# Evaluation of Some Onion Genotypes Under Calcareous Soil Conditions

**Gomaa[1], M. A., F.I. Radwan[1], I. A. A. Yaso[2], E. E. Kandil[1] and M. S. Abd El-Gawad[2]**

1- Plant Production Department, The Faculty of Agriculture (Saba Basha), Alexandria University

2- Onion Crop Department, Field Crops Institute, Agric. Res. Center (ARC), Egypt.

**ABSTRACT:** To evaluate fourteen local Egyptian genotypes of onion (*Allium cepa,* L.) under calcareous soils and drip irrigation for increasing economic income by through cultivation of the high yielding onion genotypes (cvs) and found the high quality cultivars in export characters. In this respect, two filed experiments were conducted at Experimental Farm of Nubaria Agricultural Research Station during 2014/2015 and 2015/2016 winter seasons in randomized complete block design (RCBD) with 5 replications. The obtained results cleared that there were a significant difference among the 14 onion genotypes in all studied characters. Whereas, the combined analysis of variance revealed significant differences among the fourteen genotypes for all studied characters. It can be concluded that Composite 16 large oblong genotype recoded the highest total and market yield of onion under calcareous soils under drip irrigation in Nubaria Region to increase economic income.

**Key words:** onion, genotypes, yield, quality, calcareous soil, drip irrigation, Nubaria.

## INTRODUCTION

Onion (*Allium cepa,* L.) is the most important bulb crops and it is one of the most important vegetable crops grown in many parts of the world. It belongs to the family *Alliceae*, genus *Allium* that contains about 600 species. Onions have been valued for their medicinal qualities by many cultures around the globe. Numerous health benefits have been attributed to the onion, including prevention of cancer and cardiovascular disorders. It has a positive relationship between onion intake and risk for these common diseases. In Egypt, the total cultivated area of onion is 144.00 thousand feddans (FAO, 2012). The estimated productivity per feddan each of loaded and solo onions was 15.53 tons. The quantity exported annually from fresh onions about 202.1 thousand tons. In the world, the total cultivated area of onion is 3971000.51 ha, it produced 75.98 million tons by average of productivity per ha is 19.10 tons (FAO, 2012). Onions find widespread usage in both fresh green and dried forms. It is used as a flavor additive in a wide variety of food formulations such as comminuted meats, sauces, soups, salad dressings and pickle relishes (Kumar *et al*., 2006).

For many years, a program for improving the Delta genotypes was carried out at Onion Research Department. The workers succeed to obtain three new selections which have more uniform bulbs and better keeping quality. An increasing area is planted with onion in Nubaria region, appeared through the last few years some agricultural problems, especially, drought, salinity and diseases. Accordingly, it is essential to evaluate the performance of newly developed local lines and the introduce ones under Nubaria region conditions.

Onion cultivars are characterized by bulb skin, color, thickness, bulb pungency taste and bulb shape. Bulb shape can be globe, flattened globe, sometime with a flat to spindle or cylindrical. Onion cultivars differ in their quality characters. The quality characters of onion cultivars are described in several ways that include bulb doubling, the firmness of bulb, dry matter content, bulb pungency, flavor and its potential storage life. Also cultivars are characterized by inflorescence fertility, the flower number in umbel, the sepal and anther color, and the presence or absence of bulbils in the inflorescence. Hybrid varieties have replaced many of the standard open-pollinated cultivars. The hybrids are vigorous and uniform in bulb shape, size, and maturity and higher in yield (Swiader *et al*., 1992 and Brewster, 1990). Major factors that affect onion bulbs in storage include time of harvest, type of cultivar, pests and diseases, and atmospheric composition such as oxygen, carbon dioxide, temperature and relative humidity (Kader, 1992 and Thompson, 1992).

