

EVALUATION OF SOME HORTICULTURAL CHARACTERISTICS AND ALLICIN CONTENT FOR SOME GARLIC GENOTYPES

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ABSTRACT

A field experiment was carried out during the two successive winter seasons of 2017/2018 and 2018/ 2019 at the Farm of Sids Hort. Res. Station, Agric. Res. Center, Beni-Suief Governorate, Egypt, to evaluate of some five garlic genotypes, namely Egyptian (Balady) and Sids-50 (soft neck garlic white), Sids-40, Eggaseed-1 and Eggaseed-2 (hard neck garlic purple) on some vegetative growth, bulb characteristics and productivity as well as Allicin content in cloves during fresh and cured yield .

***The results showed** the uppermost plant height, maximum leaves number per plant and longest leaf, highest total plant fresh weight/ plant, bulb diameter, both fresh and cured yield / fed. were obtained by Sids-50 genotype in both seasons. Meanwhile, Eggaseed-2 cultivar gave the largest leaf width and bulbing ratio. However, Balday cultivar recorded the highest number of cloves/ bulb in both seasons.*

The relative increases in cured yield due to Sids -50 genotype were about (6.15 and 22.58 %) over Baldy cultivar , (30.18 and 31.03 %) over Sids-40, (15.0 and 24.59 %) over Eggaseed-1 and (68.29 and 80.95 %) over Eggaseed-1 in the 1st and 2nd seasons, respectively.

The maximum concentrations of Allicin content in fresh and cured cloves of garlic were recorded with the two cultivars Eggaseed-2 and Sids-40, while the minimum concentrations were recorded with Sids- 50 genotype and Baldy cultivar in both growing seasons.

***Conclusively:** It could be concluded that the highest garlic growth, yield and its components can be achieved from Sids-50 garlic cultivar followed by cv. Balady, and Eggaseed-1 (purple). In order to obtain the highest Allicin content it is recommended to cultivate Sids-40 or Eggaseed-2.*

Key words: Garlic , cultivars , Balady Sids-40, Sids-50, Eggaseed-1, Eggaseed-2, growth , yield and Allicin content.

INTRODUCTION

Garlic *Allium sativum* L. belongs to the family Alliaceae (Kilgori *et al.*, 2007), the same family as onions, shallots and leeks which are grown for spices/condiment. Majority of the garlic is sold to the fresh market as a whole, fresh bulbs, green garlic or escapes. Processed products such as garlic spreads or chopped garlic are also sold, but to a lesser extent. It has a higher nutritive value than other bulbs crops and it is the 2nd most widely used member of the *Alliums* species (Abou El-Magd *et al.*, 2012). The major garlic areas are El-Minia and Beni-Sueif governorates (Ammar, 2007).

For many countries, various species of the genus *Allium* have been used as vegetables, spices and as folk medicines. Garlic is a common food spice, and is used widely in many parts of the world as a condiment in various prepared food (Ahmed *et al.*, 2001) and is also cultivated for its medicinal properties and this aspect is steadily on the rise worldwide. It lowers total plasma cholesterol, reduces blood pressure and decreases platelet aggregation (Sterling and Eagling, 2001).

Most of the medicinal effects of garlic are attributable to a sulfur compound known as Allicin (Schulz *et al.*, 1998). Allicin of garlic which has antibacterial properties Al-Otayk *et al.*, 2008).

The great variation on the growth and production of different garlic cultivars according to the different locations in Egypt was a wide field for many workers (Gad El-Hak and Abd El-Mageed, 2000, Hassan, 2002, El-Sayed, 2004, Mohamed, 2004, Gowda *et al.*, 2007; Moustafa *et al.*, 2009; Aly, 2010; Dawood *et al.*, 2011; Anwar, 2012; Ahmed, 2013; El-Nagar and El-Zohiri, 2015, Asiya *et al.*, 2017, and Shibana and Jalaja, 2019).

