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Analysis of Some chemical components of fifteen garlic ecotypes and its relations with environmental and cultural practices.*

Mohamed M. Aly Abdalla, Mohamed H. Aboul-Nasr, Ayman K. Metwaly and Shreen H. Aly
Dept. of Horticulture Fac. Agric. Assiut Univ. Assiut

Key words: Garlic- Ecotypes- *Allium sativum* - Chemical Components

Abstract

Field experiments were conducted at the Experimental Farm of Faculty of Agriculture, Assiut University, Egypt in three consecutive winter seasons of 2004-2005, 2005-2006 and 2006-2007. The aim of the present experiments were to determine the effects of three planting dates, fifteen garlic ecotypes (11 Balady and 4 Chinese ecotypes) and two plant density (30 and 60 cloves in each row sides) on garlic quality under Assiut province conditions. The obtained results indicated that percentage of total soluble solids, percentage of vitamin C and percentage of sulphur were increased by early planting. However late planting increased the percentage of volatile oil.

Ecotypes from Balady surpassed Chinese in content of vitamin C and percentage of sulphur. On the other hand, Chinese ecotypes surpassed Balady ecotypes in percentage of total soluble solids, and percentage of volatile oil.

Plant density did not show any significant effect in any of the four studied treats.

Introduction

Garlic (*Allium sativum* L.) is the second most widely used of the cultivated bulb crops after onion,and one of the main vegetable crops which have been cultivated since 3000 B.C. in Egypt. Garlic can be consumed in many forms; fresh as an intact clove or in tomato salads, cooked as spice and flavoring agent, pickled or in pharmaceutical preparations (powders, granules, tablets and oil). In addition, it also has a medical value, as it possesses antiseptic and bacterial properties. It enhances immunity system; also, it is useful in cases of blood vessels diseases and blood pressure.

The chemical composition of garlic compounds is divided into two main groups: sulfur containing compounds and non-sulfur containing compounds. Most of the medicinal effect of garlic are referable to sulfur compound known as allicin (Schulz,1998). The intact clove does not contain allicin but rather its precursor, the non amino acid alliin . Alliin is converted to allicin, purvate

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Referees: Prof.Dr.: Saif E. H. Gad Prof.Dr.: Said A. Abdel Aal

and amonia by the enzyme allinase when the bulb is cut or crushed (Rabinkov *et al.*, 1994).

The steam volatile components of garlic are diallyl, dimethyl, disulfide, trisulfide and some other minor components, all formed from decomposition of allicin.

Garlic is an ancient and widely grown crop in Egypt for export and local consumption, it is demanded for local markets all over the year, besides it is also required for foreign markets due to its early maturity.Garlic in Egypt is planted between mid-Aug. and December. Bulbing on garlic is controlled by the daylength and temperature to which dormant cloves and growing plants are exposed before bulbing begins. Bulbing requires long photoperiods and warm temperatures (Takagi, 1990).

The cultivated garlic area in A.R.E. decreased from 33534 fed. in 2000 to 32944 in year 2007 and the total production increased from 301270 tons to 308812 tons respectively, for single and intercropping garlic production, according to Agricultural Economic and Statistics Bulleten, 2007. A.R.E. Department of Agriculture. The average garlic production in Egypt was 9.5 Ton/Fed.

The objective of this work was to compare some chemical composition as will as number of leaves on some different ecotypes collected from different governorates of Egypt under Assiut conditions.

Materials And Methods

Field experiments were conducted at the Experimental Farm of Faculty of Agriculture, Assiut University, Egypt in three consecutive winter seasons of 2004-2005, 2005-2006 and 2006-2007. The aim of the present experiments were to determine the effects of three planting dates, fifteen garlic ecotypes (11 Balady and 4 Chinese ecotypes) and two plant density (30 and 60 cloves in each row side) on some chemical composition as will as number of leaves under Assiut province conditions.

Experimental factors:-

1- Planting dates:

The experiment was consisted of three planting dates i.e. September 1st, October 1st and November 1st evaluated in three successive winter seasons of 2004-2005, 2005-2006 and 2006-2007.

2- Ecotypes:

Garlic ecotypes (11 Balady and 4 Chinese) were collected from different authentic framers and Agricultural Research Centers in different Egyptian province. The garlic ecotypes used in the present study are shown in Table (1).

