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# Behavior of New and Promising Egyptian Garlic Clones Resulting from Clonal Selection Program

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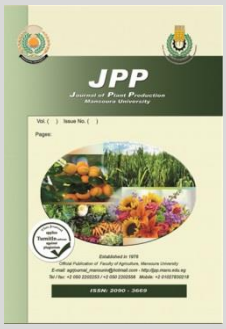


## ABSTRACT

Seven field experiments were conducted to study the effect of six cycles of clonal selection on some economical characters of garlic Egyptian cultivar (Balady). In this respect, this work was carried out at the Experimental Station Farm (at Abies), the Faculty of Agriculture, Alex. Univ., during seven garlic growing seasons from 2014/2015 to 2020/2021. The obtained results illustrated that the estimated coefficients of variability and ranges for all studied characters of Egyptian cultivar reflected high and enough variability, which suggested high possibilities of conducting successful and efficient selection to produce an improved cultivar with better performance than its original population. Cloves number per bulb and average clove weight were used as the main selection criteria in this study in all cycles of selection. Some other important traits that were indicative during the selection program were measured, such as plant height, leaves number per plant, leaf width, bulb diameter, bulb weight, cloves weight per bulb, orbits number per bulb and yield per experimental unit and per feddan. After six cycles of clonal selection, selected ten clones which were statistically superior in fewer cloves number per bulb and heavier clove weight than the original "Egyptian" population. Moreover, the selected clones exhibited high efficiency for improving all other studied characters, but with different rates, compared with the original population. The results also added that six successive cycles of clonal selection produced a group of improved clones, the most prominent of which is clones 5 and10, which can be considered as promising clones of Egyptian garlic, as they were characterized by high productivity with fewer cloves number per bulb with an increase in average clove weight inside the bulb.

***Keywords*:** Garlic, Egyptian cultivar, clonal selection, coefficients of variability.

## INTRODUCTION

*Allium sativum* L. (2n = 2x = 16), commonly known as garlic, belongs to the onion family Alliaceae. Garlic is the second most widely used spice of the cultivated vegetable crops of the genus *Allium*, after onions in the world Salahuddin *et al*. (2019). It was noted during the construction of the pyramids in Egypt that garlic was grown and consumed between 2780 and 2100 BC Yamaguchi (1983). The Egyptian Book of the Dead also included 22 remedies for garlic Holder and Gail (1996). Garlic has gained a reputation in various traditions as a preventive and curative plant, having played important nutritional and medicinal roles throughout history Sultan and Raina (2020). Due to its flavor and health-promoting value, it has become a staple in the human diet worldwide Matłok *et al*. (2014), and the importance of garlic has been clearly evident after the new Corona pandemic, which one of its roles is to increase the body's immunity.

Currently, the commercially grown garlic cultivars in Egypt are divided into two groups, the first group is known as Balady garlic, and the second group is known as Chinese garlic. Varieties of garlic, whether Egyptian or foreign (Chinese) vary in growth, essential oils, and yield potentiality (Al-Otayk *et al*., 2008; Walters, 2008 and Abdel-Razzak and El-Sharkawy, 2013). Balady garlic was a popular cultivar that was characterized by high yield and good quality; besides possessing a very sharp smell, distinctive taste, and disease and pest resistance, besides having good storability characteristics in the past and has a long history in Egyptian agriculture. But, during the last few decades its productivity has deteriorated and the demand for Balady garlic for local consumption or foreign markets is limited. The deterioration of garlic may be due to some changes in the genetic origins and the appearance of undesirable characteristics Abd El-Hamed *et al*. (2006).

This deterioration was represented by the Balady cultivar in the form of low productivity, and the size of small bulbs with thin cloves and varying in size, where the characteristic of small and thin garlic cloves was one of the most important reasons for the low demand for it, whether from the local market or exporting abroad. Such a deterioration in the characteristics of local garlic can now be attributed to the occurrence of natural somatic mutations, natural selection, as well as the lack of interest in selection during the cultivation practices, as the farmer is usually interested in selecting plants with good, high-quality heads for sale and leaves only low-quality heads for cultivation in the next year Abdel Halim (2014). Besides, the absence of the role of specialists in seed production and the lack of interest in breeding programs for that crop. Based on the previous reasons, a wide range of differences appeared within the Balady cultivar, in addition to the deterioration of its characteristics, which prompted the farmers to show less interest in cultivating the Balady garlic and trying to search for new cultivars Goda (2012) Accordingly, many efforts have been made to introduce new high-quality and productivity garlic varieties to Egypt to overcome the problem.

