# Influence of Different Planting Date on the Performance of New Garlic Genotypes Grown Under El-Minia Governorate Conditions

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**Abstract:** Field experiments were conducted in the 2010/2011 and 2011/2012 seasons at the Experiment Farm of Mallawy Agriculture Research Station, Institute of Horticulture Research, A.R.C., Giza, Egypt. The objective of the study was to find out appropriate planting time for two colored and two white skin garlic genotypes to overcoming the problem of yield decline under El-Minia Governorate conditions. These problems are commonly attributed to the use of poorly adapted planting material. Three planting dates, viz. September, 7; October, 10 and November, 1) (in the first season) and September, 11; October, 10 and November, 1 (in the second season) and two white skin color (Egyptian, Clone 24) and two red skin color (Sids-40, Egaseed 1) were tested. The results obtained revealed that plant height, No. cloves/bulb, bulb diameter, bulb clove weight, yield (ton/fed.) were higher at, early planting date for the white garlic genotype "Clone 24" followed by "Egyptian". Sowing date for colored garlic genotypes affected yield and yield component and October, 10 date gave the higher values. The lowest yield and higher disease incidence % of leaf blight was scored at the late of planting date (November, 1) with all tested genotypes. So, the white garlic genotypes (Egyptian and Clone 24) must be planted early in the mid of September (7-10) while, colored genotypes (Sids-40 and Egaseed 1) could be planted in the mid of October under El-Minia Governorate conditions Moreover, cultivar Egaseed-1 ranked the first for whole plant weight, bulb weight, clove weight, yield as ton/fed. as well as bulb and leaf TSS followed by Sids-40 when planted in 10 Oct. All tested genotypes gave the lowest values when planted early in the 1st of November in both seasons under El-Minia Governorate conditions.
[N. S. Youssef and Tony, H. S.H. **Influence of Different Planting Date on the Performance of New Garlic Genotypes Grown Under El-Minia Governorate Conditions.** *Nat Sci* 2014;12(5):112-119]. (ISSN: 1545-0740). http://www.sciencepub.net/nature. 15

**Key words:** garlic genotypes**,** planting dates**,** early planting, bulb diameter, yield, leaf blight.

## 1. Introduction

Garlic (*Allium sativum* L.) is a bulb crop belonging to the family *Alliaceae*. It is the second most widely cultivated crop in the family after onion (*Allium cepa* Hamma *et al.* (2013). Egypt ranks the fourth leading country in the world for garlic production (244.626 MT) after China, India and Korea (FAO, 2011 and Abou El-Magd *et al*., 2012). The economic importance of the garlic crop has increased considerably in the entire world in recent years. The most suitable sowing date and planting density are very important management practices in garlic production (Khodadadi and. Nosrati 2012). Garlic has a wide area of adaptation and cultivation throughout the world (Etoh, and Simon, 2002). Among garlic cultivars and clones, the morphological and genetic variations are great and the great differences can be found in most of the garlic characteristics, i.e. plant height, shoot fresh weight, bulb weight, bulbing ratio, yield, T.S.S, and storage ability (Osman and Abd El-Hameid, 1990 and 1994. Gad El-Hak and Abd El-Mageed, 2000 and Metwally and El-Denary, 2003. Põldma, *et al.* (2005) showed that the highest yield of garlic was obtained when planting time 1-1.5 months before diurnal temperature remained constantly below 0°C. Kilgori, *et al.* (2007) found that the bulb yield in planting date of 13 November and 14 December is greater than planting date of 28 December. They attributed this result to availability of more favorable temperature conditions in the planting date of 13 November and 14 December. With the delay in planting time from Oct 30, yield was reduced in later plantings (Swati *et al*., 2013)

Jones and Mann (1963) reported that garlic yields depend on the amount of vegetative growth made before bulbing. Raham and Talukdar (1986) found that large vegetative plants that developed under cool temperature and short photoperiod produced the highest yields and also, showed that early planting increased significantly the weight of bulb and yield.