The combined analysis of variance revealed significant differences among the six genotypes for all studied characters except % of double bulbs. Giza 20, Red Giza and (Giza 20 x TEYG) genotypes had the highest values for plant height and no. of leaves/plant, while Comp. 13 Oblong gave the lowest ones. Comp. 13 Ob., was the earliest in bulb maturity, while Giza 20 and Red Giza were the latest ones. Giza 20, Red Giza, (Giza 20 x TEYG) and Group of Composites were the highest in total and marketable yield and average bulb weight Comp. 13 Ob., had the highest % of single bulbs 99.69 %, the lowest % of double bulbs and normal % of bolters (0.31 %) (Yaso, 2007). Giza 20 and Red Giza and (Giza 20 x TEYG) genotypes had the highest means for plant height and No. of leaves/plant, while Comp. 13 Oblong gave the lowest ones. Compo“13Ob” was the earliest in bulb maturity, while Giza 20 and Red Giza were the latest ones. Giza 20, Red Giza, (Giza 20 x TEYG) and Group of composites were the highest in total and marketable yield and average bulb weight (Yaso, 2007).

Lai *et al*. (1994) tested 60 onion cultivars and found that (Niz 1003 x PH 3325), Granex x PRR, Granex 429 and Henry’s. Special gave the highest marketable yields. However, Bettoni *et al*. (2012) reported that the cultivars Alfa Sao Francisco and Alfa Sao Francisco_RT produced higher values of dry mass and productivity in January. However, Kattak *et al*., 2013 inducted that heaviest individual bulb was produced by cultivar Swat-1 whereas the local cultivar gained weight. Cultivar Swat-1 produced heavy bulb at location-1 (Chokora) while bulb weight was recorded in location 2 (Chountra) by the same cultivar. The highest bulbs yield was recorded for cultivar Swat-1 at both locations, respectively, which was associated with the individual bulb weight and diameter gained by the same cultivar. The main objective of this study was to evaluate fourteen local Egyptian genotypes of onion (*Allium cepa* L.) under calcareous soils under drip irrigation to increase economic income through cultivation the high yielding onion genotypes and found the high quality varieties in export characters.

## MATERIALS AND METHODS

Fourteen onion genotypes varied in their origin and characteristics were chosen from the onion germplasm collection at Onion Research Department, Field Crops Institute, Agricultural Research Center (ARC), Egypt. The genotypes were grown at the Experimental Farm of Nubaria Agricultural Research Station during 2014/2015 and 2015/2016 winter seasons. The tested genotypes were: (Composite 16 White, Composite 16 Large oblong, Composite 12, Composite 17, 1866- Behairy, New Valley, Giza Red Bulk, Nubaria DSR, Shandawil 1, Giza 6 Mohassan, Giza 20, Giza Red, 024-001-2014 and Yellow Creole).The soil of the experimental field was calcareous sandy loam in texture with pH 8.3 and 25% $CaCO_3$ content. Other soil properties are presented in Table (1) was described according to (Chapman and Partt, 1978).Seedlings of fourteen genotypes were transplanted to drip irrigation beds on December 5$^{th}$ and December 17$^{th}$ in 2014 and 2015 season, respectively. The experimental plot size was planted space at 10 cm in the bed, 80 cm in width and 7.2 m in length. Recommended doses of nitrogen, phosphorus and potassium fertilizers were added at the rate of 90 kg N, 45 kg $P_2O_5$ and 48 kg $K_2O$/fed. All other cultural practices for onion production in calcareous soil were followed. A randomized complete blocks design (RCBD) with five replicates was used.

