Testing of Some Garlic (*Allium sativum* L.)
Cultivars under Assiut Conditions

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**Abstract:**
Two field experiments were carried out at the Experimental Farm of the Faculty of Agriculture, Assiut University, Assiut, during winter seasons of 2008/2009 and 2009/2010, to evaluate the growth, bulb characteristics and total yield per feddan in five garlic entries (four cultivars namely; Balady, Chinese, Sids-40 and Egaseed-1 and one clone Egaseed-2). The obtained results showed considerable variation among all these garlic entries for all studied characters. The parameters of vegetative growth i.e., plant height, number of leaves per plant and whole-plant weight showed an increase at the beginning of growing season till 135 days from planting, then deceased towards 155 days. While, bulbing ratio decreased and bulb weight increased with the progress of the plant in age (155 days from planting).

Sids-40 cultivar showed the highest bulb weight with less number of cloves per bulb as well as greater clove weight (as an average of two seasons) compared to all tested entries. Also, it has proved to be high yielding cultivar for total yield per feddan, which surpassed all other entries. On the contrary, Balady cultivar gave the lowest bulb weight, the highest number of cloves per bulb with the minimum clove weight. Also, it produced the lowest total yield per feddan.

**Introduction:**
Garlic (*Allium sativum* L.) is among the important vegetable crops in Egypt for both local marketing and exportation. During the past several years, garlic show considerable decrease in both area and production. In 2000, its area was 33534 feddan and it dropped to 20259 feddan in 2009 (39.6%). The total production was 301270 tons and decreased to 195743 tons in the same respective years (35.0%). Out of this area, 81.6% is located in middle Egypt which also account for 83.3% of the total production during 2009. While, only 1.3 is located in Assiut Governorate which produced 1.6%. (Agricultural Statistics, Bulletin of Winter Crops, Volume 1, 2009)

This reduction in cultivated area and consequently in garlic production is due to the low and unstable yield from season to season. The "Balady" is the main cultivar grown as a winter

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vegetable, which characterized with low yielding capacity and small cloves. Increasing productivity and improving the quality are the primary interest of most garlic investigators. It could be achieved by growing heavy yielding garlic cultivars. Therefore, many new garlic cultivars and clones are appeared in the Egyptian cultivation. However, no enough information is available on the productivity and quality of these cultivars, especially, under Assiut conditions.

The varietal differences of garlic with regard to vegetative growth, yield, bulb and cloves characteristics were reported by several investigators (Shalaby (1973), Maksoud and El-Oksh (1983), Hassan et al. (1990), Gad El-Hak and Abd El-Maged (2000), Singh and Tiwari (2001), Hassan (2002), Tiwari et al. (2002), Pardo-Roldan and Marin (2003), Patil et al. (2003), El-Sayed (2004), Costa et al. (2004), Mohamed et al. (2004), Gowda et al. (2007), Moustafa et al. (2009) and Aly (2010). Pardo and Marin (2003) reported that a wide variations were observed for leaf length, the bulb diameter and bulb weight between two garlic varieties. Patil et al. (2003) showed that the maximum number of leaves per plant, height plant and highest average weight of bulb were recorded by Sel-2 variety compared to other studied varieties.

Experiments on two garlic cultivars were conducted at Beni-Suef Governorate by Mohamed (2004) to improve its productivity. He concluded that Sids-40 had higher values of vegetative growth, bulb characters and total yield as compared with cv. Balady. Baghalian et al. (2005) found that garlic ecotypes from different origins were significantly different for yield, mean bulb weight, mean clove weight, plant height and leaves number. Under Minia conditions, Moustafa et al. (2009) some new imported and locally cultivated garlic genotypes showed significant differences among. Studied conducted by Aly (2010) at Assiut indicate that garlic ecotypes from Balady and ecotype from Chinese significantly differed for all studied characters. The present study was undertaken to investigate the vegetative growth, bulb characteristics and yield per feddan on four different garlic cultivars (Balady, Chinese, Sids-40 and Egaseed-1) and one clone (Egaseed-2) under Assiut conditions.

Materials and Methods

The present study was carried out during the two winter seasons of 2008/2009 and 2009/2010 in a clay soil at the Experimental Farm of Assiut university. Four cultivars and one clone of garlic were used in the study. The sources of these entries were as follows:

1- Balady: garlic cloves of this cultivars were obtained from Mansoura Governorate which grown commercially.
2- Chinese cultivar: (obtained from Prof. Waly, E. A.), which
grown in Experimental Farm of Assiut University.