Cultivated garlic cultivars are sexually sterile and are therefore vegetatively propagated for commercial production by cloves. Clonal selection is a major breeding method for garlic since plant sterility usually precludes crop improvement by means of cross hybridization. Since no segregating population is available, stability and inheritance of specific traits obtained

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through clonal selection is hard to monitor by normal genetic analysis (Lampasona *et al*., 2003; Moustafa *et al.*, 2009 and Jo *et al*., 2012). Despite the importance of garlic and abundance of germplasm resources, very limited breeding work has been done in garlic so far Agrawal *et al*. (2003)

Based on the above, it was necessary to search for a solution in the use of local ecotypes, which are perfectly adapted to local conditions and are important genetic resources and materials for primary clonal selection. So, the aim of this study was improving the local garlic cultivar by using clonal selection program to increase productivity and head quality specifications by focusing on improving the average weight of the clove and the number of cloves per bulb, which in turn leads to an increase in the economic return from the unit area and thus increases the export potential. Considering that this study is part of an integrated study to improve garlic.

## MATERIALS AND METHODS

### Experimental site

This study was conducted over seven years during the garlic growing seasons from 2014/2015 to 2020/2021. The field trials were carried out at the Experimental Station Farm, in Abies region, Faculty of Agriculture, Alexandria University, Alexandria Governorate, Egypt.

### Original genetic material

The clonal selection breeding program started with popular population consisting of about 1000-bulb of garlic "Balady" cultivar, which considered the widely cultivar grown in Egypt; marked by its strong aroma as well as the mature cloves have white covering scale with relatively long storability; However, the number of cloves in the bulb is large and thin. The experimental material of garlic used in the present study were collected from various provinces in Egypt where they have been commonly grown for several decades. Usually in the local cultivars of any crop usually farmers stored garlic planting resources in bulb form for the planting season, which happens from May to December.

### Clonal Selection program

### First cycle of clonal selection program

After the storage period, and before the time of cultivation; the primary selection was made among the collected bulbs (1000-bulb). 200 bulbs characterized with the lowest bulb discharge rate, the above-average bulb size and weight, the lowest number of cloves per bulb, and the highest average clove weight were selected. Cloves were separated from the bulb, and only 10 healthy cloves were selected for uniformity in shape and size from each selected bulb were planted separately as single clones in un-replicated plots on 15 of September 2014. Cloves were hand planted on both sides of ridge at about 7.0 cm apart between cloves. All the recommended agronomic packages of practices and plant protection measures were followed to raise a good crop. After planting directly and before irrigation, weeds were controlled by using pre-emergence of herbicide. Conventional other agronomic practices and pest control treatments were done as needed and were like those used in commercial garlic production in Egypt.

The crop was harvested when leaves on plants turned brown during the first week of Abril 2015. The bulbs were stored traditionally at ambient temperature in a well-ventilated room for before measuring yield and bulb characteristics. The data obtained were subjected to statistical analysis and mean, range, and coefficient of variation (C.V.%) were calculated to estimate the degree of variation of some bulb traits in the original population.

