

EFFECTS OF PRE-PLANTING TREATMENTS OF GARLIC (*Allium sativum* L.) CLOVES ON GROWTH AND YIELD UNDER MIDDLE EGYPT CONDITIONS.

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ABSTRACT

The field experiment was conducted during the two successive winter seasons of 2008/2009 and 2009/2010 at the Experimental Farm, Sids Horticulture Research Station, Agriculture Research Center, Giza, Egypt. Two garlic cultivars (Eggaseed 1 and Sids 40) were selected for this study. Pre-sowing treatments of cloves were: cooling at 5°C for 10 or 20 days, GA3 soaking at 5 ppm for 12 or 24 hrs., water soaking for 12 or 24 hrs. or without treatment (control plants). The obtained results indicated that:

- 1- Sids 40 cultivar was superior than cv. Eggaseed 1 in regard to plant height, leaf number / plant, fresh weight of vegetative parts and bulb dry matter percentage. On the other hand, there were insignificant differences between cv. Eggaseed 1 and Sids 40 concerning the percentage germination after 30 days and 45 days from planting, fresh bulb weight, cured bulb weight, cured bulb diameter, bulbing ratio, fresh and cured yield.
- 2- Seed cloves treated at low temperature of 5°C for 10 to 20 days before planting gave the highest values of germination percent after 30 and 45 days from planting and earlier in bulb initiation and maturity but resulted in the lowest yield and yield quality compared to other treatments. Soaking garlic cloves in either water or GA3 at 5 ppm for 24 hrs. proved to be effective in improving almost all the previously mentioned parameters.
- 3- The interaction of soaking treatments GA3 at 5 ppm for 24 hrs. with either cvs. Sids 40 or Eggaseed 1 could be recommended to produce higher yield with better bulb quality under middle Egypt conditions.

INTRODUCTION

Garlic *Allium sativum* L. is used mainly as spice, seasoning and flavouring of food stuff due to its pungent flavour. The yield of garlic in cultivation depends on appropriate cultural practice and factors such as the cultivars (Mustafa *et al.*, 2009), the planting date (Bhuiya *et al.*, 2003, Rahman, 2004), temperature (Rahim and Fordham, 2001), light (Del Pozo and Gonzalez, 2005) moisture (Bhuiya *et al.*, 2003) and soil nutrients (Kilgori *et al.*, 2007), which affect the plant at different stages of growth.

Nassar *et al.* (1972) stated that the Chinese cultivar proved to be of high yielding ability, more uniform clove of heavier weight and fewer number/bulb than that of the local variety. Moustafa *et al.* (2009) evaluated some new imported cultivars under the Egyptian conditions and showed that there were significant differences among the tested genotypes. Hassan (2002), Mohamed (2004). And Ammar (2007) found that Balady cultivar surpassed significantly Sids 40 cultivar in plant height. but Sids 40 cultivar produced more leaves. El-Sawah (1990) reported that cv. Chinese produced more yield comparing to cv. Balady Hussein *et al.* (1995) and Mohamed (1995)

found that Chinese cultivar significantly gave better bulb quality (bulb diameter, bulb weight. Fresh and cured yield per unit area) better than Balady cultivar. Concerning the effect of gibberllic acid on garlic, little work had been reported. So, plant growth regulators have been known to play a vital role in sprouting of garlic (Moon&Lee,1980; Rahim&Fordhan, 1988).Treatment of seed garlic bulbs (cloves) with GA3 solution stimulate sprouting and bulbing as well as its development (Moon&Lee, 1980). It is well known that exogenous application of gibberllic acid (GA3) had enhanced the germination of onion seed (Wareing & Philips,1983; Taize & Zaiger 1991; El-Bakkosh, 2001: El-Barghothi, 2005 &2007). While Muhammed et al. (2006) found that 250 ppm of GA3 gave the miximum sprouting of garlic whereas the 500 ppm produced the minimum sprouting. On the other hand, Knypke (1979) disclosed that GA3 application halved the weight of onion bulbs at maturity.