Mathew *et al.*, (2011) show that garlic genotypes vary significantly in response to long photoperiod, and that in some clones the treatment enhances florogenesis, flower stalk elongation and bulbing. Swati *et al*., (2013) showed that with the delay in planting time from Oct 30 yield was reduced in later plantings. The performance of garlic largely depends on the time of planting as the vegetative growth is

encouraged under short day and cool temperature. While long day and high temperature is favorable for better bulb development (Subrata *et al*., 2010).

Volk and Stern (2009) have shown that clove number, clove skin coloration, and topset number are representative of cultivar type across growth locations, whereas phenotypic traits such as bulb wrapper color, bulb size, and bulb elemental composition were specific to sites. Waterer and Schmitz, (1994) observed that bulb size, yield, and flavor influenced by growth environment, cultivar, and production year Rahman and Talukda, (1986) observed that early planting increased significantly the weight of bulb and yield. In Egypt, There were great variations on the production of different garlic genotypes (Maksoud and El-Oksh, (1983); Osman and Abd El-Hameid, (1990 and 1994); Metwally and Zanata, (1996); Gad El-Hak and Abd-El Mageed, (2000) and Metwally and El-Denary, (2003).

The objective of this work aims to overcoming the problem of yield decline and to search about more new garlic genotypes suitable for grown and good production under El-Minia governorate conditions.

## 2. Materials and Methods

A two-years field study was executed during the two winter seasons of 2010/2011 and 2011/2012 at Mallawy Agriculture Research Station, El-Minia Governorate, Horticulture Research Institute, Horticulture Research Centre, Giza, Egypt. The objective of the study was to find out appropriate planting time of different garlic genotypes having good yield and quality under El-Minia Governorate conditions. The treatments consisted of four garlic genotypes [two white skin color namely Egyptian (local) and Clone 24 and two, red skin color namely Sids-40 and Egaseed 1. The source and color of the tested garlic genotypes were listed in Table1 and Fig1. These four genotypes were planted in three dates, viz. September, 7; October, 10 and November, 1 in the first season and September, 11; October, 10 and November, 1 in the second season. The treatments were laid out in split- blot design with three replications. The tested genotypes were randomly arranged in the main plots, while, planting dates were assigned to the sub-plots. The size of the sub-plots was 10.5 $m^2$ (1/400fed.), each sub-plot consisted of 5 rows, 60 cm wide and 3.5 m long. Prior to planting, the field was irrigated (2-3 days) in order to provide good clove-soil- water contact. Healthy garlic bulbs were split into the individual cloves. The cloves were chosen for size homogenate and free from all defects, then soaked in water over-night. Cloves were planted on both sides of each ridge at 10 cm apart. Fertilization and other culture practices were carried out as recommended. The average of maximum and minimum temperature during the growth seasons under El-Minia Governorate conditions were listed in Table 2. Samples of 10 plants were taken randomly from each sub-plot at 160 days after planting and their plant height, number of green leaves /plant and fresh weight of whole plant and leaf TSS were recorded. Plants of each planting time were harvested manually when older leaves turned yellowish green and only three to five green leaves remained, as recommended by Engelman (1991). The harvested plants were cured in an open space for 21 days and then the following traits were estimated on samples of 10 plants, bulb weight, bulb diameter, bulbing ratio, number of cloves per bulb, clove weight per bulb, total yield per feddan, and bulb TSS were recorded. Total soluble solid contents (TSS) were determined by squeezing the tissue and placing one drop of juice from each sample into a refractometer (Mahdieh Najafabadi *et al.* 2012). Also, the leaf blight diseases caused by **a** fungus was determined. All data were subjected to statistical analysis of variance according to the procedure outlined by Gomez and Gomez, (1984).