### The second to sixth cycles of the clonal selection program

As it was previously explained, the characteristics on which the current selectorial program depends are five basic characteristics of the bulb, which are bulb weight, cloves weight per bulb, orbits number per bulb, cloves number per bulb, and the average clove weight. Accordingly, five successive cycles of clonal selection program were conducted, following the aforementioned first cycle, where the five cycles took place during five consecutive seasons during the years of 2015 to 2019 in the first week of October. Noting that during the first three selection cycles, i.e., from the first to the third cycle; five bulbs were selected from each genotype, as the selection was carried out within and between different genotypes. As for the following three cycles, from the fourth to the sixth, selections were held at the genotype level; in the sense that completely homogeneous bulbs were selected within the genotype and their cloves were mixed and planted to represent the selected genotype. All agricultural practices such as fertilization, irrigation, and pests' control were performed as recommended for commercial garlic production. The selection was made in the store after the curing process about four months, as in the first season for the same previously mentioned traits. After six cycles of clonal selection, ten clones, which reflect superior in studied bulb characteristics compared to the original population "Balady" cultivar, were selected as the final target of this program. The original population was also planted throughout the selection seasons to preserve it and compare it with the selected clones.

### Evaluation of the derived clones

After six cycles of clonal selection, the ten selected clones and one bulk of the original population "Balady" cultivar were planted on the 1st of October 2020 to evaluate the behavior of the new selected clones and choose the promising ones. The experimental design was a Randomized Complete Block Design. Each treatment (garlic genotypes) was replicated three times and the experimental genotype plot area was 8.4 $m^2$. Each plot consisted of 4 ridges, 3 meters length and 0.7 m width. Cloves were handly planted on the basis of 7 cm apart between cloves on both sides of ridge. During the cultivation, cloves of the same average weight were selected for planted within each replicate. Horticultural practices that were commonly applied in garlic management were followed as usual. Plants of each plot were harvested when older leaves turned yellowish-green and started withering. The harvested bulbs were spread in single layers under room temperature conditions (in twenty-one-day period) for the curing process. After curing, ten plants from each experimental plot were randomly taken to determine data of plant height (cm), leaves number per plant, leaf width (cm), bulb diameter (cm), orbits number per bulb, bulb weight (g), cloves weight per bulb, cloves number per bulb, average clove weight (g), total yield per $m^2$ (kg) and total yield per feddan (ton) were recorded. The cloves were graded according to the average weight of the clove into the following sections > 3.0 g, 1.0 – 3.0 g, 0.5 – 0.9 g, < 0.5 g and estimate number and weight cloves of each grade, as well as average clove weight within each grade.

### Statistical analysis

The mean values of each character under the study were computed and subjected to analysis of variance, following the procedures described by Al-Rawi and Khalf-Allah (1980), using Co-Stat computer software program (2004).

## RESULTS AND DISCUSSION

### Variability estimates in the original population

Data in Table 1 shows the mean, range, and coefficient of variation percentage for the important bulb traits studied for the original population, the Egyptian (Balady) cultivar. As can be seen from the calculated coefficients of variation values, the original population reflected a lot of variability in all the traits studied. The estimated coefficients of variation revealed values of more than 20% for all the traits investigated. Furthermore, estimated coefficients of variation for the five studied traits ranged from 30.00 to 45.52% for orbits number and bulb weight, respectively. The findings also revealed that the calculated range values for each character were quite large. This is due to the fact that this cultivar is old enough and has been produced commercially for a long time without any purification or improvement. So, the garlic crop, Balady cultivar, has great chances of improvement. The obtained results agreed, generally, with those of Mostafa *et al*., (2020) on some Egyptian garlic genotypes, who, found wide ranges of variation in most of the studied characters and concluded that the studied characters could be improved through selection methods.

### Performances of different selected clones

### Vegetative growth characters

The obtained results, in Fig. 1, showed that the three vegetative growth characters, plant height (cm), leaves number per plant and leaf width (cm), obviously increased after six cycles of clonal selection. Where clone C10 recorded the highest significant value for plant height (100.14 cm), while clone C2 recorded the lowest significant mean value (87.97 cm) of this trait among the group of selected clones. On the other hand, Egyptian cultivar (Balady); recorded the lowest significant mean value (85.22 cm) of plant height compared to all the ten selected clones. Concerning leaves number per plant, clone C5 showed the highest significant value (9.45) compared to the selected clones or even to the original population, which recorded a mean value of 6.46, which was the least significant. Also, the Egyptian (Balady) cultivar recorded the lowest significant mean value for the leaf width trait compared to the selected clones; While the mean values of the selected clones converged with each other, but still were significantly higher than the original population. These results are in a harmony with that are reported by Omar and Abu Hadid (1992), Osman and Moustafa (2009) and Anwar *et al*., (2017), when evaluated different genotypes of Egyptian garlic cultivar.

