dependent upon the accuracy with which the phenotype reflects the genotype. Singh (1997) reported that mass selection is extensively practiced to improve local material of onion. In this concern, several investigators studied also the effect of mass selection technique in improving different characters of onion such as Ahmed and Ahmed (1976), Melo *et al.* (1981), Pike *et al.* (1988), Shalaby *et al.* (1991), Gamal (1994), Gamie *et al.* (1995), Gamie (2000), Hulscher *et al.* (2006), and Ananthan and Moorthy (2007).

Interrelationships among various agronomic traits are vital to plan an effective breeding program for onion. Hence, using phenotypic correlation coefficient is an important tool for the breeder to help in selecting a difficult measured character through the selection of another,

easier in measuring. Therefore, some researchers estimated the relationships among the different pairs of the various characters of onion such as McCollum (1968), Patil and Kale (1985), Sherif *et al.* (1988), Mulungu *et al.* (1998), Mohanty (2001), Hayder *et al.* (2007), and Pavlovic *et al.* (2007). These authors concluded, generally, that there were significant correlations between pairs of some economic characters of onion, but, with different trends (positive and / or negative), which were found useful in selection and evaluation of the different genetic materials of onion.

Accordingly, the purposes of the present investigation were to determine and estimate the variability magnitudes for some important characters of onion. Moreover, evaluate the general behavior of a new developed population after one cycle of mass selection in comparison with the original "Beheri" cultivar of onion. In addition to estimate the phenotypic correlation coefficients among all possible pairs of the studied characters due to their importance for selection in breeding programs.

MATERIALS AND METHODS

This study was carried out during the consecutive seasons of the years from 2003 till 2006 at the Experimental Station Farm (at Abies) of the Faculty of Agriculture, Alexandria University, Alex., A.R.E.

The execution of this investigation can be summarized in the following main steps: (1) estimation of the variability present in the original population. This was achieved through the calculation of the coefficients of variation (C.V. %) and ranges for the important characters that are going to be considered in this investigation, (2) selection of some promising plants from the previous population to discard the inferior or undesirable characters and to concentrate the favorable and desirable ones. (3) evaluation of the efficiency of only one cycle of mass selection on the improvement through the comparisons of the vegetative, and yield, and its components characters, of the new developed population with its original one,(4)calculate the phenotypic correlation coefficients among all possible pairs of the studied characters.

Original Genetic Material

The original genetic material used in this investigation was the common commercial "Beheri" cultivar of onion; since, it showed a lot of variation and deterioration that were observed and reported by many growers and researchers. It was thought that a mass selection program may help in improving its important characteristics through the visual

selection of new genotype with better characteristics than those common in the original population.

METHODS

Growing the original population in the season of 2003/ 2004:

Seeds of the "Beheri" cultivar were sown in nursery on October 15, 2003 and the seedlings were transplanted on November 25, 2003. The experimental area consisted of 230 rows; 4.00 m long and 0.60 m wide. The spacing within rows was 10cm between plants. All the recommended cultural practices of onion production; such as fertilization, irrigation ,weeds and pests control were followed for raising a healthy crop, whenever they appeared necessary.

Estimation of variability's

The following studied characters were measured on individual plant basis, and they were used to calculate the statistical parameters; ranges, means and coefficients of variations (C.V. %). The studied characters were leaves length (cm), number of leaves per plant, leaves dry matter content (%), leaves weight per plant (g), plant fresh weight (g), bulb fresh weight (g),bulb dry matter content (%), bulb polar diameter, (P, cm), bulb equatorial diameter (E, cm), bulb shape index (P/E, cm), total soluble solids (T.S.S.%)- using a hand referactometer and percentages of single-center bulb and external doubling bulb.

At the end of bulbs formation stage; (in April, 2004), two to three leaves from each of the tested bulbs were cut-out to record the leaves dry matter content (%). Leaves weight per bulb (g), leaves' number per bulb and length of leaves, (cm) were, also, estimated.

Initial visual seiection was made according to the criteria; more number of leaves, heavier leaves weight, longer leaves, and higher dry matter content of leaves. Then, the bulbs were left to complete their maturity stage. At harvesting stage, all bulbs were harvested and left for two weeks for curing. Cull bulbs which had obvious undesirable characters such as external doubling and any infection were discarded. Fresh weight of bulb, polar and equatorial diameter characters were also measured, and bulb shape index was calculated by dividing polar diameter by equatorial diameter. On the basis of the criteria of lower polar diameter and wider equatorial diameter, a second selection was conducted. Then, the selected bulbs were stored in a storage until the time for replanting, when a further selection were made for other quality traits just prior to planting the bulbs.