The growth stages of *A. sativum* include clove sprouting , shoot growth, bulb growth and maturation (Del Pozo and Gonzalez, 2005). Clove sprouting and emergence are controlled mainly by temperature (Takagi, 1990,Barrera *et al.*, 1998). The early growth stage of garlic is suited by exposure of cloves to low temperature. Such exposure could be achieved by using controlled temperature chambers such as refrigerators (Del Pozo and Gonzalez, 2005) or planting in a cool growing period and is essential for proper development of shoot and good yield of bulbs (Bhuiya *et al.*, 2003). Seed cloves stored either at 5 or 10 C° for 15 to 30 days before planting also accelerates initiation, development and maturity of bulbs relative to those of cloves stored at 15 and 20 C° (Rahim and Fordham 2001). Bulb initiation is promoted by the previous exposure of garlic cloves treatment to low temperature (Takagi,1990:Rahim and Fordham,2001). While Ade-Aemilua *et al.* (2009) found that pre planting cold treated garlic cloves enhanced total leaf area, fresh and dry weight of plants under open shade. Plants from treated cloves had better yield (clove, bulb, clove size, clove dry weight) than plants from untreated cloves. Alejandro and Gonzalez, (2005) found that all plants of both studied clones formed bulbs when storage temperature was 4 or 7 C°. Also, linear relationships between the number of leaves and thermal time above 0 C° have been reported in garlic growing in field condition(Buwalda ; 1986,Espagnacq *et al.*, 1987; Bertoni *et al.*,1992 , Cabrera ,1993).

This study was conducted to investigate the responses of seed clove of two garlic cultivars "Eggaseed1 and Sids 40" to temperature, GA3 soaking and water soaking on development of garlic in field condition. The aim was to determine temperature, GA3 soaking and water soaking requirements of clove seed garlic cultivars.

MATERIALS AND METHODS

The field experiment was carried out at the Research Farm, Sids Horticulture Research Station for Agriculture Research Center, Beni Suif,during the two successive winter seasons of 2008 / 2009 and 2009/ 2010 in a clay loam soil . Two garlic cultivars were selected for this study, i.e, Sids 40 and Eggseed – 1. The pre- sowing treatments of cloves were:

- 1- Cooling at 5^oC for 10 days
- 2- Cooling at 5^oC for 20 days
- 3- Soaking in GA3 at 5 ppm for 12 hours
- 4- Soaking in GA3 at 5 ppm for 24 hours
- 5- Soaking in water for 12 hours
- 6- Soaking in water for 24 hours
- 7- Control (dry clove)

The experimental design used was a split-plot in randomized complete blocks with four replicates. The two cultivars, Sids 40 and Eggseed1 were allocated as the main plots, and treatments of garlic cloves were devoted as sub – plots. Each sub – plot was consisted of 4 rows, 60 cm apart and 3.5 m long. Cloves were planted 10 cm apart on one side of each row.

Planting date was September 15th of both seasons. The N.P.K. fertilizers at the rate of 180 kg / fed. as ammonium nitrate (33.5 %), 65 kg/fed. P₂O₅ as calcium super phosphate (15.5%) P₂O₅ and 48 kg /fed. K₂O as potassium sulphate (48% K₂O) were applied to all treatments .

The other culture practice recommended for garlic production were applied and the plants were harvested April 1st of both seasons except treatments stored under low temperature. The treatment of cooling at 5 C^o for 20 days was harvested February 21st while the treatment of cooling at 5 C^o for 10 days was harvested March 10th in both seasons.

Data were recorded for the following characters:

A. Germination.

The percentage of clove germination was estimated at 30 and 45 from planting

B. Vegetative growth.

Ten plants from each experimental plot were randomly taken, at two weeks before harvest to determine the Plant height, leaf number and Fresh weight of vegetative portion

C. Fresh bulb characters.

On the same samples obtained at two weeks before harvest the following data were measured:- Bulb fresh weigh , bulbing ratio : neck diameter / bulb diameter , according to Mann(1952).and bulb dry matter percentage. Thin bulb slices were oven dried at 70^oC up to a constant weight.

D- Fresh yield at harvesting date.

Garlic was harvested on the first of April in both seasons except treatments stored under low temperature as previously mentioned. Fresh yield per plot at was recorded and per fedden was calculated .

E- Cured yield and bulb quality.

The harvested garlic plants were left in the field to be cured for 21 days and cured plants were then weighted. Cured yield was calculated. Ten plants from each experimental plot were randomly taken to determine cured bulb weight and diameter .