3- Plant density:

Two plant densities were used in these experiments. Garlic plant spaced five and ten cm apart between plants within ridge on both sides of the rows (northern and southern ridge side). The cloves number, per ridge, was 30 in low plant density to 60 cloves in the higher plant density. The depth of planting was about three-to-five cm and cloves should be set with tip up. Garlic

was planted by planting individual cloves per hill. Bulbs for planting were first "cracked" (separated into individual cloves) and graded. Small, damaged, and infected cloves were discarded. All the cloves were planted except the long, slender ones in the center of the bulb and those that are less than one gram in weight. Bulbs that have side growths were discarded. The cloves were not being so deep that the soil will interfere with the swelling of the bulbs, nor so shallow that irrigation water will wash them out.

Table (1): Garlic ecotypes used in the present study.

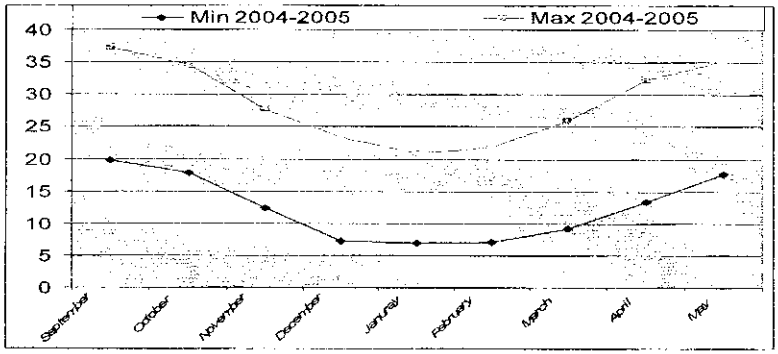
Number	Ecotypes	Landraces	Source
1	Balady	Assuit-1(Arab El-Awamer)	Assiut
2	Balady	Beni-Suef	Beni-Suef
3	Balady	Assiut-2 (Moasha)	Assiut
4	Balady	El-Gharbia	El-Gharbia
5	Balady	El-Menia-1(Smalot)	El-Menia
6	Balady	Suhag	Suhag
7	Balady	El-Menia-2(Malawey)	El-Menia
8	Balady	Assiut-3(Dronka)	Assiut
9	Balady	Qena	Qena
10	Balady	Aswan	Aswan
11	Balady	El-Behairah	El-Behairah
12	China	Assiut(Arab El-Awamer)	Assiut
13	China	Sids 40	Beni-Suef
14	China	Aswan	Aswan
15	China	El-Menia (Smalot)	El-Menia

The soil texture of the experimental site was clay with a pH average of 7.6 Average available nitrogen was about 1.76 % and average available phosphorus was 14.3 ppm. Data of some physical and chemical properties of the experimental site for the three winter seasons of 2004-2005, 2005-2006 and 2006-2007 are shown in Table (2).

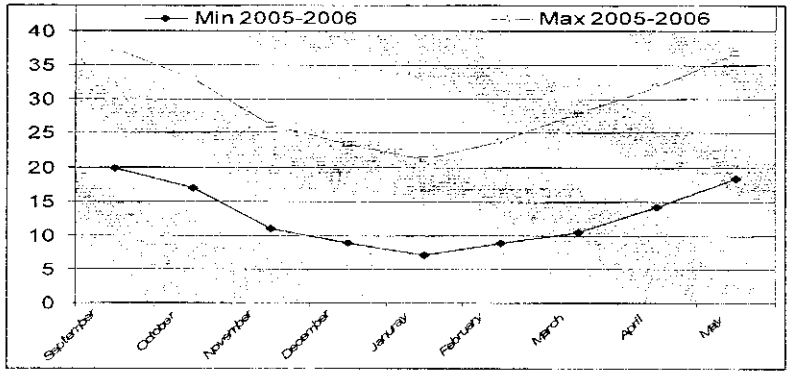
Table (2): The physical and chemical properties of the soil used for growing garlic before applying of any fertilizers.