**Table (1). Physical and chemical properties of the experimental soil sites during the two cropping seasons 2015 and 2016.**

| Soil characteristics | 2014/2015 | 2015/2016 |
|---|---|---|
| **Soil texture** | **Sandy clay loam** | |
| Sand % | 51.83 | 52.73 |
| Silt % | 25.64 | 22.46 |
| Clay % | 22.53 | 24.81 |
| pH (1: 2.5 water suspension) | 8.24 | 8.31 |
| EC ($dSm^{-1}$) | 3.72 | 3.47 |
| O.M. (%) | 0.39 | 0.21 |
| $CaCO_3$ (%) | 22.74 | 26.32 |
| **Soluble cations (meq /L.)** | | |
| $Ca^{++}$ | 8.72 | 9.63 |
| $Mg^{++}$ | 1.29 | 1.17 |
| $Na^{+}$ | 23.83 | 21.11 |
| $K^{+}$ | 3.16 | 2.79 |
| **Soluble anions (meq /L.)** | | |
| $HCO_3^{-}$ | 3.52 | 2.86 |
| $Cl^{-}$ | 26.14 | 24.32 |
| $SO4^{--}$ | 7.54 | 7.52 |
| Available N(mg/kg) | 19.40 | 20.60 |
| Available P (mg/kg) | 3.51 | 2.74 |
| Available K (mg/kg) | 159.00 | 137.00 |

**The following data were recorded:**

After 120 days from transplanting, 20 randomly selected plants were taken from each plot in both seasons to measure: Plant height (cm), number of green leaves/plant, total chlorophyll content (mg $m^{-2}$), plant fresh weight (g/plant), plant dry weight (g/plant), number of days to maturity, total yield (tons/fed.), marketable yield (tons/fed.), average bulb weight (g), bulb diameter (cm), percentage of single bulbs, percentage of double bulbs, percentage of bolters, bulb and total soluble solids (TSS).

**Statistical analysis**

All statistical analysis was performed using analysis of variance technique by means of CoStat computer software package (CoStat, Ver. 6.311., 2005). Recorded data of all studied characters were statistically analyzed according to the used design and the means were compared using LSD test (Duncan, 1955).. The analysis of variance was made separately for each season, then a combined analysis for the two seasons was calculated (Gomez and Gomez, 1984).

## RESULTS AND DISCUSSION

Highly significant differences occurred among seasons and combined analysis was carried out for plant height, number of leaves/plant, total chlorophyll, days to maturity, total yield, marketable yield, average of bulb weight, bulb diameter and % of bolters (Table 2). Whereas, the highest mean value for number of leaves/plant (7.50 leaves), total chlorophyll (66.30 mg/$m^2$), number of days to maturity (150.40 days), average bulb weight (67.44 g), total yield (17.88 tons/fed.), and marketable yield (17.03 tons/fed) were recorded for the first season 2014/2015. Meanwhile plant height (69.43 cm), bulb diameter (6.68 cm), and % of bolters (2.73 %) recorded the highest mean value in 2015/2016 season but there was no significant difference between the second season and the combined analysis in bulb diameter and % of bolters (Table 2).

However, the lowest values of plant height (63.17 cm), bulb diameter (6.11 cm), % of bolter (2.03 %) were obtained in the first season 2014/2015. In the otherwise, the lowest mean values of No. of leaves/plant (7.19 leaves), No. of days to maturity (144.61 days), average bulb weight (65.76 g), total yield (11.18 tons/fed) and marketable yield (10.54 tons/fed) in combined analysis. These results are in harmony with those obtained by Gamie and Yaso (2007), Yaso (2007), Bettoni *et al*. (2012) and Kattak *et al*. (2013) who revealed that there was a significant difference among seasons and location at different environmental conditions.

Genotypes responses differ under agro-ecological conditions and several genotypes of the same species behave different even grown under same environment. Bolting (formation of seed stalk followed by the initiation of flowering) is a highly undesirable character for bulb crop. Temperature and photoperiod are

considered to be the main factors for bolt initiation in onion (Diaz-Perez *et al.,* 2003) and different genotypes have different bolting percentage in a specific agro-climatic condition.

Also data in Table (2) indicated that there was no significant difference among seasons and combined data in these traits i.e. plant fresh weight, plant dry weight, % of single bulbs and % of double bulbs.

Figure (1) cleared that the highest and lowest mean values of the two seasons and combined analysis for all studied characters of onion genotypes.