**Table 1. Estimates of variability parameters; range, mean X and coefficient of variation (C.V. %), for bulb characteristics in the original population of Egyptian garlic.**

| Parameters / Traits | Mean (x) | Range (r) | Coefficient of variation (C.V.%) |
|---|---|---|---|
| Bulb weight (g) | 29.15 | 10.21 – 60.80 | 45.52 |
| Cloves weight per bulb(g) | 25.37 | 8.30 – 55.11 | 35.00 |
| Cloves number per bulb | 40.51 | 15.00 – 65.00 | 30.13 |
| Average clove weight (g) | 0.85 | 0.51 – 2.00 | 44.52 |
| Orbits number per bulb | 4.60 | 2.00 – 6.00 | 30.00 |

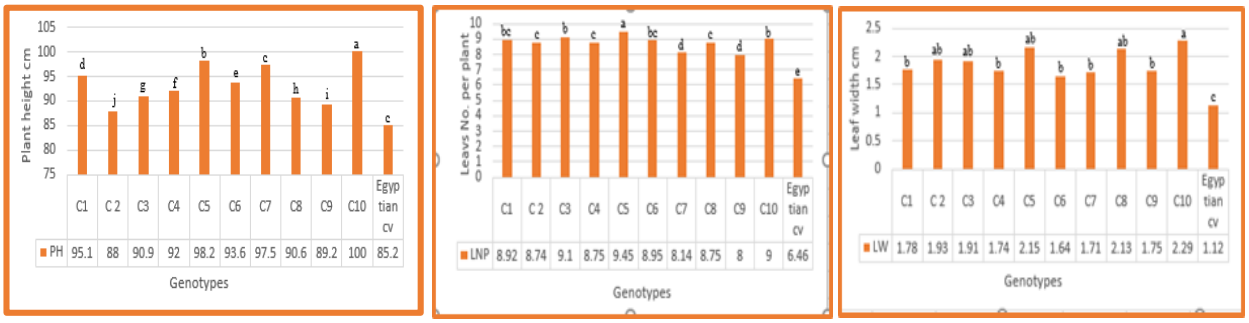


**Fig. 1. Mean performances of vegetative growth characters of ten selected garlic clones and their original population.**

### Total yield and bulb characteristics

The trait of bulb diameter is among the major yield components that contribute to the eventual development of different genotypes. In this regard, data in Table 2 showed that the Egyptian selected clones gave the highest average values for the diameter of the bulb compared to the original population. The maximum significant mean value of this trait resulted from clone C10 followed by clone C9 which was 7.32 cm and 7.00 cm versus 4.50 cm for cultivar Balady (Egyptian). This result agreed with Anwar *et al*., (2017) and Hegazy *et al*., (2018**)** when compared garlic Balady cultivar with some white garlic clones.

**Table 2. Mean performance of bulb characteristics of the ten garlic clones and their original population.**

| Traits / Genotypes | Bulb diameter (cm) | Bulb weight (g) | Cloves weight per bulb (g) | Orbits No. per bulb | Cloves No. per bulb | Average clove weight (g) |
|---|---|---|---|---|---|---|
| Clone 1 | 6.31 d | 66.15 b | 61.97 c | 4.00 b | 39.22 b | 1.59 ab |
| Clone 2 | 5.80 e | 51.26 fg | 48.20 e | 2.00 d | 25.13 j | 1.93 a |
| Clone 3 | 5.81 e | 53.23 ef | 49.79 e | 3.00 c | 35.11 g | 1.56 a |
| Clone 4 | 6.52 cd | 63.11 c | 61.90 c | 3.00 c | 36.40 e | 1.72 a |
| Clone 5 | 6.83 bc | 71.31 a | 69.37 a | 3.00 c | 37.32 c | 1.87 a |
| Clone 6 | 5.91 e | 54.36 e | 49.63 e | 3.00 c | 37.23 d | 1.34 bc |
| Clone 7 | 5.23 f | 45.21 h | 40.85 f | 3.00 c | 36.12 f | 1.14 cd |
| Clone 8 | 5.00 f | 49.89 g | 48.17 e | 2.00 d | 28.21 i | 1.72 a |
| Clone 9 | 7.00 ab | 59.00 d | 55.36 d | 3.00 c | 30.00 h | 1.85 a |
| Clone 10 | 7.32 a | 70.10 a | 64.00 b | 4.00b | 36.10 f | 1.90 a |
| Egyptian (Balady) | 4.50 g | 38.21 i | 35.30 g | 4.90 a | 47.31 a | 0.88 d |