After storage stage, (in November, 2004), sorting of stored bulbs was performed to discard the sprout bulbs .Single-centered bulbs were identified immediately after cut off the top one-third of the bulbs to check for single-center bulbs through the third and more sever selection practice. The samples of the bulbs; which taken by cutting the top one-third of the bulbs; which were taken to measure the total soluble solids (T.S.S. %), using a hand refractometer, and measure the bulb dry matter content. The best final selected bulbs were came out to be only 25,which had the most desirable characters and were replanted in the end of November,2004 under an isolation cage (in a greenhouse). At flowering stage (seed stalk formation), the bulbs were left to open-pollination by entering honey bee insects during flowering period (March, 2005). To obtain the seeds of the first cycle of mass selection, the produced seeds from the open-pollination of all selected bulbs were harvested and bulked (massed) in June, 2005.

Evaluation of the population of the first mass selection cycle(C_1),season of 2005/2006

The experiment of this season was carried out to evaluate the effect of the first cycle of mass selection on variability and performances of the bulbs for their studied characters.

The seeds of the two populations, the original population (C_0) and that of the first cycle of mass selection (C_0) were sown on October 20, 2005, and their seedlings were transplanted in the open field on December 5, 2005. In this experiment, a randomized complete blocks design (R.C.B.D), with three replicates, was used. Each plot consisted of 5 rows; 5m long and 60cm wide; and the plants were allowed to grow at 10 cm spacings, using a single side growing. All cultural practices were performed whenever they were necessary. Means, ranges and coefficients of variations (C.V. %) were calculated for all the studied characters, as previously mentioned.

Statistical analyses

The statistical analyses of all the recorded data of the previously mentioned characters were conducted by the standard method of the randomized complete blocks design as illustrated by Al-Rawi and Khalf-Allah (1980), using Co-State Software (2004), computer program for statistics. The least significant difference test (L.S.D) was used to test the significance of the differences between means. The phenotypic correlation coefficients between the different pairs of all studied characters were, also, estimated as illustrated by Mather and Jinks (1971).

RESULTS AND DISCUSSION

The results arranged in Table 1 showed the estimated values of the means, ranges and coefficients of variability (C.V %) for the most important characters of the original population of "Beheri" cultivar of onion. The results reflected, clearly, that the original population (C_0) was characterized by pronounced variabilities for most characters as appeared from the estimated coefficients of variation values . The characters that showed variability higher than 25% were leaves length (42.13%), bulb diameter (30.11%), leaves fresh weight (28.33%), and plant fresh weight (26.15 %). Whereas, the bulb characters ; fresh weight, dry matter, length, shape; and leaves dry matter showed relatively moderate levels of variability with estimated values of 23.56%, 22.71%, 21.19%,20.66% and 20.09% for their C.V.%, respectively. The obtained results, generally, appeared to agree with those reported by Ananthan and Moorthy (2007) on bulb weight, shape index, total soluble solids and dry matter content of onion; and Sendek *et al.* (2008) on number of leaves per plant, bulb diameter, total soluble solids and dry matter content in shallot. The two investigators reported wide ranges of variabilities in the original population, suggesting the effectiveness of selection for improvement of the mentioned traits.

On the other hand, the three remaining characters; i.e., total soluble solids (T.S.S.%), single-center bulb and external doubling bulb percentages; showed relatively low coefficients of variation values that were estimated by 19%, 19.73% and 17.11%, respectively. However, Gamie *et al.* (1995) reported high variability estimates in the original population of onion for the external doubling bulbs and single-center bulbs characters. Moreover, the highest detected variability values, that were also reflected by the noticed wide ranges for most of the studied characters, suggested the high potentialities of selection for improving such characters in the original population of onion. Generally, it might

Table 1: Means(X), ranges and coefficients of variations (C.V.%) for all studied characters of the original population of the "Beheri" cultivar of onion in 2003/2004 season.