Statistical analysis

Data from both years were subjected to combined analysis. Analysis of variance and Duncan's Multiple Range test at 0.05 level means separation

tests using MSTST(1985). Software C were used to compare the collected data.

RESULTS AND DISCUSSION

A- Vegetative growth.

1- Germination percentage.

The difference between cvs Sids 40 and Egaseed 1 in germination percentage after 30 and 45 days from planting was insignificant in both seasons as shown in Tables (1).

Concerning the effect of the studied treatments on germination percentage after 30 and 45 days from planting, there are significant differences among these treatments as compared with control plants, in both seasons. Treatments of cooling at 5°C for 20 days gave the highest values, in both seasons. Whereas, control soaking treatment and gloves in water for 12 hrs showed the lowest values ,in both seasons. These results are in line with those obtained by Takagi, (1990), Farrag *et al.* (1991) and Barrera *et al.* (1998).

The interactions between the two studied factors declared that significant effect was obtained, in both seasons. The highest values of germination percentage after 30 days from planting was obtained from the interactions of Sids 40 x cooling at 5°C for 20 days. While the highest values of germination percentage after 45 days from planting was obtained from the interactions of Egaseed 1 x cooling at 5°C for 20 days, in both seasons.

2- Plant height.

Data listed in Table (2) show that "Sids 40" cultivar significantly produced taller plants than cv "Eggaseed 1", in both seasons.

It is clear also that, there are significant differences among the studied treatments as compared with control plants, in both seasons.. The tallest plants were obtained from the treatment of soaking in GA3 at 5 ppm for 24 hrs, in both seasons. In the sametime the shortest plants were gained from cooling cloves for 20 days, in both seasons. These results are in agreement with those obtained by Knyple (1980) on onion, Pimpini *et al.* (1988) on tomato Hassan *et al.* (1990) on cabbage and Farrag *et al.* (1991) on garlic.

Moreover, there are significant interaction between cultivar and different treatments. It is obvious from data presented in Table (2) that cv. "Sids 40" plants produced from cloves soaked in GA3 at 5 ppm for 24 hrs gave the tallest plants as compared with the other treatments in both seasons.

3- Number of leaves per plant.

Data in Table (2) that plants of cv Sids 40 had more leaves per plant than Eggaseed 1cultivar .However,the differences were not significant in the second season. Hassan (2002), Mohamed (2004),and Ammar (2007) found also, that Sids 40 cultivar produced more leaves than that in Balady cultivars.

Results also showed that the highest number of leaves was significantly obtained from soaking in GA3 at 5 ppm for 24 hrs in both seasons. Whereas both cooling treatments showed significant reduction in this character as compared with any other treatment in both seasons. In general, obtained results are in harmony with those obtained by Farrag *et al.* (1991) on garlic.

The interaction of variety and treatments seed on clove indicated that plants of cv Sids 40. had the most number of leaves per plant due to the treatment of soaking cloves in GA3 at 5 ppm for 24 hrs, in both seasons.

4- Fresh weight of vegetative portion.

Data in Table (3) revealed that fresh weight of vegetative portion of garlic cv. " Sids 40" was higher than that of cv. "Eggaseed 1", in both seasons.

Among the various clove treatments, soaking clove seed in GA3 for 24 hrs showed to be the most superior treatment in this character , in both seasons .whereas , storage at 5°C for 10 or 20 days resulted in the most significant reduction as compared to control plants ,in both seasons.

Concerning the interaction between cultivar and different treatments, it is clear from data present in Table (3) cv. "Sids 40" plants gave the highest values of this character when plants were treated with soaking in GA3 at 5 ppm for 24 hrs .in both seasons. On the other hand, cooling cvs Egaseed and sids 40 cloves for 24 hrs showed the most significant reduction in their mean values of this character , in both seasons.

B- Yield component:

1- Bulb fresh weight

Regarding the effect of cultivars, data indicated that differences between cultivars in fresh weight per bulb was insignificant, in both seasons as shown in Table (3). Similar results were reported on garlic by Mustafa *et al.* (2009) and Tantaway (2010)

As for the effect of some treatments on seed clove, data illustrated in Table (5) show that the highest values were obtained from plants which treated with soaking in GA3 at 5 ppm for 24 hoers in both seasons. Whereas ,both cooling treatments significantly decreased this character , in both seasons. The obtained results are in harmony with those reported by Moon and Lee (1980) and Farrag *et al.* (1991).