**Values having the same alphabetical letter (s) within each column, don't significantly differ from one another, using Duncan's multiple range test at 0.05 level of significance.**

For bulb weight and cloves weight per bulb, data in Table 2 showed that there were highly significant differences between Balady cultivar and the selected clones. Both Bulb - and cloves - weight (g/plant) of Balady cultivar was the lowest among the tested genotypes, that reflected significantly highly differentials, with the mean value of 38.21 g and 35.30 g for bulb weight and cloves weight, respectively, versus 58.42 g and 54.92 g, respectively for the clones' grand mean, for the two previously mentioned characters.

On the other hand, the selected clones C5 and C10 showed highly significant differentials, with mean values of 71.31 g and 69.37 g, and 70.10 g and 64.00 g for bulb weight and cloves weight, respectively. And such a noticeable increase in the mean weight value of the bulb as well as the cloves; will be positively reflected in the increase in productivity from the unit area as is shown in Fig 2, where the selected clones C5 and C10 were recorded 18.04 kg and 17.50 kg that considered the highest productivity in relation to the unit area by experiment (experimental unit) as well as the feddan productivity (11.21 ton and 11.04 ton). On the contrary, the original population recorded a significant decrease for yield per plot or yield per feddan traits, which reflected mean values 9.82 kg per plot and 6.25 ton per fed, respectively. The obtained results in this respect were confirmed by the findings of Sakr (1996); Zepeda (1997) and Zepeda *et al*., (1997) when applied clonal selection program on garlic. Also, Abou El-Magd *et al*., (2012), reported that Balady Mohassan cultivar produced a higher yield in comparison with that of Egyptian cultivar.

**As for the three characteristics:** orbits number per bulb, cloves number per bulb, average clove weight; it is constituting a very important factor for the quality characteristics of the bulb as well as productivity. Where these three characteristics were considered the most important reasons for the consumer's reluctance to buy Egyptian garlic, as well as the low level of export from it. Therefore, it was necessary to focus on improving these characteristics by using clonal selection program, which was based on reducing both orbits number per bulb and cloves number per bulb with an increase in the average weight clove; where, through six cycles of clonal selection, a significant improvement in these traits was achieved, as shown in Table 2 and Fig 3. The results illustrated that Balady cultivar produced more orbits number per bulb and more cloves number per bulb compared with selected clones. The maximum and significant mean value of orbits - and cloves - number per bulb were 4.90 and 47.31 for Balady cultivar, respectively; while significantly minimum mean value of orbits - and cloves - number per bulb were recorded by clone 2 (2.00 and 25.13), followed by clone 8 (2.00 and 28.21), respectively. The opposite trend was observed for average clove weight, where Egyptian selected clones resulted in more clove weight compared with the original population. The highest mean values of this trait were 1.93 g, 1.90 g, 1.87 g, and 1.85 g for clones 2, 10, 5, and 9; which didn't differ significantly from one another or from most of the selected clones; however, it differed significantly from the original population (0.88 g) as shown in Table 2. The same results were obtained, especially for the characteristic of cloves number per bulb, by Zepeda (1997) and Zepeda *et al*., (1997), who obtained six individual selections which statistically superior in fewer cloves per bulb than the original population, after six cycles of clonal selection of garlic.