3- Sids-40: a selected strain of Chinese cultivar, its cloves produced from Sids Hort. Res. Station, Beni-Suef Governorate.

4, 5- Egaseed-1 cultivar and Egaseed-2 clone were obtained from Prof. Gad El-Hak, S. H. Faculty of Agriculture, El-Minia Univ.

Garlic cloves of these entries were planted on 8th and 18th of October in 2008/2009 and 2009/2010 seasons, respectively. In the two seasons, the treatments were arranged in a Latin squares over split-plot (Gomez and Gomez, (1984)). The experimental cultivar plot area was 6.3 m². Each plot consisted of 3 ridges, 3 meters length and 70 cm width. Garlic cloves were hand planted approximately 10 cm apart on both sides of ridges running east to west.

Normal cultural practices of cultivation, irrigation, fertilization, weed and pest control of garlic were followed.

Data were recorded for the following characters:

A- Percent field emergence:
The total emerged plants were counted after 30 days from planting and the percent field emergence calculated according the following formula, reported by Gritsenko and Katoshina (1976):

Field emergence % = (Number of emerged plants / Number of planted cloves) X 100

B- Vegetative growth measurements:

Random samples of three plants from the two outer rows of each plot were taken after 75, 105, 135, 155 days from planting and the following characters were studied:

1- Average plant height (cm): measured from bulb base to top leave blade.
2- Average number of leaves/ plant.
3- Whole-plant fresh weight (g).
4- Bulbing ratio: measured according to Mann's (1952), using the Formula Bulbing ratio = (neck diameter / bulb diameter).
5- Bulb weight (g).

These data were illustrated in histograms.

C- Bulb characteristics and total yield:
After harvesting, plants were left to cure before cutting off dry leaves and roots. The following data were measured as follows:-

1- Average bulb weight (g).
2- Average number of cloves per bulb.
3- Average clove weight (g).
4- Total yield (Ton/ Fed.): represented by weight of all harvested garlic bulbs for each plot and expressed as Ton/ Fed.

Bulb characteristics and data on total yield were subjected to the statistical analysis of variance according to Gomez and Gomez (1984).

Means was compared using the L.S.D. method.

Experimental Results and Discussion

A- Percent field emergence:
Data for this character in both seasons are illustrated in Fig 1. It
is clear that percent emergence was affected by all five garlic entries. Generally, after 30 days from planting, Balady cultivar showed a tendency towards better emergence than other entries in both seasons. Of all tested entries, Egaseed-2 clone recorded the lowest percent emergence. These results agreed with those reported by Moustafa et al. (2009) and Aly (2010) who found that imported and locally cultivated cultivars and ecotypes showed wide variation in their field emergence percentage.

Fig 1. Field emergence, percentage as influenced by garlic cultivars.

B- Vegetative growth measurements:
1- Average plant height (cm)
It is clear that plant height increased with the advance in growing season after 75 days to 135 days from planting, then decreased by 155 days for all garlic entries in both season. The histograms showed that plants of Balady cultivar reached its maximum tall after 135 days from planting, followed by Egaseed-2 clone, in both seasons. While, the shortest plant were obtained from Chinease and Sids-40 cultivars in first and second seasons, respectively (Figure 2a and 2b).
Figure 2. Average plant height (cm) as influenced by garlic cultivars and age of plant.

2- Average number of leaves per plant
As shown in Fig. 3 (a and b), number of leaves per plant increased gradually with the progress of the plants in age (from 75 days to 135 days). On other hand, all cultivars reached their highest value at 135 days except Egaseed-2 clone decreased in its number of leaves per plant compared to 105 days in age. It is evident that highest number of leaves per plant was found in Sids-40, followed by Chinese cultivar at 135 days in age in the first season, while in the second season Egaseed-1 recorded the highest values.
The results showed that weight of whole-plant increased with age of plants till 135 days in both seasons (Figure 4a and 4b). At 155 days from planting, the whole plant weight decreased. In the first season, at 135 days, Egaseed-1 cultivar ranked first for whole-plant weight, followed by Sids-40 and Egaseed-2, while Chinease ranked last. On the contrary, Chinease cultivar showed the highest value, followed by Egaseed-1, while Balady cultivar had the lowest value (in the second season).
Figure 4. Whole-plant fresh weight (g) as influenced by garlic cultivars and age of plant.