Population	Original population (Co)		
Parameters / Characters	$\bar{X}$	Range	C.V. %
No. of leaves/plants	7.70	5-13	27.13
Leaves length (cm)	45.73	30-66	42.13
Plant fresh weight (g)	198.62	105-346	26.15
Leaves fresh weight (g)	79.09	40-140	28.33
Leaves dry matter (%)	12.17	9-19	20.66
Bulb fresh weight (g)	110.17	50-312	23.56
Bulb dry matter (%)	15.22	12.00-28.76	22.71
Bulb diameter (D, cm)	4.21	2.50-7.33	30.11
Bulb length (L, cm)	3.86	2.50-6.80	21.19
Bulb shape index (D/L)	1.00	0.67-1.60	20.09
Total soluble solids (%)	7.63	5-12	19.00
Single – center bulb (%)	11.50	-------	19.73
External doubling (%)	25.12	-------	17.11

be stated that all studied characters could be improved through mass selection method, but with varying degrees depending upon the amount of variation present in the population, the selection intensity and the heritability of the concerned character. Therefore, the studied characters of onion appeared to have high chances to be improved; since, they reflected relatively high variability in the original population and seemed to have high heritability values, due to the high additive gene effects involved in their inheritance, as reported by McCollum (1968), who estimated narrow sense heritability with high values for bulb's weight, diameter, length, shape index and soluble solids content of onion. Also, Shalaby (1991) found that external doubling bulbs appeared to have relatively high heritability.

The results concerning the estimated statistical parameters; i.e. means (X), ranges and coefficients of variation (C.V.%); for the studied characters of the two evaluated populations; original population (C_0) and the population of the first mass selection cycle (C_1); are presented in Table 2 .The obtained results illustrated, generally that the first mass selection population (C_1) reflected high efficiency for using mass selection method on increasing all studied characters ;with only two exceptions. The comparisons between the two population mean values of each studied character indicated that only one cycle of mass selection was able to

increase, significantly, the particular studied character. The increments in the mean values of the characters number of leaves per plant, leaves length, plant fresh weight, leaves fresh weight and leaves dry matter after the first cycle of mass selection (C_1) were estimated by 20.27%, 13.07%, 43.64%, 15.63% and 13.87% for these five characters, respectively, relative to those of their original population means.

The results concerning the performances of the bulb characteristics; fresh weight, dry matter content, diameter , shape index, total soluble solids and single – center; illustrated that the mean values of these characters were noticed to be increased after using the mass selection method for only one cycle. The increases in the mean values of such characters ranged from 13.83% for total soluble solids (T.S.S. %) up to 45.17% for bulb diameter. The two characters bulb length and external doubling bulbs reflected desirable performances after one cycle of mass selection, since the mean values of these two characters were noticed to be reduced by 18.07% for bulb length and 28.66% for external doubling bulbs. Such results were , generally , in agreement with those obtained by several investigators such as Ahmed and Ahmed (1976) on single-center bulbs and external doubling bulbs; Melo *et al.* (1981) on bulb size; Shalaby *et al.* (1991) on single-center bulb and bulb weight; Gamal (1994) on bulb dry matter, bulb shape and bulb size; Gamie *et al.* (1995) and Gamie (2000) on single-center bulb, external doubling bulbs and bulb weight. These authors suggested that mass selection was efficient in improving the studied characters of onion.

The results showed generally that the estimated coefficients of variation (C.V.%) values and ranges for all the studied characters of the derived population after one cycle of mass selection (C_1) were found to be lower and narrower, relative to those of the original population (C_0). The estimated coefficients of variations (C.V. %) values for the studied characters were severely reduced to reach the range from 6.31% for external doubling bulb up to 29.11% for leaves length character. Such a result clearly indicated that most of the variability detected among the original population individuals could be related, in a sound part of its magnitude, to the genetic component, which was reflected on the general performance of the population of the first mass selection cycle. The obtained results ,generally, appeared to agree with those reported by Bajaj *et al.* (1980and1990) on dry matter content and total soluble solids; Randle(1992a and b) on bulb size, shape index and total soluble solids ; Gamie *et al.*(1995)on bulb weight and single -center bulb; Mohanty(2001) on number of leaves per plant, bulb weight and bulb diameter ; Haydar *et al.* (2007) on number of leaves per plant ,bulb weight, bulb diameter and

length ;and Ananthan and Moorthy(2007) on bulb weight, shape index, total soluble solids and bulb dry matter content. Since, their results indicated ,generally, that the estimated variability magnitudes were high in the original population of onion, but after selection cycles, the estimated coefficients of variation values for these characters were reduced.

The estimated simple correlation coefficient values among all possible pairs of the studied characters are presented in Table 3. The results illustrated that all possible pairs of relationships (78 relationships) appeared to be highly correlated and desirable for the objectives of the present study, since their estimated values of correlation coefficients were found to be either significant or highly significant.