Concerning the interaction between cultivar and different treatments, it is clear from data present in Table (3) cv. "Sids 40" or Eggaseed plants gave the highest values of this character when plants were soaked in GA3 at 5 ppm for 24 hrs with insignificant differences between them , in both seasons Also the two cultivars showed the most significant reduction in this character when their cloves received cooling treatment for 24hrs , in both seasons..

2- Bulb dry matter percentage

Data presented in Table 4 indicate that bulb dry matter percentage did not show any significant differences between the mean values that obtained from cv. Sids 40 and Egaseed 1 in the first season. Whereas,significant increases were obtained with cv Egaseed 1, in the second season.

Among the applied pre-sowing treatments, cooling treatments showed significant reduction in this character as compared with other treatments. Although insignificant effects were gained from the other treatments as compared with other treatments, in both seasons.

Regarding the interactions between cultivars and treatments, there are insignificant differences between the studied interactions except the treatments of cooling which showed significant reductions for both cultivars compared with other treatments and control plants, in both seasons..

3- Cured bulb weight.

Data in Table 4 indicated insignificant difference between the mean value of cured bulb weight in cv. Sids 40 and cv. Eggaseed 1 in both seasons.

There were significant differences among the studied clove treatments. The highest values were obtained from those treated with soaking in GA3 at 5 ppm for 24 hrs in both seasons. Followed by soaking in water for 24 hrs. Quite similar results were obtained by Knyple (1981) and Farrag *et al.* (1991).

Moreover, there is significant interaction between cultivar and different clove treatments. Eggaseed 1 cultivar gave the highest value when the seed cloves were treated by soaking in GA3 at 5 ppm for 24 hrs in both seasons.

1- Cured bulb diameter:

Data in Table (5) showed insignificant differences between the grown cultivars in cured bulb diameter, in both seasons. Similar results were reported by Mustafa *et al.* (2009) and Tantawy (2010) on garlic..

Concerning the effect of studied different clove treatments soaking in GA3 at 5 ppm for 24 hrs gave the highest values, whereas cooling treatments showed the most significant reduction, in both seasons. These results are in harmony with those reported by El-Habbasha and Beharry (1977) on onion, and Farrag *et al.* (1991) on garlic.

It is clear also that there are significant differences between the interactions of cultivars and different treatments. Eggaseed 1 cultivar plants produced from cloves soaked in GA3 at 5 ppm for 24 hours gave the highest cured bulb diameter, in both seasons. In the meantime, the interactions between either cv. Sids 40 nor Eggaseed 1 with cooling treatments showed the most significant reductions.

5-Bulbing ratio.

Data obtained after 170 days from planting (two weeks before harvest) as shown in Table (5) indicate that there were insignificant differences between cv. Sids 40 and Eggaseed 1 in this character, in both seasons..

With regard to the effect of the different clove treatments on bulbing ratio, insignificant differences were obtained between the treatments and control plants except cooling at 5°C for 20 days which showed significant reduction in this character as compared to other treatments, in both seasons. This indicates that cooling at 5°C for 20 days was effective in accelerating bulb maturity than other treatments. Similar results were reported by **Alejandro and Maria (2005)**.

Concerning the interactions of cultivars and different clove treatments cvs. Sids 40 and Eggaseed plants raised from cloves soaked in GA3 at 5 ppm for 24 hrs gave slight higher values, in both seasons. In the meantime ,

plants of cloves treated by cooling at 5°C for 20 days gave the lowest values, regardless cultivars in both seasons.

C- Yield.

Fresh and cured yield.

Insignificant differences were obtained between the mean values of fresh and cured yield of cvs. Eggaseed 1 and Sids 40 , in both seasons. Similar results were reported by Mustafa *et al.* (2009) and Tantawy (2010) on garlic

Concerning the effect of studied different treatments on clove seed, there are significant differences among those treatments, in both seasons. Soaking in GA3 at 5 ppm for 24 hours gave the highest values followed by soaking in water for 24 hrs, in both seasons. While. Cooling at 5°C for 20 days gave the lowest values in both seasons. Farrag *et al.* (1991) reported that seed clove of garlic soaked for 24 hrs in GA3 at 20 ppm could be recommended to produce higher yield with better quality.