Furthermore, genetic factors can play an important role in differences of Allicin content between ecotypes (Baghalian *et al.*, 2005). Clonal selection of garlic with suitable content of Allicin and agronomical traits is desirable for large-scale culture and drug production. Lee (2005) showed that hardneck garlic (similar to Sids-40, Eggaseed-1 and Eggaseed-2) contains higher Allicin content than soft neck garlic (similar to Balady cultivar and Sids 50 genotype). Camargo *et al.* (2005) stated that the Allicin content can vary significantly between cultivars, keeping constant of the variability attributed to the climate conditions and dormancy state of the cloves. Raslan *et al.* (2015) found a significant differences in Allicin content among the two cultivars (Balady and Sids-40), furthermore, cultivar type showed more differences in Allicin content in case of cured mature bulb stage than in fresh premature bulb stage, where cured Sids-40 mature bulbs had higher Allicin content (3.02 mg/g FW) than Balady cv. (2.59 mg/g FW). (Wongsa *et al.*, 2016) observed the differences in

Allicin content, which affected by garlic genotypes, agronomical practices and locations. The amount of Allicin varied from 4.5 to 26.8 mg/ g DW.

Therefore, the objective of the current study was to evaluate of some vegetative growth, bulb characteristics and productivity as well as Allicin content of some garlic genotypes.

MATERIALS AND METHODS

A field experiment was carried out during the two successive winter seasons of 2017/2018 and 2018/ 2019 at the Farm of Sids Hort. Res. Station, Agric. Res. Center, Beni–Suief Governorate, Egypt, to evaluate of some five garlic genotypes, namely Egyptian (Balady) and Sids-50 (soft neck garlic white), Sids-40, Eggaseed-1 and Eggeseed-2 (hard neck garlic purple) on vegetative growth, bulb characteristics and productivity as well as Allicin content in cloves. The genotypes were obtained from Sids Hort. Res. Station. The soil of the experimental field was clay loam in texture. The physical and chemical analysis of the soil was determined according to the methods described by Jakson (1958) as shown in Table (1).

Table (1): Physical and chemical properties of the experimental soil during 2017/18and 2018/19 seasons (average two seasons).

Mechanical analysis				Chemical analysis			Available nutrients					
Sand %	Silt %	Clay %	Texture	OM	PH	E.C mmhos/cm	N %	P ppm	K ppm	Fe ppm	Mn ppm	Zn ppm
21.16	31.34	46.43	Clay loam	1.57	7.77	1.03	0.08	29.21	374.4	33.1	19.1	6.1
22.12	33.19	44.69	Clay loam	1.77	7.80	1.0	0.09	28.25	380.5	33.0	20.2	6.7

The above mentioned genotypes were arranged in a Randomized Complete Blocks Design (RCBD) with four replicates.

The experimental unit area was 6.3 m². It contained three ridges with 3.5m length and 60 cm in width. One ridge was used for the samples to measure vegetative growth and the other ridges were used for yield determination.

Garlic cloves were selected for uniformity in shape and size. The cloves were soaked 12 h in tap water and followed soaked in aqueous sulfur solution

for 30 minutes before planting. The principal target of water and sulfur dipping was to enhance sprouting and to control pests if present on the clove surfaces and then planted at distance of 10 cm apart in both sides of the ridge on 4th and 10th October in both growing seasons, respectively.

All plots received the recommended dose of N, P and K at the rates of 180 kg N, 60 kg P₂O₅/fad., and 75 kg K₂O/fed., in the form ammonium sulphate (20.6%), calcium super phosphate (15.5% P₂O₅) and potassium sulphate (48-50% K₂O), respectively. One third of ammonium sulphate, potassium sulphate and all calcium super phosphate were added during soil preparation with farmyard manure (FYM) at 20 m³/fad., while the two third of N and K₂O was added at three portions as soil application by one month intervals beginning one month after planting. The other normal agricultural practices for growing garlic were carried out as commonly followed in district.

Data recorded:

At two weeks before harvesting, ten plants were randomly taken from each experimental plot (170 days after planting) to determine:

Vegetative growth parameters

- 1-Plant height (cm)
- 2-Number of leaves / plant
- 3- leaf length (cm)
- 4- leaf width (cm)
- 5- Fresh weight of whole plant (g).

At the harvest time:

Garlic plants were harvested on the first week of April in both seasons (185 days after planting). Total fresh yield (kg / plot) were recorded. All data were converted to ton / fed.

Cured yield and bulb quality:

The harvested garlic plants were left to be cured for 21 days and cured plants were weighted. Cured yield (ton/ fed.) were calculated. After curing, ten plants from each experimental plot were randomly taken to determine the cured bulb diameter, number of cloves/ bulb.