## 3. Results and Discussion:

Table 3 clearly showed that time of planting had a significant effect on vegetative growth characters i.e. plant height, number of green leaves, fresh weight of whole plant and bulb weight. The highest plant height was recorded from Sept. $7^{th}$ and $11^{th}$ (81.20.and 84.94 cm) in the first and second season respectively. While, Nov. 1 plantation produced the lowest plant height (67.0 and 71.51 cm) in the two seasons. The maximum number of leaves was counted in Sept. $7^{th}$ (11.03) in the first season and Oct. $10^{th}$ (11.72) in the second season, but Nov. $1^{st}$ date gave the lowest number of leaves (10.20 and 9.80). The highest weight of whole plant, and bulb weight also, were attained with early plantation (Sept. $7^{th}$ and $11^{th}$). The results may be due to that earliest plantation encourage meristimatic elongation and cell division which encourage the vegetative growth of the plants that received low temperature and short day length. The results are in agreement with those reported by Sultana *et al.* (1997) and Rahim *et al.* (1984). The beneficial influence on plant height due to early planting has been reported by Qaryouts and Kasarawi (1995).

Table 1: Source and bulb skin color of the tested garlic genotypes.

| Genotype | Bulb skin color | Source |
|---|---|---|
| Egaseed 1 | Slightly red | The Agricultural Egyptian Company for Seed Production, Egypt. |
| Egyptian | White | Department of Horticulture, Faculty of Agriculture, Minia University, Minia, Egypt.. |
| Clone, 24 | White | Sids Horticultural Research Station, Agricultural Research Center, Giza, Egypt |
| Sids -40 | Slightly red | Sids Horticultural Research Station, Agricultural Research Center, Giza, Egypt. |

Table 2: Monthly temperature (°C) and relative humidity (%) at El-Minia Governorate during 2010/2011 and 2011/2012 seasons.

| Months | 2010/2011 | | | 2011/2012 | | |
|---|---|---|---|---|---|---|
| | Temperature $^0$C | | Mean | Temperature $^0$C | | Mean |
| | Max | Min | | Max | Min | |
| September | 35.12 | 20.30 | 27.71 | 34.02 | 19.61 | 26.81 |
| October | 33.71 | 18.43 | 26.07 | 30.63 | 16.29 | 23.46 |
| November. | 28.41 | 13.49 | 20.95 | 23.03 | 8.42 | 15.72 |
| December | 23.15 | 8.04 | 15.59 | 20.16 | 6.08 | 13.12 |
| January | 18.83 | 5.82 | 12.32 | 18.78 | 3.17 | 10.97 |
| February | 23.62 | 8.26 | 15.94 | 20.80 | 5.80 | 13.30 |
| March | 23.92 | 8.85 | 16.38 | 23.38 | 6.61 | 14.99 |
| April | 29.75 | 13.08 | 21.41 | 31.67 | 12.57 | 22.12 |


Fig.1 Garlic genotypes of white skin color (Egyptian and Clone 24) and red skin color (Sids -40 and Egaseed 1)


Fig.2. Sectioned of garlic bulb of white skin color (Egyptian and Clone 24) and red skin color (Sids -40 and Egaseed 1)

Table 3: Effect of planting dates on plant height, No. green leaves/plant, fresh weight of whole plant and bulb weight of garlic genotypes during the growth seasons of 2010/2011 and 2011/2012.

| Planting dates | Plant height, cm | | No. green leaves/plant | | Weight of whole plant,g | | Bulb weight,g | |
|---|---|---|---|---|---|---|---|---|
| | 2010/11 | 2011/12 | 2010/11 | 2011/12 | 2010/11 | 011/12 | 2010/11 | 2011/12 |
| Sept.,7,11 | 81.2 | 84.94 | 11.03 | 11.14 | 144.6 | 176.6 | 65.62 | 82.54 |
| Oct., 10 | 79.5 | 84.03 | 10.73 | 11.72 | 140.0 | 163.6 | 66.14 | 77.92 |
| Nov., 1 | 67.0 | 71.51 | 10.20 | 9.80 | 67.9 | 100.5 | 42.31 | 60.25 |
| L.S.D.0.05 | 2.47 | 1.93 | 0.32 | 0.39 | 2.78 | 15.52 | 2.06 | 2.57 |
| | ** | ** | ** | ** | ** | ** | ** | ** |