**Table (2). Average of growth and yield attributes for 14 onion genotypes evaluated under calcareous soils during seasons 2014/2015, 2015/2016 and combined data.**

| | Season | | | |
|---|---|---|---|---|
| **Genotypes** | **2014/2015** | **2015/2016** | **combined** | **LSD at 0.05** |
| Plant height (cm) | 63.17c | 69.43a | 66.30b | 1.14 |
| No. of leaves/plant | 7.50a | 7.19b | 7.35 ab | 0.159 |
| Total chlorophyll (mg/m$^2$) | 66.30 a | 62.85 b | 52.52 c | 0.219 |
| Fresh weight/ plant (g) | 182.35 | 171.01 | 176.68 | n.s. |
| Dry weight/plant (g) | 23.22 | 23.30 | 23.26 | n.s. |
| Number of days to maturity | 150.4a | 144.61c | 147.51b | 1.96 |
| Average bulb weight (g) | 67.44a | 65.76c | 66.60b | 0.133 |
| Bulbs diameter (cm) | 6.11b | 6.68a | 6.69a | 0.022 |
| Percentage of single bulbs | 95.16 | 94.40 | 94.78 | n.s. |
| Percentage of double bulbs | 2.13 | 2.30 | 2.21 | n.s. |
| Percentage of bolters | 2.03b | 2.73a | 2.38ab | 0.404 |
| Total yield (tons/fed.) | 17.88a | 11.18c | 14.53b | 0.657 |
| Marketable yield (tons/fed.) | 17.03a | 10.54c | 13.79b | 0.624 |

Means at the same row followed by the same letter are not significantly different according to L.S.D. at 0.05 value.
n.s. not significant difference at 0.05 level of probability.

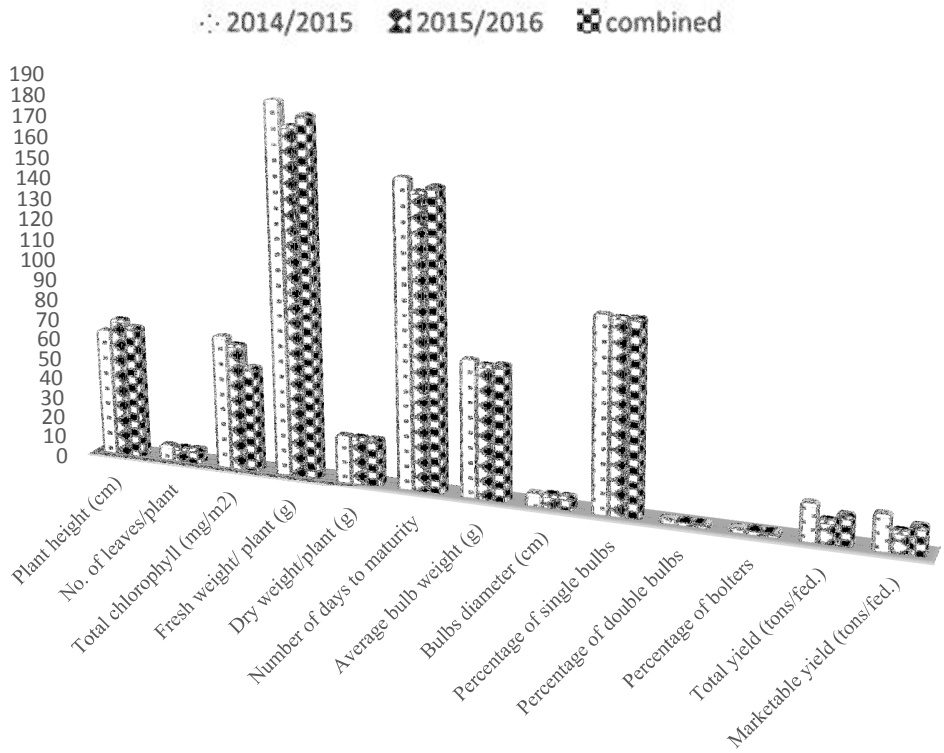


**Fig. (1). Growth and yield attributes for 14 onion genotypes as affected by two seasons 2014/2015, 2015/2016 and combined data.**