Determination of Allicin content in fresh and cured cloves:

Freshly peeled garlic cloves (2g) were chopped and blended for one min in 20 ml water. The results homogenate was allowed to stand for min at room temperature to ensure maximum production of thiosulfates. The chloroform extract was separated dried over anhydrous sodium sulfate and evaporated at 40⁰ C. The residue was re-dissolved in 3 ml aqueous methanol (50 %), filtered

through 0.2µm filter and directly injected into HPLC. The HPLC system consisted of reversed phase (C18), 250 X 2.6 mm, 5 µm particle size columns. The mobile phase consisted methanol: water: formic acid (40:60:1) at a flow rate of 1.2 ml/ min. The eluate was monitored at a wavelength of 254 nm. Allicin was isolated from garlic extract using preparative silica gel thin layer chromatography using toluene: ethyl acetate (100:30) as developing solvent then identified by spectroscopic data. The resulting spectra were compared with that reported by (Jansen *et al.*, 1987, Lawson *et al.*, 1991 and Cruz-Villalon, 2001). Pure compound was used to prepare calibration curve.

Statistical analysis:

Data from both seasons were combined in a single analysis. Analysis of variance and Duncan (1955), means separation tests using MSTST C Ver. 4 software were used to compare the means of the collected data.

RESULTS AND DISCUSSION

1. Vegetative Growth characters:

Data presented in Table (2) show clearly that there were a significant differences among the four cultivars (Balady, Sids-40, Eggaseed-1 and Eggaseed-2) and Egyptian genotype (Sids -50) respecting plant height, number of leaves / plant, both leaf length and width as well as total plant fresh weight (g) in both growing seasons. In this concern, (Sids-50) genotype was the best for plant height (94.2 and 90.0 cm), number of leaves/ plant (12.5 and 12.7), leaf length (43.7 and 42.2 cm) and total fresh weight / plant (149.9 and 154.2 g), followed by Eggaseed-2 for plant height (88.9 and 89.8 cm), Eggaseed-1 for number of leaves/ plant (12.0 and 12.1) and Baldy cultivar for total fresh weight / plant (141.5 and 140.3 g). on the other side, Eggaseed-2 recorded the highest width leaf (3.1 and 3.4 cm), followed by Sids-40 cv. (2.2 and 2.5 cm) in both seasons .

On the other hand, the shortest plant (59.9 and 60.9cm) with Eggaseed-1, lowest number of leaves (11.3 and 11.1 leaf/ plant) and total fresh weight/ plant (125.6 and 127.3 g) with Eggaseed-2 , minimum leaf length (32.4 and 27.96 cm) with Sides -40 and leaf width (0.9 and 0.8 cm) with Balady cv. In the 1st and 2nd seasons, respectively.

The previous significant differences on growth characters among various garlic cvs were confirmed by the results of Hussain *et al.*, (1995), Mohamed (2004), Moustafa *et al.*(2009), Aly (2010), Anwar (2012), EL-Nagar and El-Zohiri (2015) Asiya *et al.*(2017), Omnarayan and Thakre (2018) and Khan *et al.*(2018).

2. Yield and its components:

After 170 days from planting (two weeks before harvest), the obtained data in Table (3) revealed that there were significant differences in bulb diameter, number of cloves / bulb and bulbing ratio among cultivars and the genotype. In this concern, Sids-50 genotype significantly increased bulb diameter (8.5 and 8.0 cm) without significant differences with Balady and Eggaseed-1 in the 2nd season. Number of cloves / bulb were the highest with Balady cultivar (28.0 and 28.3 cloves) in both seasons without significant differences with Sids 50 genotype in both seasons.

Meanwhile, Eggaseed-2 cv. gave the lowest values of bulb diameter (4.6 and 4.0 cm) , number of cloves/ bulb (13.0 and 12.9 cloves) and gave the highest bulbing ratio than that of other cultivars (0.38 and 0.38) in both seasons. This indicated that Eggaseed-2 cv. was more later in maturity than other cultivars. in both seasons. These results are in agreement with those obtained by Anwar (2012), Khan *et al.* (2018) and Shibana and Jalaja (2019). who reported that number of cloves per bulb was maximized in garlic Balady El-Wady followed by Balady garlic cvs. Bulbs of cvs Sids-40 and Egaseed-2 clone contained the lowest number of cloves in both seasons.