Average years	Sand %	Silt %	Clay %	Texture	pH 1:1	ECe dS/m	Total CaCO3%	Total N %	Available nutrients ppm				
									P	K	Fe	Mn	Zn
2005, 2006 and 2007	20.1	30.1	48.3	Clay	7.6	1.26	3.3	1.76	14.3	33.9	9.1	11.1	1.35

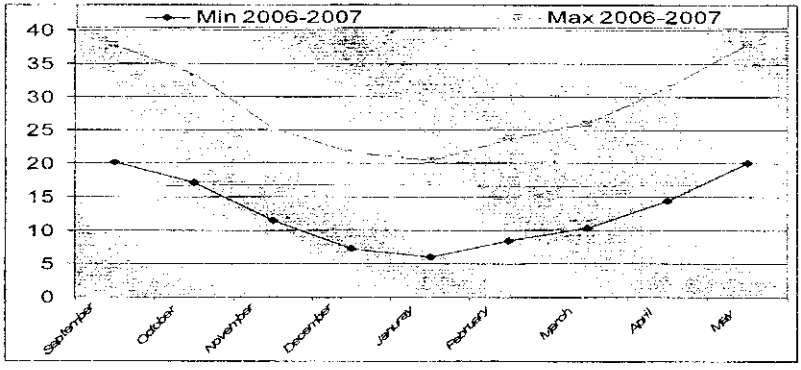
Data of maximum and minimum temperatures (°C) for the three seasons (2004-2005, 2005-2006 and 2006-2007) that prevailed during the experimental period are shown in Figs. 1



First season



Second season



Third season

Fig. (1):Average daily maximum and minimum temperatures during the three growing seasons

Experimental plots were consisted of four rows each of 3.5 meters in length and 0.7 meter in width forming a plot area of about 10.0 m2 equal to ($\frac{1}{400}$/F). The experimental site was prepared using a conventional method. Normal cultural practices, irrigation, weeds and pest control were followed as in commercial fields of garlic production.

In each season the experiment consisted of 90 treatments, which were the combination of (15 ecotypes x 3 planting dates x 2 planting densities). The experiments were laid out in a split-split-plot in randomized complete block design with four replicates according to Snedecor and Cochran (1986). Planting dates occupied the main plots, while the garlic landraces (ecotypes) were randomly distributed in the sub-plots. Plant densities were subjected to sub-sub plots.

The following data were recorded only in last two seasons.

Random samples of garlic bulbs at harvesting were used for the following chemical analysis in last two seasons of 2005-2006 and 2006-2007:

1- Number of leaves per plant.
2-Total soluble solids (T.S.S.).
3- Sulphur concentration in bulbs, assayed on fresh weight basis, A.O.A.C. (1975).
4- Ascorbic acid (v.c.%) in bulbs.

Ascorbic acid was determined according to Bajiaj and Kour (1981).

5- Volatile oil percentage in bulbs.

Volatile oil percentage was determined only in last season 2006/2007 using the return flow microdistillation apparatus, according to the procedure adopted from Guenther (1952).

Statistical analysis:

Data of vegetative and yield characters were subjected to statistical analysis using normal F-test and means of treatments were compared using the L.S.D method as reported by Steel and Torrie (1982).

Results and Discussion

1- Number of leaves per plant

The data of the number of leaves per plant are shown in Figs. (2), (3), and (4).

There were significant differences between the three planting dates concerning this character. The number of leaves per plant significantly increased in the first date as compared with the second and third date. This may be due to the suitability of temperature during early planting, which may allow more vigorous growth and consequently increasing the number of leaves per plant. These results were found to be in agreement with the findings of Fouda *et al.* (1977), Maksoud *et al.* (1983 and 1984) and Abd El-Fatah (1989) Shahien (1992), Jamroz *et al.* (2001) and Rahman *et al.* (2004) who found that early planting increased the number of leaves per plant as compared with late planting.

The number of leaves per plant was also significantly affected by ecotypes in all seasons. Differences in the behavior of ecotypes during the seasons may be due to genetics, different environmental conditions and the micro-climates that they were adapted to. Generally, the Chinese

ecotypes gave the highest number of leaves per plant as compared with ecotypes from Balady. These results were in the same trend with the findings of Maksoud *et al.* (1983 and 1984), Zaki (1984), El-Beheidi *et al.* (1985), Shahien (1987), El Sawah (1990), Shahien (1992), Gvozdanovic-Varga *et al.* (2002) and El-Sayed (2004) who found that number of leaves in the Chinese garlic were higher than the Egyptian garlic. The highest number of leaves per plant were detected from Chinese ecotypes (Assiut (Arab El-Awamer), Sids40), while the Balady ecotypes were detected from (El-Behairah, Qena).