Moreover, there was significant interaction between cultivar and different treatments on seed clove, Eggaseed 1 cultivar followed by cv.Sids 40 gave the highest values when the cloves were soaked in GA3 at 5 ppm for 24 hrs, in both seasons.

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تأثير معاملات ما قبل الزراعة على فصوص الثوم على النمو والمحصول تحت
ظروف مصر الوسطى

سعيد إبراهيم احمد و احمد عبد المنعم حميدة
بحوث الخضر- معهد بحوث البساتين - مركز البحوث
الزراعية

أجريت تجربة حقلية خلال عامين متتاليين فى الموسم الشتوى
٢٠٠٨/٢٠٠٩، ٢٠٠٩/٢٠١٠ بمحطة بحوث البساتين بسدس-مركز البحوث الزراعية- الجيزة-مصر
لدراسة استجابة صنفين من الثوم (ايجاسيد ١ وسدس ٤٠) لمعاملات تبريد الفصوص الجافة تحت
درجة ٥م درجة مئوية لمدة ١٠، ٢٠، ٣٠ يوم ، ونقع الفصوص فى حامض الجبرليك بمعدل ٥ جزء فى
المليون لمدة ١٢، ٢٤ ساعة، ونقع الفصوص فى الماء لمدة ١٢، ٢٤ ساعة ومعاملة الكنترول(فصوص
جافة).

- ١- توضح النتائج المتحصل عليها تفوق الصنف سدس ٤٠ على الصنف ايجاسيد ١ فى طول النباتات
وعدد الأوراق ووزن الأجزاء الخضرية ووزن البصلة الجاف من ناحية أخرى لا يوجد فروق
معنوية بين الصنفين(ايجاسيد ١ وسدس ٤٠) فى النسبة المئوية للإنبات ووزن البصلة الطازج
وقطر ووزن البصلة المعالج ومعدل التنبصيل والمحصول الطازج والمعالج (طن للفدان)
- ٢- وأعطت معاملات التبريد أعلى القيم فى النسبة المئوية للإنبات والتبكير فى النضج ومحصول
طازج مبكر ولكنة قليل بالمقارنة بالمعاملات الأخرى. وأدت معاملات التقع فى حامض الجبرليك
بتركيز ٥ جزء فى المليون فى الماء لمدة ١٢ ، ٢٤ ساعة الى تحسين الصفات السابق ذكرها وكان
التركيز ٥ جزء فى المليون لمدة ٢٤ ساعة أفضل التركيزات المستخدمة ويوصى به لإنتاج أفضل
محصول كما ونوعا لكل من الصنف سدس ٤٠ وايجاسيد ١.

قام بتحكيم البحث

كلية الزراعة - جامعة المنصورة
كلية الزراعة - جامعة عين شمس

أ.د / هالة عبد الغفار السيد
أ.د / ابراهيم ابراهيم العكش

Table (1) Effect of pre-sowing treatments of seed clove on germination percentages after 30 and 40 days from planting for cvs. "Sids 40 and Eggaseed 1 in 2008 / 2009 and 2009 /2010 seasons.

Treatments	Germination % after 30days from planting						Germination % after 45days from planting					
	First season			Second season			First season			Second season		
	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean
1	45.90 d	51.63 c	48.43 B	44.17 fgh	49.10 cd	46.63 BC	91.07 bc	89.00 cd	90.03 B	91.90 b	90.63 b	91.27 B
2	60.67 b	66.20 a	63.43 A	53.40 b	60.00 a	56.70 A	94.83 a	91.50 b	93.17 A	96.10 a	94.63 a	95.27 A
3	39.77 fg	38.67 gh	39.22 D	43.20 ghi	45.37 efg	44.28 C	85.23 ef	82.93 fg	84.08 C	85.10 d	80.00 e	82.55 D
4	42.93 de	43.97 de	43.45 C	50.50 bc	48.00 cde	49.25 B	89.17 bcd	87.10 de	88.13 B	87.40 c	84.40 d	85.90 C
5	36.67 h	33.00 i	35.30 E	41.77 hi	40.57 i	41.17 D	81.93 gh	79.20 i	80.57 D	78.27 ef	76.67 fg	77.47 E
6	41.83 ef	38.30 gh	40.07 D	46.47 def	45.93 efg	46.20 C	85.83 e	83.23 fg	84.53 C	79.43 e	78.67 hf	79.05 E
7	31.63 i	27.76 j	29.70 F	22.47 k	25.93 j	24.20 E	80.20 hi	75.33 j	77.77 E	75.77 g	74.933 g	75.35 F
Mean	42.80 A	42.89 A		43.14 A	44.99 A		86.90 A	84.04 A		84.85 A	82.82 A	