The data in Tables (3 and 4) indicated that there was a significant difference among the 14 onion genotypes for all studied characters. Whereas, the combined analysis of variance revealed significant differences among the fourteen genotypes for all studied characters. Composite 16 White gave the highest mean value of number of leaves/plant (7.82) as compared with other genotypes in combined analysis. Composite 16 large oblong recorded the highest means values of total chlorophyll in leaves (59.65 mg/m$^2$), bulb diameter (6.99 cm) and total yield (17.73 tons/fed), marketable yield (16.98 tons/fed), and it was the earliest genotype (140.20 days) as in comparison with other genotypes during combined analysis. Nubaria Dsr had the highest mean value of % of double bulbs (6.60 %) as compared with other genotypes in combined data. Giza 6 Mohassan and Giza 20 had the highest mean values of plant height (69.44 cm and 68.85 cm) and fresh weight/plant (328.09 g/plant) and it was the latest in bulb maturity (155.10 and 155.80 days to maturity), respectively in comparison with others. But in dry weight Giza 20 gave the highest weight (33.43g/plant) followed by Giza Red (30.88 g/plant) and Shandawil (30.78 g/plant). Yellow Creole recoded the tallest plant (69.16 cm) after Giza 6 Mohassan (69.44 cm) and the % of bolter (4.78 %) as compared with others genotypes in combined data. Genotype (024.001.2014) had the heaviest average bulb weight (79.35 g) and the highest percentage of single bulbs (98.35 %) in comparison with others.

The cultivar Composite 16 Large oblong proved to be superior for marketable yield (ton/fed), total yield (tons/fed.), bulb diameter, total chlorophyll in leaves and number of leaves/plant, and it was the earliest as well as Giza 6 Mohassan and Giza 20 produced the highest values of plant height, number of leaves/plant, fresh weight, and dry weight compared to the other genotypes under this study conditions, and exhibited wide adaptability across different environments in two seasons under climate conditions in Nubaria region, Alexandria. This could be due to some differences in the temperature, rain fall pattern with higher amount of rain occurred during the growing seasons, which had positive effect on total yield and also on marketable yield and others characters.

Meanwhile, the lowest mean values of plant height (58.08 g) with 024.001.2014 genotype, No. of leaves/plant (6.85 and 6.88 leaves) with 1866-Behairy followed by New Valley respectively, total chlorophyll concentration in leaves (44.60 mg/$m^2$) with 1866- Behairy, the lowest fresh weight (83.72 and 104.28 g/plant) with Composite 12 and Composite 17, respectively, dry weight (13.54 g/plant) recorded by Composite 12, the lowest average bulb (52.15g) with New Valley, Bulbs diameter (5.73 cm) with 024.001.2014, Percentage of single bulbs (88.85 %) with Nubaria Dsr, Percentage of double bulbs (0.19 %) with New Valley, Percentage of bolters (0.35 %) with 024.001.2014, total yield (11.67 tons/fed), and the lowest Marketable yield (11.17 tons/fed), receptively. These results are in less/more agreement with those recorded by Lai *et al*. (1994), Gamie and Yaso (2007), Yaso (2007), Bettoni *et al*. (2012) and Kattak *et al*. (2013) who indicated that there were significant differences among onions genotypes.