Desirable and negative correlations (15 relationships) were detected between bulb length with each of bulb shape index, total soluble solids, single-center bulb and external doubling bulb. In the same trend, external doubling bulb was found to be negatively correlated with all the other studied characters. These results reflected that increasing any of these correlated characters would be associated with a reducing effect on the other, suggesting that attention should be given in breeding programs for these characters. On the other hand, desirable positive correlations (63 relationships) were observed among all remaining possible pairs of the studied characters (Table 3); indicating that any achieved improvement on any of the studied characters would automatically lead to a positive improvement on the other correlated trait. The obtained results concerning relationships between different pairs of the studied characters, in the present study, were generally in accordance with those reported by several researchers such as McCollum (1968), Patile and Kale (1985), Sherif *et al.* (1988), Mulungu *et al.* (1998); Mohanty (2001); and Hayder *et al.* (2007), who obtained desirable and positive relationships among pairs of some important characters in onion. They suggested, also, that the estimates of phonotypic correlations among pairs of the studied characters of onion are useful in evaluating and selection breeding programs.

Table 2 : Means ($\bar{X}$), ranges and coefficients of variations (C.V %) for all studied characters of the two evaluated populations , original (C_0) and the first mass selection cycle (C_1) ; of the "Beheri" cultivar of onion in 2005/2006 season.

Populations	Original population (Co)			First mass selection cycle (C_1)		
Parameters / Characters	$\bar{X}$	Range	C.V. %	$\bar{X}$	Range	C.V. %
No. of leaves/plants	8.04b	5-15	24.13	9.67a	8-14	17.22
Leaves length (cm)	54.77b	30-75	49.07	61.93a	42-70	29.11
Plant fresh weight (g)	202.84b	110-365	24.55	291.37a	140-310	16.11
Leaves fresh weight (g)	84.11b	35-140	26.35	97.26a	50-135	18.22
Leaves dry matter (%)	14.85b	11-19	18.76	16.91a	11-19	11.36
Bulb fresh weight (g)	122.71b	50-325	21.75	159.24a	85-220	12.31
Bulb dry matter (%)	19.34b	13.12-29.50	21.75	22.61a	14-26	15.11
Bulb diameter (D, cm)	4.45b	2.60-2.40	29.52	6.46a	4.00-7.50	10.66
Bulb length (L, cm)	5.09a	2.50-6.30	19.27	4.17b	3.50-6.00	10.09
Bulb shape index (D/L)	1.11b	0.76-1.57	21.90	1.39a	0.98-1.51	14.21
Total soluble solids (%)	8.53b	5-11	19.58	9.71a	6-12	11.51
Single – center bulbs (%)	12.03b	----------	18.71	15.78a	---------	8.64
External doubling bulbs (%)	24.77a	----------	16.40	17.67b	----------	6.31

Values having similar alphabetical letter(s) are not significantly differ, using L.S.D test at 0.05 level of probability.

Table 3: Phenotypic correlation coefficients (r) among the studied characters of onion "Beheri" cultivar.

Characters	Leaves length (cm)	Plant fresh weight (g)	Leaves fresh weight (g)	Leaves dry matter (%)	Bulb fresh weight (g)	Bulb dry matter (%)	Bulb diameter (D, cm)	Bulb length (L, cm)	Bulb shape index (D/L)	Total soluble solids (%)	Single – center bulb (%)	External doubling bulb (%)
No. of leaves/plants	0.91**	0.99**	0.99**	0.89**	0.96**	0.95**	0.84**	0.84**	0.95**	0.79*	0.95**	-0.98**
Leaves length (cm)		0.95**	0.89**	0.93**	0.96**	0.96**	0.96**	0.87**	0.96**	0.96**	0.97**	-0.95**
Plant fresh weight (g)			0.94**	0.93**	0.98**	0.85**	0.85**	0.92**	0.96**	0.84**	0.98**	-0.99**
Leaves fresh weight (g)				0.95**	0.90**	0.83*	0.91**	0.95**	0.87**	0.83*	0.92**	-0.92**
Leaves dry matter (%)					0.91**	0.86**	0.87**	0.99**	0.92**	0.89**	0.97**	-0.93**
Bulb fresh weight (g)						0.98**	0.79*	0.90**	0.94**	0.84**	0.98**	-0.99**
Bulb dry matter (%)							0.76*	0.86**	0.93**	0.84**	0.96**	-0.97**
Bulb diameter (D, cm)								0.91**	0.72*	0.89**	0.84**	-0.81*
Bulb length (L, cm)									-0.87**	-0.95**	-0.96**	-0.91**
Bulb shape index (D/L)										0.749*	0.96**	-0.97**
Total soluble solids (%)											0.89**	-0.83**
Single – center bulb (%)												-0.98**

* = Significant at 0.05 of probability level. ** = Highly significant at 0.01 of probability level.