Further, the number of leaves per plant was not significantly affected by densities and the interaction between varieties and densities in all varieties in all dates. These results confirmed those reported on garlic by Foda *et al.* (1977), Maksoud and El-Oksh (1983), Abou-Hamela (1987), Jamroz *et al.* (2001) and Dawar *et al.* (2005). In general, slight decreases were obtained with increasing plant density.

There were significant differences among sampling dates. Maximum number of leaves was obtained at the third sample date in the first and second date in all seasons. However, the second sample gave the maximum number of leaves in the third date in the second and third seasons. These results are validated the findings of El-Gindy (1965), Maksoud *et al.* (1983) and Shahien (**1992**) who recorded an increase in number of leaves per plant with each increase in plant age. Generally, the interaction between planting dates and sampling dates showed that early planting date increased number of leaves at all sampling dates as compared with late planting.

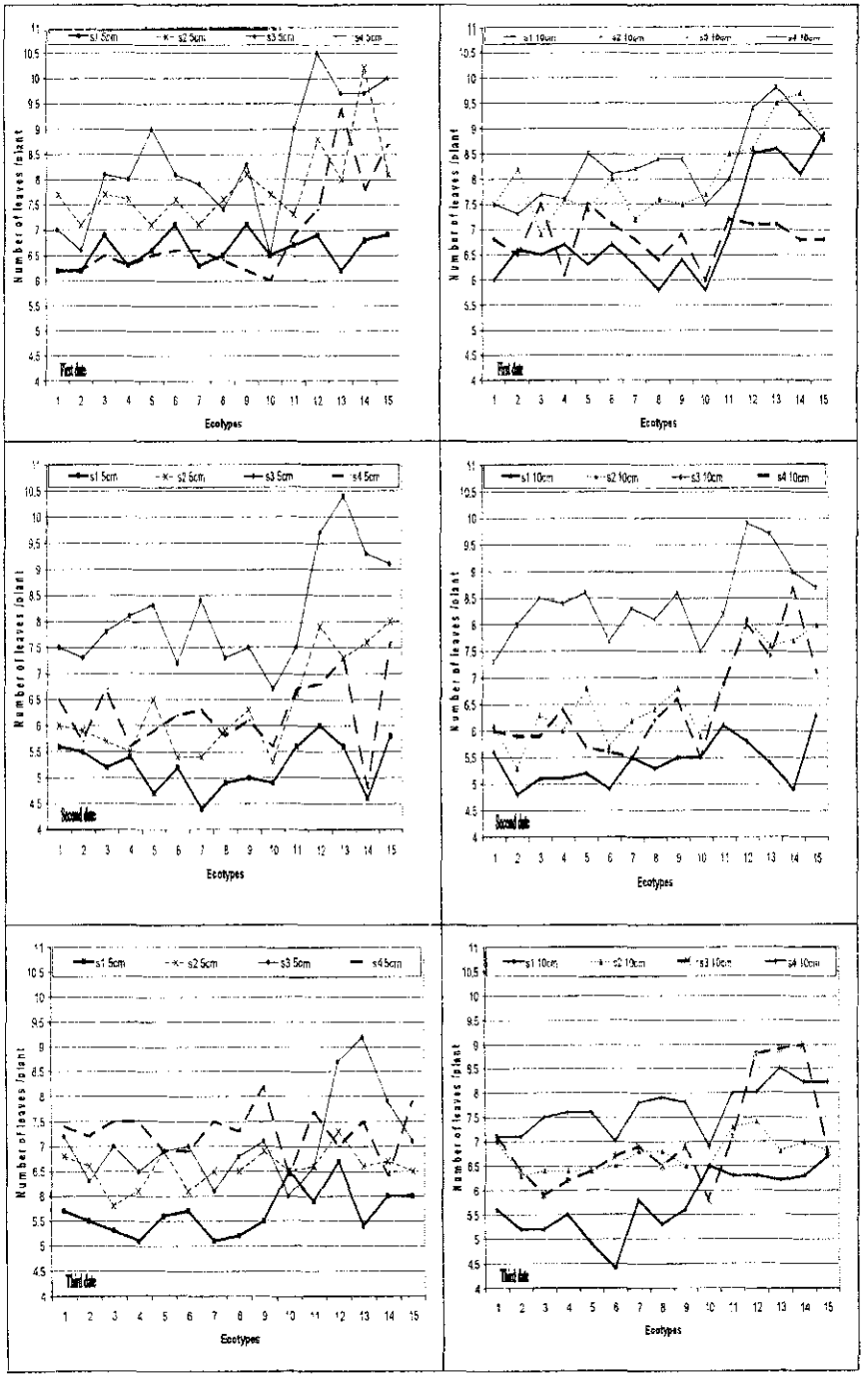


Fig. (2):Effect of planting dates, ecotypes and two plant density on number of leaves per plant during the first season (2004/2005).