**Table (3). Average of growth and yield attributes for 14 onion genotypes evaluated under calcareous soils as combined analysis of two seasons.**

| Genotypes | Plant height (cm) | No. of leaves/plant | Total chlorophyll ($mg/m^2$) | Fresh weight (g/plant) | Dry weight (g/plant) | Number of days to maturity |
|---|---|---|---|---|---|---|
| Composite 16 White | 61.25de | 7.82 a | 46.09de | 99.69d | 17.32cd | 142.10de |
| Composite 16 Large oblong | 64.94bcd | 7.45abc | 59.65a | 107.67d | 17.99bcd | 140.20e |
| Composite 12 | 67.98abc | 7.23bcd | 50.65bcde | 83.72d | 13.54d | 145.50cd |
| Composite 17 | 67.92abc | 7.36bc | 52.18bcd | 104.28d | 16.88cd | 142.30de |
| 1866- Behairy | 67.00abc | 6.85d | 44.60e | 112.60d | 15.85cd | 141.70de |
| New Valley | 66.86abc | 6.88 d | 51.07bcd | 137.64cd | 22.69bc | 151.90ab |
| Giza Red B | 67.66abc | 7.39abc | 51.37bcd | 218.75b | 26.20ab | 153.00ab |
| Nubaria Dsr | 68.10ab | 7.38abc | 50.16bcde | 191.95bc | 19.68bcd | 144.40de |
| Shandawil | 64.30cd | 7.39 abc | 53.03bc | 198.69bc | 30.78a | 143.50de |
| Giza 6 Mohassan | 69.44a | 7.48abc | 51.48bcd | 223.11b | 26.21ab | 155.10a |
| Giza 20 | 68.85a | 7.51abc | 51.64 bcd | 328.09a | 33.43a | 155.80a |
| Giza Red | 66.64abc | 7.55ab | 47.01cde | 234.41b | 30.88 a | 154.10ab |
| 024.001.2014 | 58.08e | 7.51abc | 54.23ab | 194.71bc | 22.47bc | 149.80bc |
| Yellow Creole | 69.16a | 7.06cd | 49.04bcde | 238.22b | 31.76 a | 145.70cd |
| LSD at 0.05 | 3.73 | 0.454 | 6.24 | 75.120 | 7.779 | 4.67 |

Means at the same column followed by the same letter are not significantly different according to L.S.D. at 0.05 value.

**Table (4). Average of yield attributes for 14 onion genotypes evaluated under calcareous soils as combined analysis of two seasons.**

| Genotypes | Average bulb weight (g) | Bulbs diameter (cm) | Percentage of single bulbs | Percentage of double bulbs | Percentage of bolters | Total yield (tons/fed.) | Marketable yield (tons/fed.) |
|---|---|---|---|---|---|---|---|
| Composite16 White | 60.15defg | 6.79abc | 92.02e | 2.49cde | 4.63ab | 14.47c | 13.34bc |
| Composite16 Large oblong | 69.70bc | 6.99 a | 95.41bcd | 0.71f | 3.88abc | 17.73 a | 16.98 a |
| Composite 12 | 59.95 efg | 6.67abcd | 97.25 ab | 1.49def | 1.63ef | 14.63bc | 13.94bc |
| Composite 17 | 56.10fg | 6.92ab | 96.31abc | 1.71cdef | 1.08efg | 14.64bc | 14.21bc |
| 1866- Behairy | 63.00cdef | 6.37cde | 96.02 abc | 1.22ef | 3.12cd | 15.02bc | 14.40b |
| New Valley | 52.15 g | 6.61abcd | 95.53abcd | 0.190 f | 4.21abc | 11.67e | 11.17e |
| Giza Red B | 68.95bcd | 6.45 bcde | 96.70abc | 1.43def | 0.92fg | 14.86bc | 14.36b |
| Nubaria Dsr | 76.15ab | 6.20 defg | 88.85 f | 6.60a | 0.55fg | 15.87b | 14.15bc |
| Shandawil | 59.95efg | 6.39cde | 93.83cde | 2.73cde | 3.56bc | 12.36de | 11.64de |
| Giza 6 Mohassan | 71.50abc | 6.26cdefg | 95.54abcd | 3.14c | 1.15efg | 14.05c | 13.51bc |
| Giza 20 | 71.80abc | 6.36 cdef | 92.75de | 5.01b | 2.24de | 14.82bc | 13.86bc |
| Giza Red | 68.05bcde | 5.83 fg | 96.32abc | 2.90cd | 1.23efg | 15.35bc | 14.69b |
| 024.001.2014 | 79.35 a | 5.73 g | 98.35a | 0.64f | 0.35g | 14.00c | 13.89bc |
| Yellow Creole | 76.25ab | 6.02 efg | 92.08e | 0.80f | 4.78a | 13.94cd | 12.91de |
| LSD at 0.05 | 8.864 | 0.529 | 2.92 | 1.52 | 1.20 | 1.62 | 1.38 |

Means at the same column followed by the same letter are not significantly different according to L.S.D. at 0.05 value.