Garlic genotypes were differed significantly from each other on plant height, number of green leaves/plant, fresh weight of whole plant and bulb weight (Table, 4). The highest plant height was recorded with the local garlic genotypes "Egyptian" (92.2 cm and 92.68 cm) followed by garlic genotype "Clone 24". The highest number of green leaves (11.07 and 11.26) were obtained from garlic genotype "Sids-40" but the weight of whole plant (128g. and 170.70g) and bulb weight (64.79g and 84.56g) in the first and second season, respectively, was recorded with garlic genotype "Egaseed 1". Colored genotype performed better than that of white genotype. This result may be due to genetic variation of garlic genotype. More favorable temperature conditions when growing garlic in the planting date of Sept.7$^{th}$ and 11$^{th}$ and Oct., 10$^{th}$. gave adequate vegetative growth of plants (Maksoud *et al*. 1984).

Table 4: Effect of garlic genotypes on plant length, No. green leaves/plant, fresh weight of whole plant and bulb weight during the growth seasons of 2010/2011 and 2011/2012.

| Genotypes | Plant height, cm | | No. green leaves/plant | | Weight of whole plant,g | | Bulb weight,g | |
|---|---|---|---|---|---|---|---|---|
| | 2010/11 | 2011/12 | 2010/11 | 2011/12 | 2010/11 | 2011/12 | 2010/11 | 2011/12 |
| Egyptian | 92.2 | 92.68 | 10.28 | 10.69 | 124.8 | 142.4 | 51.22 | 70.50 |
| Clone 24 | 78.6 | 79.93 | 10.83 | 11.17 | 118.8 | 114.0 | 58.02 | 64.11 |
| Sids-40 | 66.3 | 76.62 | 11.07 | 11.26 | 98.3 | 160.5 | 58.06 | 75.11 |
| Egaseed 1 | 66.6 | 71.41 | 10.43 | 10.42 | 128.0 | 170.7 | 64.79 | 84.56 |
| L.S.D.0.05 | 1.14 | 2.72 | 0.45 | 0.58 | 1.66 | 21.70 | 5.68 | 4.68 |
| | ** | ** | * | * | ** | ** | ** | ** |

Interaction effects of date of planting and garlic genotypes showed significantly effects on plant height, number of green leaves/plant, weight of whole plant, and bulb weight in the two seasons except weight of whole plant in the second season recorded insignificant effect (Table 5). The highest plant height was recorded with the genotype "Egyptian" in early planting Sept.7 and 11 in both seasons. Late planting in Nov. 1$^{st}$ gave the lowest values with all tested genotypes. Garlic genotypes "Sids-4o" and Clone 24 gave the highest number of green leaves in Sept. 7$^{th}$ in the first season (12.2) and in Sept. 11 for Clone 24 in the second season. (12.43). Concerning to weight of whole plant and bulb weight, garlic genotypes "Egaseed 1" produced the heaviest weight of whole plant and bulb weight/ in Oct., 11$^{th}$ in the two seasons. These results confirmed the previous one and lead to conclude that adequate vegetative growth of garlic plants needs more growing days.

Table 5: Combined effect of garlic genotypes and planting dates on the plant length, No. green leaves/plant, fresh weight of whole plant and bulb weight during the growth seasons of 2010/2011 and 2011/2012.