Means in the same column followed by the same latter are not statistically different at 0.05 level.

- 1- Cooling at 5°C for 10 days
- 2- Cooling at 5°C for 20 days
- 3-Soaking in GA3 at 5 ppm for 12 hrs
- 4- Soaking in GA3 at 5 ppm for 24 hrs
- 5- Soaking in water for 12 hrs
- 6- Soaking in water for 24 hrs
- 7-Control (dry clove)

Table (2) Effect of pre-sowing treatments on clove seed on plant height and number of leaves/ plant of garlic cvs. "Sids 40 and Eggaseed 1 in 2008 /2009 and 2009 / 2010 seasons.

Treatments	Plant height (cm)						Number of leaves/ plant					
	First season			Second season			First season			Second season		
	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean
1	58.27 g	56.50 h	57.38 E	62.17 ef	59.10 f	60.63 C	9.33 d	9.27 d	9.30 D	8.93 d	8.83 d	8.88 D
2	52.67 i	46.67 j	49.67 F	40.27 h	44.83 g	42.55 D	7.60 e	6.27 f	6.30 E	6.93 e	6.87 e	6.90 E
3	65.23 c	63.80 cde	64.52 BC	69.30 bc	61.67 ef	65.48 B	11.67 ab	11.00 c	11.33 ABC	11.53 abc	11.23 bc	11.38 ABC
4	70.73 a	65.33 c	68.03 A	73.57 a	63.83 de	68.70 A	11.80 a	11.43 abc	11.62 A	11.87 a	11.53 abc	11.70 A
5	62.63 de	62.73 de	62.68 CD	67.17 bc	61.00 ef	64.08 B	11.20 bc	11.00 c	11.10 C	11.30 abc	11.03 c	11.17C
6	68.50 b	64.23 cd	66.37 AB	70.27 b	61.27 ef	65.77 B	11.63 ab	11.33 abc	11.48 AB	11.63 ab	11.43 abc	11.53 AB
7	60.50 f	62.40 e	61.45 D	66.57 cd	60.77 ef	63.67 B	11.33 abc	11.10 c	11.22 BC	11.43 abc	11.07 bc	11.25 BC
Mean	62.65 A	60.24 B		64.19 A	58.92 B		10.65 A	10.20 B		10.52 A	10.29 A	

Means in the same column followed by the same latter are not statistically different at 0.05 level.

- 1- Cooling at 5°C for 10 days
- 2- Cooling at 5°C for 20 days
- 3-Soaking in GA3 at 5 ppm for 12 hrs
- 4- Soaking in GA3 at 5 ppm for 24 hrs
- 5- Soaking in water for 12 hrs
- 6- Soaking in water for 24 hrs
- 7-Control (dry clove)

Table (3) Effect of pre-sowing treatments on clove seed on fresh weight of vegetative portion and bulb fresh weight of garlic cvs. "Sids 40 and Eggaseed 1 in 2008 /2009 and 2009 / 2010 seasons.