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الملخص العربي

كفاءة الإنتخاب الإجمالي علي تحسين بعض الصفات الهامة في البصل

طلعت حسن إبراهيم سليمان

قسم الخضر – كلية الزراعة – جامعة الإسكندرية

نفذت تجارب حقلية وذلك بهدف تقدير حجم الاختلافات وتأثير دورة من الإنتخاب الإجمالي علي بعض الصفات الهامة في البصل "صنف بحيرى" بالإضافة إلي تقدير معامل الارتباط المظهري بين أزواج الصفات المختلفة ، وبناءا علي ذلك أجريت هذه الدراسة بمحطة

البحوث الزراعية بأبيس التابعة لكلية الزراعة – جامعة الإسكندرية- خلال الأعوام ٢٠٠٣ ، ٢٠٠٤ ، ٢٠٠٥. واشتملت الصفات المدروسة علي عدد الأوراق لكل نبات ، طول الأوراق ، الوزن الطازج للنبات والأوراق، المادة الجافة للأوراق والأبصال ، قطر وطول البصلة، دليل شكل البصلة، محتوي البصلة من المواد الصلبة الذائبة الكلية ، النسبة المئوية لكل من الأبصال وحيدة المركز والأبصال المندوجة خارجياً.

حيث تم زراعة العشيرة الأصلية في الموسم الأول لعام ٢٠٠٣/ ٢٠٠٤ وذلك لحساب ومعرفة حجم الاختلافات في الصفات موضع الدراسة وذلك من خلال تقدير معامل الاختلاف والمدي بالإضافة إلي تقدير المتوسط ، حيث قدرت المقاييس المختلفة للصفات علي أساس النباتات الفردية للعشيرة الأصلية. أظهرت النتائج بصفة عامة وجود اختلافات كبيرة بين النباتات وذلك للصفات المختلفة في العشيرة الأصلية للبصل ، ولكن بدرجات متفاوتة ، والتي عكست بصفة عامة أهمية البدء بأحد برامج التربية لتحسين البصل والتي منها الانتخاب الإجمالي .

وأجري الانتخاب علي عدة مراحل بدءا بالنمو الخضري و خلال فترة تكوين الابصال وبعد الحصاد وكذلك بعد التخزين ومعرفة الابصال وحيدة المركز ، وبناء علي تلك المراحل انتهي الانتخاب علي عدد خمس و عشرين بصلة. والتي تمت زراعتها في الموسم الشتوي ٢٠٠٤/٢٠٠٥ التالي داخل صوب بلاستيكية لإنتاج بنوردورة الانتخاب الاجمالي الأول، تمت زراعة و تقييم العشيرتين وهما ناتج دورة الانتخاب الاجمالي الأولي مقارنة بالعشيرة الأصلية، بناءا علي الصفات موضع الدراسة وذلك لمعرفة كفاءة استخدام طريقة الانتخاب الاجمالي كاحدي طرق التربية المستخدمة في تحسين الصفات المدروسة في البصل وذلك في الموسم الشتوي ٢٠٠٥/ ٢٠٠٦ باستخدام تصميم القطاعات العشوائية الكاملة بثلاث مكررات.

وأظهرت النتائج بصفة عامة أن استخدام برنامج الانتخاب الاجمالي قد أدي إلي تحسين ملحوظ ومعنوي في كل الصفات موضع الدراسة بعد دورة واحدة من الانتخاب الإجمالي، مقارنة بالعشيرة الاصلية، وذلك من خلال تقدير المتوسطات للصفات المختلفة و مقارنتها احصائيا،كذلك اظهرت نتائج تقديرات كل من المدي و معامل الاختلاف للصفات المدروسة أن حجم الاختلافات قد قلت بدرجة ملحوظة. مما يعكس مدي التحسين للصفات في عشيرة دورة الانتخاب الإجمالي.

أظهرت تقديرات معامل الارتباط المظهري بين أزواج الصفات المختلفة وجود علاقات ارتباط موجبة ومعنوية ومرغوبة وعددها ٦٣ من بين ٧٨ علاقة، كما اظهرت النتائج ايضا وجـود ١٥ علاقة سالبة ومعنوية ولكنها مرغوبة ايضا ، مما يعكس أهمية أخذها في الاعتبار عنـد اجـراء الانتخاب كأحد الوسائل الهامة التي يمكن أن يستفيد بها مربيي النباتات في برامج الانتخاب لهـذا المحصول.