4- Bulbing ratio
Data of bulbing ratio are illustrated in Figures 5a and 5b in both seasons. It is clear that bulbing ratio of all garlic entries decreased with the advance in growing season. In other words, bulbing ratio decreased gradually from 75 days to 155 days in age i-e bulb formation increased, in both seasons. Sids-40 cultivar produced the lowest bulbing ratio compared to all other entries in both seasons. The decrease in bulbing ratio in the last age (155 days) may be due to the effect of long photoperiod which produce more storage of nutrients in bulb.
Figure 5. Bulbing ratio as influenced by garlic cultivars and age of plant.

![Diagram showing bulbing ratio over days after planting for different garlic cultivars in two seasons: a. 2008/2009 and b. 2009/2010.]

5- Bulb weight (g)
Data of this character are illustrated in Figures 6a and 6b in the two seasons. In both seasons, bulb weight of all garlic cultivars reached its highest weight at 155 days from planting, except Chinese cultivar reached its highest weight at 135 days from planting, in the second season. Egaseed-2 clone gave the highest average bulb weight in the first season, while Egaseed-1 cultivar gave the highest value in the second season. The increase in the bulb weight of bulbs at late stages of development can be attributed to the accumulation of dry matter in the storage tissues of the bulb.
Figure 6. Bulb weight (g) as influenced by garlic cultivars and age of plant.

Under conditions of the experiment, results of the two seasons showed differences among all garlic entries for all previous characters of growth. Shalaby (1973), Hussein et al. (1995), Mohamed (2004), Moustafa et al. (2009) and Aly (2010) also reported considerable variation among garlic cultivars tested in Egypt. Generally, maximum plant height, number of leaves per plant and whole-plant weight were obtained at 135 days from planting, then decreased till 155 days. This reduction may be due to the dryness of matured plants at 155 days from planting. On the other hand, average bulb weight recorded the maximum at 155 days from planting. These results are in agreement with some findings of Ibrahim (1975), Hussien et al. (1995) and Aly (2010).

Bulbing ratio decreased proportionally with bulb age increase. Aly (2010) reported that bulbing ratio is considered to exist when bulbing ratio is 0.5, after that the increase in size of bulbs is due to the accumulation of nutrients.

C- Bulb characteristics and total yield:
Table 1 presents the five garlic entries- means for the average bulb weight, average number of...
closely per bulb, average clove weight and total yield.

1- Average bulb weight (g).
The result showed significant differences between all entries in average bulb weight, in both seasons. In the first season, the highest bulb weight was found in Sids-40 cultivar. In the second season, the highest value for bulb weight was obtained in clone Egaseed-2. The minimum bulb weight was produced by "Chinese" Cultivar and "Balady" cultivar (39.96 and 15.71 gm) in the first and second seasons, respectively.

2- Average number of cloves per bulb.
This character was significantly affected by all entries of garlic. Number of cloves per bulb for the studied five entries ranged from 27.22 to 9.67 and 15.10 to 9.17 in both seasons, respectively. Cloves number was greatest with cultivar "Balady", followed by cultivar "Egassed-1". Bulbs of cultivar "Sids-40" and clone "Egaseed-2" contained the lowest number of cloves, in both seasons, respectively. However, the differences between the two entries was not significant in the first season only.

3- Average clove weight (g).
Significant differences were observed among the entries of garlic with respect to average clove weight in both seasons. In the first season, Egaseed-2 had heavier clone than the other tested cultivars. While, in the second season, Sids-40 gave the highest value per clove weight, followed by Egaseed-2 clone. The lowest value for average clove weight were obtained in the cultivar "Balady" in both seasons.

4- Total yield (Ton/ Fed.)
There were significant differences among the different studied garlic entries with regard to this character. In both seasons, the highest total yield was found in cultivar Sids-40 and clone Egaseed-2. However, the differences between the two entries was not significant. On the contrary, total yield per feddan decreased with Balady cultivar (2.15 and 1.40 tons) in both seasons, respectively.