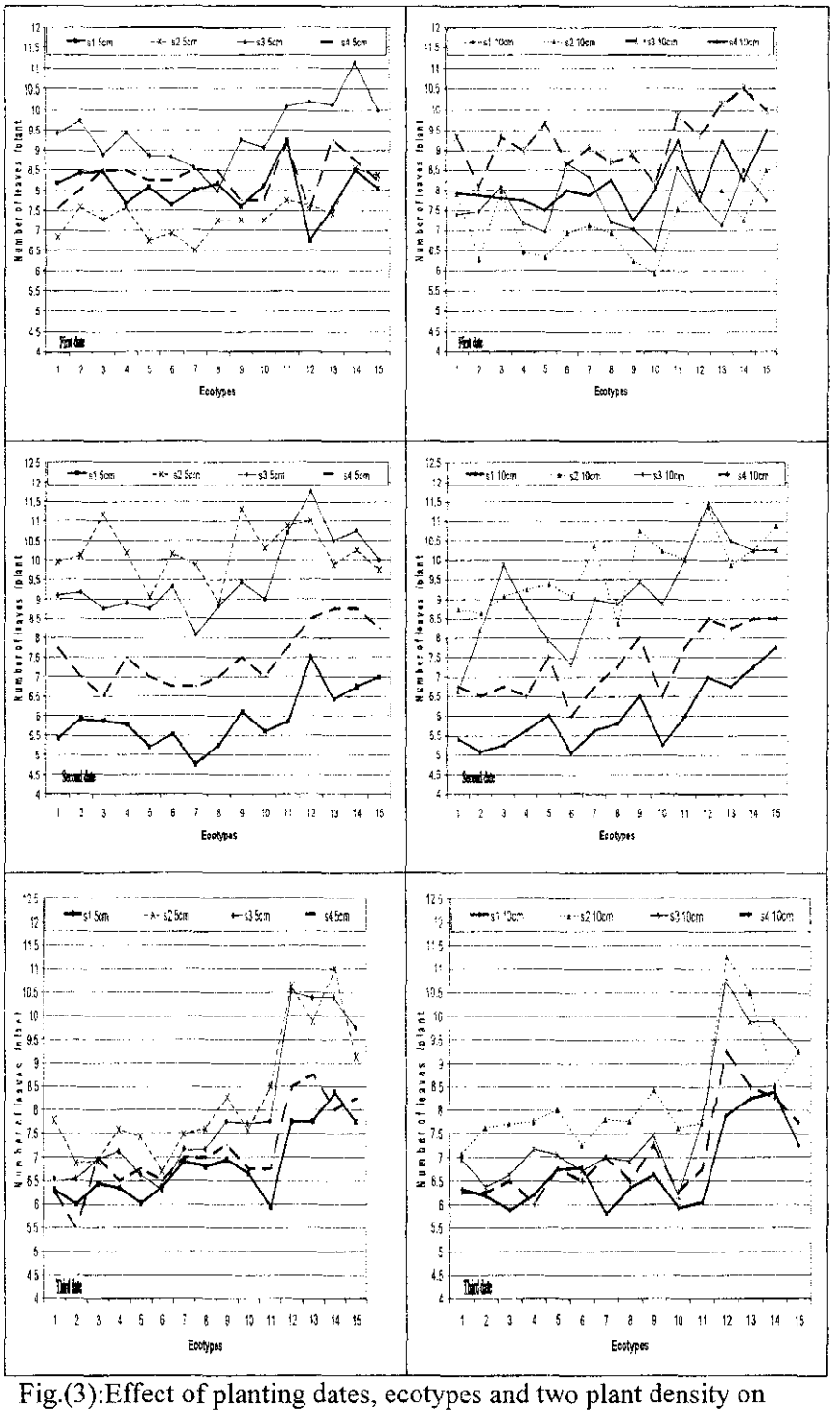


Fig.(3):Effect of planting dates, ecotypes and two plant density on number of leaves per plant during the second season (2005/2006).