| Genotypes | Planting dates | Plant height ,cm | | No. green leaves/plant | | Weight of whole plant,g | | Bulb weight,g | |
|---|---|---|---|---|---|---|---|---|---|
| Local genotype | | 2010/11 | 011/12 | 2010/11 | 2011/12 | 2010/11 | 2011/12 | 2010/11 | 011/12 |
| (Egyptian) | Sept., 7,11 | 105.0 | 99.70 | 10.50 | 11.00 | 172.5 | 177.3 | 73.67 | 80.50 |
| | Oct., 11 | 96.5 | 97.67 | 10.33 | 11.53 | 143.0 | 163.9 | 50.67 | 78.00 |
| | Nov., 1 | 75.0 | 80.67 | 10.00 | 9.53 | 59.0 | 86.0 | 29.33 | 53.00 |
| Clone 24 | Sept., | 85.8 | 86.33 | 10.40 | 12.43 | 174.3 | 150.1 | 70.00 | 83.33 |
| | Oct., 11 | 76.0 | 82.47 | 11.60 | 11.73 | 121.0 | 123.8 | 62.83 | 61.00 |
| | Nov., 1 | 74.0 | 71.00 | 10.50 | 9.33 | 61.2 | 68.0 | 41.23 | 48.00 |
| Sids-40 | Sept., 7,11 | 67.8 | 82.07 | 12.20 | 11.11 | 115.0 | 194.3 | 61.60 | 81.33 |
| | Oct., 11 | 74.0 | 78.77 | 11.00 | 12.35 | 109.0 | 167.1 | 64.23 | 78.00 |
| | Nov., 1 | 57.0 | 69.03 | 10.00 | 10.33 | 71.0 | 120.0 | 48.33 | 66.00 |
| Egaseed 1 | Sept., | 66.2 | 71.67 | 11.00 | 10.00 | 116.6 | 184.5 | 57.20 | 85.00 |
| | Oct., 11 | 71.6 | 77.23 | 10.00 | 11.27 | 187.0 | 199.7 | 86.83 | 94.67 |
| | Nov., 1 | 62.0 | 65.33 | 10.30 | 10.00 | 80.5 | 128.0 | 50.33 | 74.00 |
| L.S.D.0.05 | | 2.28 | 5.44 | 0.64 | 0.79 | 5.56 | 31.05 | 4.12 | 5.15 |
| | | ** | * | ** | ** | ** | NS | ** | ** |

Time of planting had significant effect on mean bulb diameter, yield ton/fed, clove weight and number of cloves per bulb (Table 6). Early planting in Sept. 7th, 11th produced highest values of yield ton/fed. and number of cloves/bulb but in Oct. 10th for bulb diameter and clove weight per bulb were higher. Late planting (Nov.,1) gave the lowest values. Bulb size and yield influenced by growth environment, cultivar and production year as reported by (Waterer and Schmitz, (1994). The results of this study are in agreement with Rahim, (1988) who showed that delay planting time reduced significantly the number of cloves and clove size. It may be due to that plant did not receive a long cool growing period which was essential for the development of the bulb (Swati *et al*., 2013).

Table 6: Effect of planting dates on bulb diameter, yield (ton/fed.), clove weight and No. cloves/bulb of garlic genotypes during the growing seasons of 2010/2011 and 2011/2012.

| Planting dates | Bulb diameter,cm | | No. cloves | | Clove weight | | yield (ton/fed) | |
|---|---|---|---|---|---|---|---|---|
| | 2010/11 | 011/12 | 2010/11 | 2011/12 | 2010/11 | 2011/12 | 2010/11 | 2011/12 |
| Sept.,7,11 | 5.57 | 6.99 | 34.20 | 34.82 | 2.35 | 3.22 | 10.01 | 10.98 |
| Oct., 10 | 6.03 | 6.82 | 32.01 | 33.78 | 2.82 | 3.25 | 9.19 | 9.80 |
| Nov., 1 | 5.17 | 5.81 | 26.67 | 27.70 | 2.10 | 2.52 | 5.07 | 6.52 |
| | 0.24 | 0.21 | 2.36 | 1.23 | 0.12 | 0.24 | 0.26 | 0.49 |
| L.S.D.0.05 | ** | ** | ** | ** | ** | ** | ** | ** |

The obtained results (Table 7) showed significant differences among all garlic genotypes in bulb diameter, yield ton/fed., clove weight and number of cloves per bulb. Cultivar Egaseed-1 surpassed the other genotypes in its yield ton/fed. and clove weight followed by Sids-40 in both seasons, while Egyptian and Clone 24 ranked the last position in this respect. Garlic genotype "Clone 24" gave the highly significant increase in the number of cloves per bulb (49.51 and 53.38) in both seasons and in bulb diameter, (5.95cm) in the first season. The lowest number of cloves per bulb was given by Sids- 40 (12.87 and 15.38). The rest variation between the two seasons may be due to climatic changes. The previous significant differences on growth characters among various garlic cvs were confirmed by the results of Hussain *et al,* (1995); Moustafa *et al,* (2009) and Aly (2010). The performance of garlic largely depends on the time of planting as the vegetative development needs short day and cool temperature, while long day and high temperature are favorable conditions for better bulb development (Subrata *et al*., 2010).