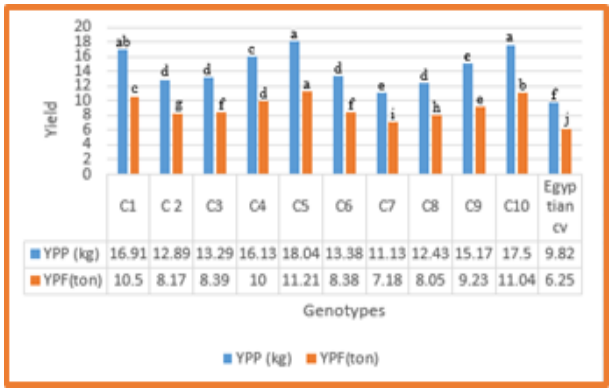


**Fig. 2. Yield per plot (YPP) and yield per feddan (YPF) of ten selected garlic clones and their original population.**


**Fig. 3. Egyptian garlic clones after six cycles of clonal selection: (A) graded bulb shape of two selected clones (above and below), (B and C) two different selected clones with the same bulb diameter, (D and E) comparing Egyptian selected clone (right) with commercial cultivar Chinese (left) with the same bulb diameter, (F) comparing selected clone (right) with original cultivar (left) with the same bulb diameter**

**Table 3. Mean performance of graded cloves of the ten garlic clones and their original population.**

| Traits / Genotypes | Cloves graded | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | > 3.0 | | 1.0 – 3.0 | | 0.5 – 0.9 | | < 0.5 | |
| | Number | Weight | Number | Weight | Number | Weight | Number | Weight |
| Clone 1 | 4.88 d | 19.85 b | 18.95 b | 33.18 cd | 8.00 c | 5.14 d | 6.91 b | 3.20 b |
| Clone 2 | 2.00 f | 8.12 e | 17.87 b | 35.16 a-c | 5.10 d | 4.93 d | 0.00 f | 0.00 e |
| Clone 3 | 1.98 b | 7.32 ef | 20.05 b | 34.46 b-d | 8.95 b | 6.00 c | 4.05 c | 1.95 c |
| Clone 4 | 8.00 a | 25.45 a | 24.10 a | 31.68 d | 4.07 e | 3.13 f | 0.00 f | 0.00 e |
| Clone 5 | 7.20 b | 25.19 a | 25.00 a | 37.75 a | 5.16 d | 3.00 f | 0.00 f | 0.00 e |
| Clone 6 | 3.63 e | 12.10 d | 24.92 a | 28.50 e | 9.90 a | 8.93 a | 0.00 f | 0.00 e |
| Clone 7 | 1.00 g | 3.37 g | 19.90 b | 31.84 d | 9.85 a | 6.00 c | 0.00 f | 0.00 e |
| Clone 8 | 1.98 f | 6.43 f | 15.00 c | 32.32 cd | 8.88 b | 8.13 b | 2.11 e | 1.00 d |
| Clone 9 | 4.9 d | 18.10 c | 18.41 b | 31.49 d | 5.14 d | 4.00 e | 3.09 | 1.50 c |
| Clone 10 | 6.11 c | 2.00 b | 22.85 a | 37.11 ab | 4.20 e | 3.03 f | 2.88 d | 1.25 c |
| Egyptian (Balady) | 0.00 h | 0.00h | 20.15 b | 21.00 f | 10.21 a | 9.13 a | 17.00 a | 4.77 a |

**Values having the same alphabetical letter (s) within each column, don't significantly differ from one another, using Duncan's multiple range test at 0.05 level of significance.**