Treatments	Fresh weight of vegetative portion (g / plant)						Bulb fresh weight (g)					
	First season			Second season			First season			Second season		
	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean
1	46.13 b	34.97 f	40.55 D	45.40 def	40.30 h	42.85 D	59.00 f	60.60 f	59.80 E	53.23 f	56.87 e	55.05 D
2	13.00 g	10.43 g	11.17 E	11.90 i	9.93 i	10.91 E	33.20 h	37.37 g	35.28 F	25.87 h	30.80 g	28.33 E
3	47.47 b	39.23 de	43.35 BC	48.30 bc	43.60 fg	45.95 BC	69.40 cde	70.20 cd	69.80 C	70.87 cd	71.30 cd	71.08 BC
4	50.37 a	43.07 c	46.72 A	52.43 a	47.37 cd	49.90 A	73.80 ab	75.37 a	74.58 A	75.37 a	76.80 a	76.08 A
5	47.53 b	38.20 e	42.87 C	47.77 bcd	43.97 efg	45.87 BC	70.13 cd	71.63 bc	70.88 BC	70.20 cd	72.57 bc	71.38 BC
6	48.47 ab	41.13 cd	44.80 B	49.93 b	45.47 def	47.70 AB	71.50 bc	74.03 ab	72.77 B	72.23 bc	74.20 ab	73.22 B
7	47.07 b	37.80 e	42.43 C	46.40 cde	42.37 gh	44.38 CD	66.33 e	67.47 de	66.90 D	69.33 d	70.73 cd	70.03 C
Mean	42.87 A	34.98 B		43.16 A	39.00 B		63.34 A	65.24 A		62.44 A	64.75 A	

Means in the same column followed by the same letter are not statistically different at 0.05 level.

- 1- Cooling at 5°C for 10 days
- 2- Cooling at 5°C for 20 days
- 3-Soaking in GA3 at 5 ppm for 12 hrs
- 4- Soaking in GA3 at 5 ppm for 24 hrs
- 5- Soaking in water for 12 hrs
- 6- Soaking in water for 24 hrs
- 7-Control (dry clove)

Table (4) Effect of pre-sowing treatments on clove seed on dry matter percentage of bulb and cured bulb weight of garlic cvs. "Sids 40 and Eggaseed 1 in 2008 /2009 and 2009 / 2010 seasons.

Treatments	Dry matter percentage of bulb						Cured bulb weight (g)					
	First season			Second season			First season			Second season		
	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean
1	26.00 c	26.67 bc	26.33 B	28.00 b	28.00 b	28.00 B	37.43 c	39.93 f	38.68 E	39.57 f	40.87 ef	40.22 D
2	23.33 d	23.93 d	23.63 C	26.60 b	27.67 b	27.13 B	23.20 h	25.20 h	24.20 F	27.20 h	30.80 g	29.00 E
3	27.80 abc	28.30 ab	28.05 A	31.63 a	28.70 b	30.17 A	45.63 d	50.53 c	48.08 B	47.47 cd	49.40 c	48.43 C
4	28.87 a	28.50 ab	28.68 A	31.73 a	29.00 b	30.37 A	53.03 b	58.53 a	55.78 A	56.80 ab	59.93 a	58.37 A
5	27.77 abc	28.30 ab	28.03 A	31.80 a	28.27 b	29.95 A	43.20 e	47.03 d	45.12 C	44.40 de	47.13 cd	45.77 C
6	29.00 a	28.77 a	28.88 A	31.80 a	28.57 b	30.18 A	51.48 bc	56.43 a	53.95 A	53.63 b	56.17 b	54.90 B
7	27.83 abc	28.20 ab	28.02 A	31.90 a	28.37 b	30.13 A	40.47 f	45.37 de	42.92 D	42.13 ef	43.33 e	42.73 D
Mean	27.23 A	27.52 A		30.47 A	28.37 B		42.06 A	46.15 A		44.46 A	46.81 A	

Means in the same column followed by the same letter are not statistically different at 0.05 level.

- 1- Cooling at 5°C for 10 days
- 2- Cooling at 5°C for 20 days
- 3-Soaking in GA3 at 5 ppm for 12 hrs
- 4- Soaking in GA3 at 5 ppm for 24 hrs
- 5- Soaking in water for 12 hrs
- 6- Soaking in water for 24 hrs
- 7-Control (dry clove)

Table (5) Effect of pre - sowing treatments on clove seed on cured bulb diameter and bulbing ratio of garlic cvs. "Sids 40 and Eggaseed 1 in 2008 /2009 and 2009 / 2010 seasons.