Such data in Table 3 that significantly highest total fresh yield were recorded in Sids-50 garlic genotype (15.4 and 15.7 ton/fed) and cured yield (6.9 and 7.6. ton/fed. in the 1st and 2nd seasons, respectively), followed by cv. Balady (13.7 and 13.2 ton /fed. fresh yield) and (6.5 and 6.2 ton/fed. cured yield , in the 1st and 2nd seasons, respectively), while it was lowest in fresh yield produced by cv. Eggaseed-2 (7.3 and 6.9 ton/fed.) and cured yield (4.1 and 4.2 ton/fed.) in the 1st and 2nd seasons respectively. The remained Sids-40 and Eggaseed-1 cultivars occupied an intermediate position between the maximum and minimum total fresh and cured yield.

The relative increases in cured yield due to Sids -50 genotype were about (6.15 and 22.58 %) over Baldy cultivar , (30.18 and 31.03 %) over Sids-40, (15.0 and 24.59 %) over Eggaseed-1 and (68.29 and 80.95 %) over Eggaseed-1 in the 1st and 2nd seasons, respectively.

These results are in agreement with those obtained by Asiya *et al.* (2017) who found that the genotype Yamuna Safed-3 recorded maximum bulb yield per hectare (14.51 t/ha). On the basis of growth and yield parameters Yamuna Safed-3, Yamuna Safed-2, Yamuna Safed-9 and Yamuna Safed-5 produced highest yield when grown under Eastern Dry Zone of Karnataka., Omnalayan and Bhupendra (2018) reported that best results were recorded on all the parameters in variety KS-2 followed by variety G-4 and the minimum were recorded with the genotype Agrifound White. Best results on quality parameters were also recorded in KS-2. Khan *et al.*(2018) indicated that the NARC-G1 cultivar gave maximum fresh yield (25.6 t/ha), followed by Cultivar

Italian, which gave (22.4 t/ha), while cultivar LehsonGulabi was noted at the bottom and gave (15.2 t/ha). Hence, NARC-G1 cultivar could be utilized in term of better yield and as well as industrial use for value addition purposes. Shibana and Jalaja (2019) stated that the genotype Yamuna safed-3 recorded a highest yield of 1.19Kg/2m² followed by local cultivar and Ooty-1 (0.90 Kg/2 m² and 0.89Kg/2 m² respectively). While considering both yield and quality aspects in trade, local cultivar, Yamuna Safed-3 and Ooty-1 were found to be the promising genotypes.

3. Allicin content mg/g Fresh and cured cloves:

In general, Allicin content in cured cloves were the highest than fresh cloves (Fig. 1). Such data in the Fig.1 show that Allicin contents of fresh and cured cloves were highest in two garlic cultivars Eggaseed-2 and Sids-40 compared with other cultivars. Whereas, Eggaseed-1 cultivar was ranked as the second order in cases of Allicin contents of fresh and cured cloves in both seasons. While, Balady cultivar and Sids-50 genotype produced the lowest