Table 7: Effect of garlic genotypes on bulb diameter, yield (ton/fed.), mean clove weight and No. cloves/bulb during the growth seasons of 2010/2011 and 2011/2012.

| Genotypes | Bulb diameter, cm | | No. cloves | | Clove weight, g | | yield ton/fed | |
|---|---|---|---|---|---|---|---|---|
| | 2010/11 | 2011/12 | 2010/11 | 2011/12 | 2010/11 | 2011/12 | 2010/11 | 2011/12 |
| Egyptian | 5.61 | **6.75** | 47.16 | 42.64 | 1.06 | 1.56 | 7.82 | 8.83 |
| Clone 24 | **5.95** | **6.34** | **49.51** | **53.38** | 1.10 | 1.12 | 7.46 | 7.20 |
| Sids-40 | 5.09 | **6.39** | 12.87 | 15.38 | 3.32 | 4.65 | 8.07 | 9.63 |
| Egaseed 1 | 5.71 | **6.67** | 14.30 | 17.00 | **4.23** | **4.65** | **9.02** | **10.73** |
| | 0.29 | **0.34** | 2.09 | 1.37 | 0.36 | 0.22 | 0.54 | 0.45 |
| L.S.D.0.05 | ** | **NS** | ** | ** | ** | ** | ** | ** |

The interaction of date of planting and garlic genotypes showed significant effect for all traits except yield per/fed. in the second season which showed insignificant effect (Table 8). Genotype "Egyptian" and "Clone 24" showed the highest bulb diameter and number of clove per bulb in the three planting dates of both seasons. Genotype "Egaseed-1" ranked the highest yield and mean clove weight in Oct., 10 in both seasons. The lowest values for all characteristics in the tested genotypes were observed in the late planting time at Nov., 1. in the two seasons. Rahman and Talukda, (1986) observed that early planting increased significantly the weight of bulb and yield. Highest bulb weight may be due to receive of sufficient cool and dry weather which possibly increased the vegetative growth and subsequently yield of bulb (.Swati *et al*., 2013).

Total soluble solids of bulb and leaves are one of the most important traits of garlic for processing, storage and export. These traits are influenced by date of planting (Table 9). Bulb and leaves TSS significantly affected by date of planting in both seasons except leaves TSS in the first season. The highly significant increase in TSS was shown when the planting date was in Oct, 10 for bulb (34.29 and 30.0) and in Nov, 1 for leaves (13.91 and 11.33Brix) in the first and second season respectively. Concerning percentage of leaf blight disease, data shown that early date gave the least % of leaf blight, while late plantation encourages the severity of leaf blight disease in both seasons.

Data in Table (9) showed significant differences among garlic genotypes with regard to bulb TSS, Leaves TSS and leaf blight disease incidence (Table 10). Maximum TSS was recorded with the garlic red skin color cultivar Egaseed 1, (36.69) in the first season and Sids-40 (30.96) in the second season. The lowest bulb TSS values were recorded with the garlic white skin color Clone 24, (28.66 and 25.61) compared to local genotype "Egyptian", (31.80 and 26.19) in the first and second season respectively. The lowest leaf blight disease percentage was recorded with garlic white skin color cultivar "Egyptian" which recorded (16.06 and 8.70 %) followed by "Egaseed 1".(21.72 and 13.59 %) in both seasons. Garlic genotype "Sids-40" showed the highly significant increase in leaf blight disease percentage (28.51 and 28.93 %) followed by "Clone 24" (22.40 and 22.30 %) in the first and second seasons, respectively. The variation among garlic genotypes for its response to leaf blight disease may be due to the genetic effect. However, further studies should be done in this respect.