Treatments	Cured bulb diameter (cm)						Bulbing ratio					
	First season			Second season			First season			Second season		
	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean
1	4.47 f	5.00 e	4.73 D	4.33 g	4.57 g	4.45 E	0.28 bc	0.24 cd	0.26 B	0.22 a	0.22 a	0.22 A
2	3.40 h	4.00 g	3.70 E	3.33 h	3.50 h	3.42 F	0.18 de	0.17 e	0.17 C	0.15 b	0.14 b	0.15 B
3	5.60 bc	6.00 b	5.80 BC	5.27 de	5.57 cd	5.42 BC	0.34 ab	0.33 ab	0.33 A	0.35 a	0.32 a	0.33 A
4	6.57 a	6.93 a	6.85 A	6.00 ab	6.13 a	6.07 A	0.36 a	0.35 a	0.35 A	0.36 a	0.35 a	0.36 A
5	5.27 cde	5.50 cd	5.38 C	5.10 ef	5.43 d	5.27 C	0.33 ab	0.33 ab	0.32 A	0.33 a	0.34 a	0.34 A
6	6.00 b	6.50 a	6.25 B	5.50 cd	5.80 bc	5.65 B	0.35 a	0.35 a	0.34 A	0.35 a	0.35 a	0.35 A
7	5.07 de	5.60 bc	5.33 C	4.93 f	5.07 ef	5.00 D	0.34 ab	0.31 ab	0.32 A	0.34 a	0.32 a	0.33 A
Mean	5.20 A	5.65 A		4.92 A	5.15 A		0.31 A	0.29 A		0.30 A	0.29 A	

Means in the same column followed by the same letter are not statistically different at 0.05 level.

- 1- Cooling at 5°C for 10 days
- 2- Cooling at 5°C for 20 days
- 3-Soaking in GA3 at 5 ppm for 12 hrs
- 4- Soaking in GA3 at 5 ppm for 24 hrs
- 5- Soaking in water for 12 hrs
- 6- Soaking in water for 24 hrs
- 7-Control (dry clove)

Table (6) Effect of pre-sowing treatments on clove seed on fresh yield and cured yield of garlic cvs. "Sids 40 and Eggaseed 1 in 2008 /2009 and 2009 / 2010 seasons.

Treatments	Fresh yield (Ton/fed.)						Cured yield (Ton/fed.)					
	First season			Second season			First season			Second season		
	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean	Sids 40	Eggaseed 1	Mean
1	4.67 g	4.70 g	4.68 E	5.03 f	5.20 ef	5.12 E	2.70 f...	2.77 ef	2.37 C	2.77 f	3.00 e	2.88 D
2	3.00 h	3.13 h	3.07 F	4.03 h	4.47 g	4.25 F	1.50 g	1.67 g	1.58 D	1.60 g	1.67 g	1.63 E
3	6.00 de	6.20 cd	6.01 BC	5.77cd	6.07 c	5.92 C	3.50 bcd	3.50 bcd	3.50 B	3.30 d	3.50 c	3.40 B
4	6.60 ab	6.80 a	6.70 A	6.77 b	7.33 a	7.05 A	3.90 ab	4.07 a	3.99 A	3.67 bc	3.97 a	3.82 A
5	5.80 ef	6.033 de	5.92 C	5.17 ef	5.60 de	5.38 DE	3.27 cde	3.60 abc	3.43 AB	3.10 e	3.67 bc	3.38 B
6	6.27 cd	6.40 bc	6.33 B	6.20 c	6.80 b	6.50 B	3.73 abc	3.80 ab	3.77 A	3.50 c	3.83 ab	3.67 A
7	5.57 f	5.57 f	5.57 D	5.50 de	5.80 cd	5.65 CD	3.07 def	3.23 cde	3.15 B	2.97 e	3.30 d	3.13 C
Mean	5.41 A	5.55 A		5.49 A	5.89 A		3.10 A	3.23 A		2.99 A	3.28 A	

Means in the same column followed by the same latter are not statistically different at 0.05 level.

- 1- Cooling at 5°C for 10 days
- 2- Cooling at 5°C for 20 days
- 3-Soaking in GA3 at 5 ppm for 12 hrs
- 4- Soaking in GA3 at 5 ppm for 24 hrs
- 5- Soaking in water for 12 hrs
- 6- Soaking in water for 24 hrs
- 7-Control (dry clove)