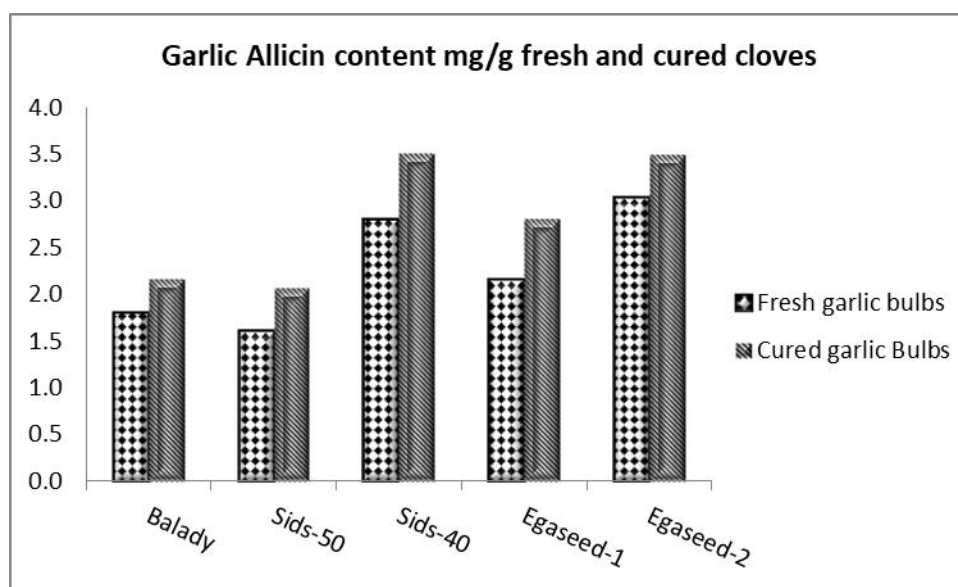


Fig. (1). Allicin content on five garlic cultivars and genotype

Allicin content of fresh and cured cloves. (Lee, 2005) showed that hard neck garlic (similar to Sids-40, Eggaseed-1 and Eggaseed-2) contains higher Allicin content than soft neck garlic (similar to Balady cultivar and Sids-50 genotype). Al-Otayk *et al.* (2008) found contrast result on Allicin content and Raslan *et al.*

(2015) on garlic found that Sids-40 had a higher Allicin content than the cv. Balady. (Wongsa *et al.* 2016) reported that a significant differences were observed in Allicin content between garlic genotypes. The amount of Allicin varied from 4.5 to 26.8 mg/ g DW. The difference in Allicin concentration between genotypes and agronomical practices was significant.

CONCLUSIONS

Referring to the obtained results, it could be concluded that the highest garlic yield and its components can be achieved from Sids-50 garlic cultivar followed by cv. Balady, and Eggaseed-1 (purple). In order to obtain the highest allicin content it is recommended to cultivate Sids-40 or Eggaseed-2.

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تقييم بعض الخصائص البستانية ومحتوى الأليسين لبعض الطرز الوراثية للثوم

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أجريت تجربتان حقليتان خلال عامين متتاليين في الموسم الشتوي 2018/2017 و 2019/2018 بمحطة بحوث البساتين بسدس – مركز البحوث الزراعية – الجيزة – مصر بهدف تقييم 5 تراكيب وراثية للثوم هي الثوم المصري (البلدي) ، سدس-50 ، سدس-40 ، إيجاسيد-1 و إيجاسيد-2 على بعض صفات النمو الخضري ، صفات الأصيل ، الإنتاجية ، ومحتوى الفصوص من الأليسين في المحصول الطازج والمعالج.

وقد أظهرت النتائج أن أعلى ارتفاع للنبات ، أقصى عدد لأوراق النبات ، أطول ورقه ، أعلى وزن طازج للنبات ، قطر البصله ، كل من المحصول الطازج والمحصول المعالج كانت مع السلالة سدس 50 في كلا الموسمين. بينما تم تسجيل أكبر عرض للورقه ومعامل التبصيل في الصنف إيجاسيد 2، علاوة على ذلك، كان فقد سجل الصنف البلدي أعلى عدد للفصوص في البصله في كلا الموسمين.

كانت مقدار الزيادة النسبيه في المحصول المعالج للسلاله سدس 50 تتراوح بمقدار (6.15 ، 22.58 %) عن الصنف البلدي ، (30.18 ، 31.03 %) عن الصنف سدس 40 ، (15.0 ، 24.59 %) عن الصنف إيجاسيد-1، (68.29 ، 80.95 %) عن الصنف إيجاسيد-2 في الموسم الأول والثاني على التوالي. كان أعلى تركيز لمحتوى فصوص الثوم الطازجه والمعالجه من الأليسين مع الصنفين إيجاسيد-2 والصنف سدس-40 ، بينما أقل تركيز من الأليسين مع السلاله سدس-50 والصنف البلدي في كلا الموسمين.

التوصية : يمكن التوصيه وذلك للحصول على أعلى نمو ثوم ، ومحصول ومكوناته من السلاله سدس 50 ، يليه الصنف البلدي ثم إيجاسيد-1 (الأرجواني). وللحصول على أعلى محتوى من الأليسين يمكن زراعة الصنف إيجاسيد-2 أو الصنف سدس-40.