Table 8: Interaction effect of garlic genotypes and date of planting on bulb diameter, yield (ton/fed.), mean clove weight and No. cloves/bulb during the growing seasons of 2010/2011 and 2011/2012.

| Genotypes | Planting dates | Bulb diameter | | No. cloves | | Clove weight | | Yield ton/fed | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2010/11 | 2011/12 | 2010/11 | 2011/12 | 2010/11 | 2011/12 | 2010/11 | 011/12 |
| Egyptian | Sept., 7,11 | 6.34 | 7.62 | 54.67 | 40.47 | 1.46 | 1.94 | 10.35 | 10.64 |
| | Oct., 10 | 5.43 | 6.92 | 49.67 | 46.67 | 0.90 | 1.63 | 8.58 | 9.83 |
| | Nov., 1 | 5.07 | 5.70 | 37.13 | 40.80 | 0.81 | 1.11 | 4.54 | 6.03 |
| Clone 24 | Sept., 7,11 | 6.62 | 7.03 | 55.53 | 65.13 | 1.29 | 1.19 | 10.45 | 9.01 |
| | Oct., 11 | 6.49 | 6.55 | 50.33 | 55.80 | 1.06 | 1.10 | 7.26 | 7.42 |
| | Nov., 1 | 4.73 | 5.44 | 42.67 | 39.20 | 0.94 | 1.07 | 4.66 | 5.19 |
| Sids-40 | Sept., 7,11 | 4.64 | 6.56 | 11.67 | 16.87 | 3.07 | 4.77 | 9.23 | 11.66 |
| | Oct., 10 | 5.40 | 6.62 | 13.27 | 14.93 | 4.05 | 5.10 | 9.70 | 10.02 |
| | Nov., 1 | 5.23 | 6.00 | 13.67 | 14.33 | 2.85 | 4.08 | 5.27 | 7.20 |
| Egaseed -1 | Sept., 7,11 | 4.69 | 6.73 | 14.93 | 16.80 | 3.79 | 4.99 | 10.00 | 12.60 |
| | Oct., 10 | 6.78 | 7.19 | 14.77 | 17.73 | 5.28 | 5.16 | 11.22 | 11.92 |
| | Nov., 1 | 5.66 | 6.10 | 13.20 | 16.47 | 3.60 | 3.81 | 5.83 | 7.68 |
| L.S.D.0.05 | | 0.49 | 0.42 | 0.53 | 4.72 | 2.46 | 0.49 | 0.53 | 0.97 |
| | | ** | ** | ** | ** | ** | * | ** | NS |

Table 9: Effect of planting dates on bulb TSS, leaf TSS and leaf blight disease of garlic genotypes during the growth seasons of 2010/2011 and 2011/2012.

| Planting dates | Bulb TSS ($^0$Brix) | | Leaf TSS ($^0$Brix) | | Leaf blight % | |
|---|---|---|---|---|---|---|
| | 2010/11 | 2011/12 | 2010/11 | 2011/12 | 2010/11 | 2011/12 |
| Sept.,7,11 | 32.45 | 27.91 | 13.62 | 13.98 | 19.72 | 17.70 |
| Oct., 10 | 34.29 | 30.00 | 13.49 | 13.24 | 12.35 | 19.63 |
| Nov., 1 | 32.81 | 26.92 | 13.91 | 11.33 | 34.45 | 17.75 |
| L.S.D.0.05 | 0.54 | 1.63 | 0.45 | 0.75 | 0.88 | 0.94 |
| | ** | ** | NS | ** | ** | ** |

Table 10: Effect of garlic genotypes on bulb TSS, leaves TSS and % leaf blight disease during the growing seasons of 2010/2011 and 2011/2012.