From the beginning and throughout the six selection cycles, the selectorial program relied on the selection for the number of the least cloves number and the average weight of the largest for clove, as previously explained. To achieve this goal, the cloves inside each bulb were graded into four sections: >3.0, 1.0 – 3.0, 0.5 - 0.9 and < 0.5; so that the bulb contains the largest number of cloves with a clove weight greater than 1.0 g is selected. Accordingly, as can be seen from Table 3 and Fig 3; the bulbs of the five selected clones (C2, C4, C5, C6 and C7) did not contain cloves with an average weight of less than 0.5 g, whereas the bulbs of Balady cultivar contained the highest mean in relation to the number of cloves less than 0.5 g (17 clove). The bulbs of the Balady cultivar also significantly contained the highest number of cloves in the grade 0.5 - 0.9 g (10.21 clove); while clones C4 and C10 recorded the least significant number of cloves in the same previous scale (4.07 and 4.20 clove). As for the number of cloves in the bulb greater than 1.0 g, the bulbs of clones C4, C5 and C10 were contained the highest number of cloves that weight > 3.0 g and 1.0 – 3.0 g in the bulb; while the bulbs of Balady cultivar did not contain cloves that weight > 3.0 g, and it was the least significant in the case of the grade 1.0 – 3.0 g. Also, the results are shown in Fig 4 showed that clone C2 recorded the highest average weight of the clove within the different grading, as well as clone C8, gave the same result in all clove weight grading except for grading > 3.0; whereas Balady cultivar recorded significantly the lowest mean clove weight within the different grades. This result was agreed with those obtained by Zepeda, (1997) and Zepeda *et al*., (1997).


**Fig. 4. Average clove weight in different clove grades**

## CONCLUSION

From the results of this study, it can be concluded that all the Egyptian garlic clones selected, after six cycles of the breeding garlic program by clonal selection, showed improvement and superiority over the original population. Those strains outperformed in productivity, whether per unit area or feddan, as well as for head specifications, they reflected a high moral improvement, both in average head weight, average lobe weight as well as the number of lobes in the head. Accordingly, it can be recommended to intensify evaluation experiments on those distinct strains for the possibility of re-spreading the local garlic variety to restore its position, whether at the level of local consumption or export.

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## سلوك سلالات الثوم المصري الجديدة والواعدة الناتجة عن برنامج انتخاب السلالة الخضرية

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خلال تلك الدراسة أجريت سبع تجارب حقلية لدراسة تأثير ست دورات من انتخاب السلالة الخضرية على بعض الصفات الاقتصادية لصنف الثوم المصري (بلدي). في هذا الصدد ، تم تنفيذ هذا العمل في مزرعة المحطة البحثية (بأبيس) ، كلية الزراعة ، جامعة الإسكندرية ، خلال سبعة مواسم شتوية من2015 /2014 إلى 2021/2020. أوضحت النتائج التي تم الحصول عليها بشكل عام أن تقدير كلا من معامل الاختلاف والمدى لجميع الصفات المدروسة فى صنف الثوم المصري تعكس تباينا كبيرا، مما يشير إلى احتمالات عالية لإجراء انتخاب ناجح وفعال لإنتاج صنف محسن بأداء أفضل من العشيرة الاصلية. تم استخدام عدد الفصوص للرأس ومتوسط وزن الفص كمعيارين رئيسيين في هذه الدراسة في جميع دورات الانتخاب. تم قياس بعض الصفات الهامة الأخرى التي كانت ذات دلالة أثناء برنامج الانتخاب ، مثل ارتفاع النبات ، وعدد الأوراق لكل نبات ، وعرض الورقة ، وقطر الرأس ، ووزن الرأس ، ووزن الفصوص للرأس، وعدد المدارات للرأس ، والإنتاجية لكل من الوحدة التجريبية والفدان. بعد ست دورات من انتخاب السلالة الخضرية، تم انتخاب عشر سلالات خضرية متفوقة معنويا في عدد أقل من الفصوص لكل رأس ووزن أثقل للفص من العشيرة الأصلية (Egyptian). علاوة على ذلك، أظهرت السلالات المنتخبة كفاءة عالية في تحسين جميع الصفات المدروسة الأخرى ولكن بنسب مختلفة مقارنة بالعشيرة الاصلية. كما أضافت النتائج أن ست دورات متتالية من الانتخاب أثمرت عن مجموعة من السلالات المحسنة ، أبرزها السلالات رقم 5 و 10 والتي يمكن اعتبارها سلالات واعدة للثوم المصري ، حيث تميزت بالإنتاجية العالية مع عدد أقل من فصوص الثوم للرأس مع زيادة متوسط وزن الفص داخل الرأس.