## CONCLUSION

Considering the obtained results, it can be concluded that Composite 16 large oblong genotype recoded the highest total and market yield of onion under drip irrigation in Nubaria Region, Alexandria, Egypt.

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## الملخص العربى

# تقييم بعض التراكيب الوراثية لمحصول البصل تحت ظروف الأراضى الجيرية

**محمود عبد العزيز جمعة[١]، فتحي إبراهيم رضوان[١]، اسماعيل عبد اللطيف ياسو[٢]، عصام إسماعيل قنديل[١] ، محمود صالح عبد الجواد[٢]**

١- قسم الانتاج النباتى – كلية الزراعة سابا باشا – جامعة الاسكندرية – الاسكندرية – مصر

٢- مركز البحوث الزراعية – محطة النوبارية – معهد بحوث المحاصيل الحقلية – قسم البصل

أجريت تجربتان حقليتان بالمزرعة البحثية بمحطة بحوث النوبارية خلال موسمى الزراعة ٢٠١٤/٢٠١٥ و٢٠١٥/٢٠١٦ فى تصميم القطاعات العشوائية الكاملة فى ٥ مكررات لتقييم ١٤ تركيب وراثي من البصل المصري تحت ظروف التربة الجيرية ونظام الري بالتنقيط لزيادة الدخل عن طريق زيادة محصول الفدان واستخدام الأصناف عالية الجودة التصديرية . وكانت أهم الصفات المدروسة :

١- التقديرات الفسيولوجية: عدد الأوراق/نبات – ارتفاع النبات (سم) – الوزن الجاف(جم)/نبات – الوزن الرطب (جم)/نبات – تركيز الكلورفيل الكلي فى الأوراق.

٢- صفات المحصول (فترة النضج – المحصول الكلى/فدان – المحصول المسوق/فدان – قطر البصيلة (سم) – متوسط وزن البصلة (جم) – نسبة البصل المفرد – نسبة البصل المزدوج – نسبة التزهير المبكر.

**ولخصت النتائج فيمايلى:**

- يوجد أختلافات معنوية بين موسمين الزراعة وتحليل التباين المجمع للموسمين.
- يوجد اختلافات معنوية بين الـ ١٤ تركيب وراثية من البصل المصري فى معظم الصفات الفسيولوجية والمحصولية خلال التحليل التباين المجمع.
- التركيب الوراثى Composite 16 Large Oblong للبصل المصري سجل أعلى القيم فى الصفات الأتية (تركيز الكلورفيل فى الأوراق – قطر البصيلة – والمحصول الكلى (طن/فدان) – ومحصول التسويق (طن/فدان) – كما أن

هذا التركيب الوراثى أعطى أقل عدد أيام للنضج (كصنف مبكر) مقارنة بباقى التراكيب الوراثية تحت الدراسة وفى حين ان بعضها اعطت قيم عالية فى بعض الصفات الهامة تحت الدراسة.

**التوصية:**

- يوصى البحث بزراعة التركيب الوراثى Composite Large Oblong تحت ظروف الأراضى الجيرية ونظام الري بالتنقيط فى منطقة النوبارية ولا سيما الظروف المثالية ، كما يمكن الأستفادة من باقى التراكيب الوراثية فى برامج التربية لزيادة محصول الفدان من البصل وجودته وبالتالى زيادة الدخل القومى عن طريق تصديره .