| Genotypes | Bulb TSS | | Leaf TSS | | Leaf blight % | |
|---|---|---|---|---|---|---|
| | 2010/11 | 2011/12 | 2010/11 | 2011/12 | 2010/11 | 2011/12 |
| Egyptian | 31.80 | 26.19 | 12.53 | 11.85 | 16.06 | 8.70 |
| Clone 24 | 28.66 | 25.61 | 11.50 | 9.63 | 22.40 | 22.32 |
| Sids-40 | 35.59 | 30.96 | 15.71 | 14.65 | 28.51 | 28.93 |
| Egaseed 1 | 36.69 | 30.33 | 14.95 | 15.28 | 21.72 | 13.59 |
| L.S.D.0.05 | 0.79 | 1.19 | 0.52 | 1.09 | 1.71 | 1.19 |
| | ** | ** | ** | ** | ** | ** |

Regarding to the interaction effect between garlic genotypes and date of planting, data showed significantly effects on bulb TSS of bulb in the two seasons and leaves TSS in the first season. Also, leaf blight disease % exhibited significant effect in the both seasons (Table 11). Garlic genotype "Egaseed 1" and "Sids-40"expressed higher bulb TSS in the first season (36.91) and second season (32.67) respectively. Late plantation in Nov, 1 of Sids-40 in the first season and early plantation of garlic "Egaseed 1" in Sept, 11 in the second season showed the highest

leaves TSS. The variation between the first and the second season may be due to the environmental conditions (Table 2). The lowest leaf blight disease value (8.0 %) was recorded with local garlic genotype "Egyptian" in the early planting at Sept,7 in the first season and in Oct, 11 (5.10 %) in the second season. For all tested garlic genotypes, late of plantation in Nov, 1 increased significantly leaf blight disease % incidence and the highest values were recorded in the first season.

Table 11: Interaction effect of garlic genotypes and planting dates on bulb TSS, leaf TSS and leaf blight disease during the growth seasons of 2010/2011 and 2011/2012.

| Genotypes | Planting dates | Bulb TSS | | Leaf TSS | | Leaf blight % | |
|---|---|---|---|---|---|---|---|
| | | 2010/11 | 2011/12 | 2010/11 | 2011/12 | 2010/11 | 2011/12 |
| Egyptian | Sept., 7,11 | 31.91 | 27.75 | 13.30 | 13.32 | 8.00 | 10.33 |
| | Oct., 10 | 34.00 | 29.33 | 12.00 | 11.88 | 10.17 | 5.10 |
| | Nov., 1 | 29.50 | 21.50 | 12.30 | 10.33 | 30.00 | 10.67 |
| Clone 24 | Sept., | 27.25 | 25.17 | 10.50 | 11.00 | 20.00 | 19.88 |
| | Oct., 10 | 29.66 | 26.67 | 12.00 | 9.89 | 15.13 | 35.02 |
| | Nov., 1 | 29.07 | 25.00 | 12.00 | 8.00 | 32.07 | 12.05 |
| Sids-40 | Sept., | 34.00 | 29.70 | 15.00 | 15.64 | 25.23 | 25.20 |
| | Oct., 10 | 36.60 | 32.67 | 15.37 | 15.32 | 15.21 | 30.00 |
| | Nov., 1 | 36.17 | 30.50 | 16.75 | 13.00 | 45.09 | 31.60 |
| Egaseed 1 | Sept., 7,11 | 36.65 | 29.00 | 15.66 | 15.97 | 25.64 | 15.70 |
| | Oct., 10 | 36.91 | 31.33 | 14.58 | 15.88 | 8.89 | 8.40 |
| | Nov., 1 | 36.50 | 30.67 | 14.60 | 14.00 | 30.64 | 16.67 |
| L.S.D.0.05 | | 1.09 | 3.27 | 0.91 | 1.50 | 1.77 | 1.87 |
| | | ** | * | ** | NS | ** | ** |

These results may be attributed to the availability of more favorable temperature conditions in the planting dates to the adequate development of disease pathogen(s).

**Conclusion:**

This study has shown that planting date and garlic genotypes had significant effects on garlic economic yield and its components under El-Minia governorate condition. Delaying planting date to the first of November significantly reduced yield and its components. On the other hand, early planting date resulted in heavy bulbs and high yield. However, planting date of 7th September, was better for garlic white skin color (Egyptian and Clone 24) but 10th October, was better for red skin color cultivars Egaseed 1 and Sids-40**.**

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4/12/2014