The previous obtained results indicated that the used five garlic entries differed significantly in their effect on bulb characteristics and total yield per feddan. Sids-40 cultivar and Egaseed-2 clone produced the highest bulb weight with heaviest clove weight and minimum number of clove per bulb, compared to the other cultivars. On the contrary, Balady cultivar recorded the lowest values of bulb weight and clove weight, also produced bulbs with maximum number of cloves. Because of the total yield per feddan is very important to the Egyptian farmers, the obtained data showed that the highest yield was obtained from cultivar Sids-40, followed by Egaseed-2 clone. These results are confirmed with the conclusions of Hassan (2002), Mohamed (2004) and Moustafa (2009).
Table 1: Mean values of bulb characteristics and total yield per feddan of different garlic cultivars and clones over the two growing seasons.

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<tr>
<td>Treatments</td>
<td>Balady</td>
<td>41.44</td>
<td>15.71</td>
<td>27.22</td>
<td>15.10</td>
<td>0.94</td>
<td>0.71</td>
<td>2.15</td>
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<td></td>
<td>Chinease</td>
<td>39.96</td>
<td>27.91</td>
<td>11.76</td>
<td>12.35</td>
<td>2.34</td>
<td>1.59</td>
<td>2.82</td>
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<td></td>
<td>Sids-40</td>
<td>72.75</td>
<td>33.51</td>
<td>9.67</td>
<td>10.68</td>
<td>3.84</td>
<td>2.19</td>
<td>5.90</td>
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<td></td>
<td>Egaseed-1</td>
<td>51.46</td>
<td>28.18</td>
<td>13.18</td>
<td>12.51</td>
<td>2.96</td>
<td>1.45</td>
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<td></td>
<td>Egaseed-2</td>
<td>59.23</td>
<td>37.20</td>
<td>9.90</td>
<td>9.17</td>
<td>4.02</td>
<td>1.90</td>
<td>4.70</td>
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<tr>
<td></td>
<td>L.S.D 0.05</td>
<td>16.39</td>
<td>1.02</td>
<td>1.71</td>
<td>1.40</td>
<td>1.16</td>
<td>0.16</td>
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Conclusions:
From the results of this study, it could be concluded that the highest total yield of garlic was produced by Sids-40 cultivar (as an average of two seasons) followed by clone Egaseed-2. Therefore, these entries may be recommended for garlic production for high yielding capacity under Assiut conditions.

References:


اختبار بعض أصناف الثوم تحت ظروف أسيوط

أحمد رجب داود، سيد عباس عبد العال، عبد الحكيم شوفي بنوي، و شرين بعقوب عطالة

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قسم البساتين - كلية الزراعة - جامعة أسيوط

أجريت تجربتان حديثتان بمزرعة التجارب البحثية - كلية الزراعة - جامعة أسيوط - أسيوط، خلال موسمين شتاء 2009-2010 و2010-2011، وتم تقسيم النمو صفات النبتة والمحصول الكلي من الثوم للفدان (اربعة أصناف بلدي، صيني، سدس-40، إيجاسيد-1 وسلالة واحدة إيجاسيد-2)، تحت ظروف أسيوط. أظهرت النتائج المتحصل عليها ما يلي:

1- كانت هناك اختلافات واضحة بين جميع الأصناف والسلالات المستخدمة لجميع الصفات المدروسة.

2- بالنسبة لقياسات النمو الخضري للثوم وجد أن هناك زيادة ملحوظة لكل من طول النباتات والأوراق ووزن النبات الكامل بداية من 75 يوم من الزراعة، وبالتقدم في موسم النمو حتى 135 يوم تم إنخفاض هذه القياسات حتى 155 يوم، أما بالنسبة لمعامل التبضيل وزن الرأس زادت زيادة مطردة بداية من 75 حتى 155 يوم من الزراعة.

3- أعطى الصنف سدس-40 زيادة معنوية في كل من وزن الرأس ووزن الفص (متوسط الموسمين) ونقص معنوي في عدد الفصول للرأس بالمقارنة بالأصناف والسلالات المستخدمة في الدراسة.

4- أيضا تفوق الصنف سدس-40 في كمية المحصول الكلي للفدان (كمIssuer) والسلالة إيجاسيد-2، بينما الصنف البلدي كان أقل الأصناف بالنسبة للمحصول الكلي للفدان.

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