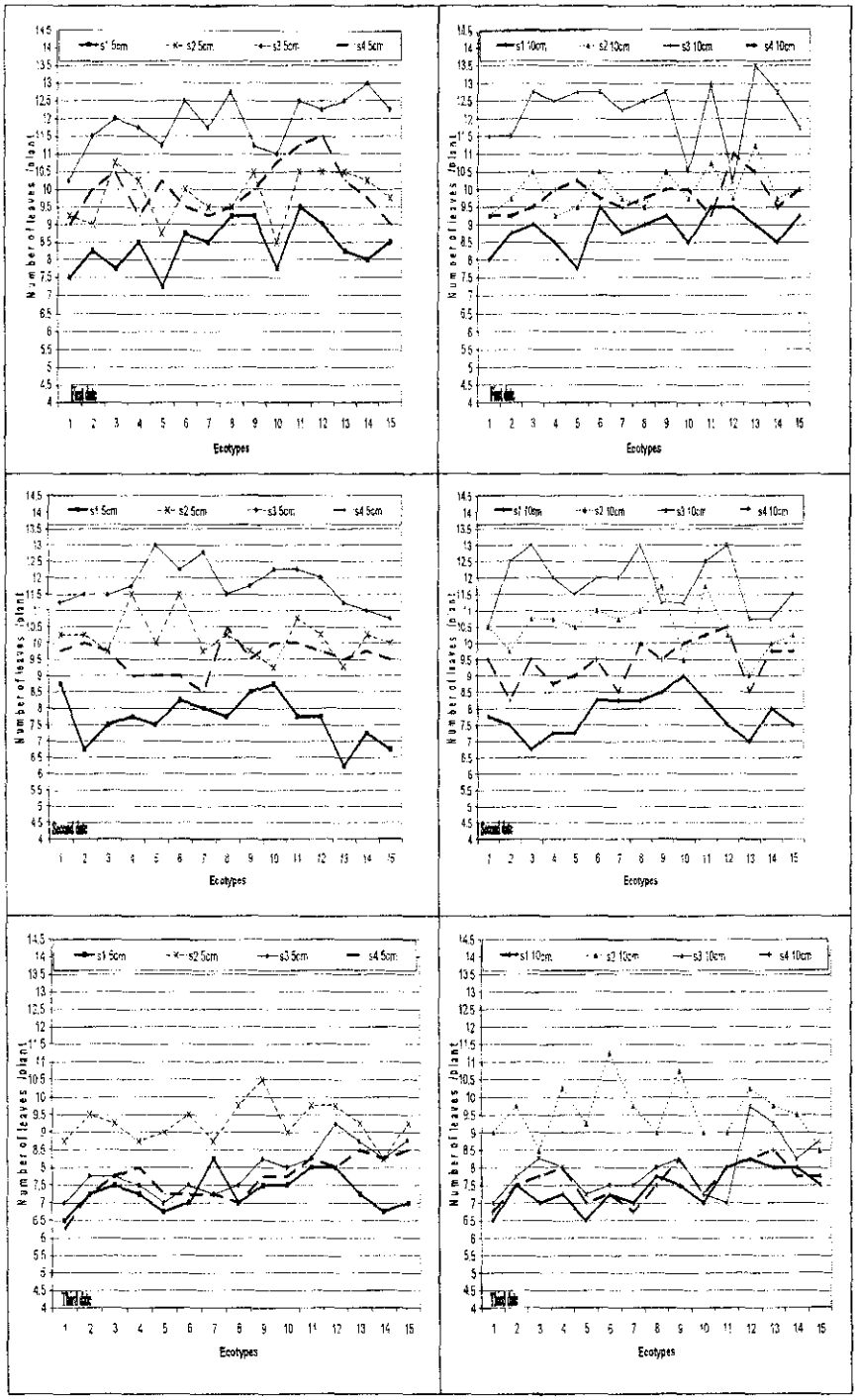


Fig. (4`):Effect of planting dates, ecotypes and two plant density on number of leaves per plant during the third season (2006/2007).

2- Percentage of total soluble solids (T.S.S.):

Data concerning total soluble solids are shown in table (3).Results indicated significant differences between planting dates in the second and third season. Planting at the first and second date produced higher total soluble solids in bulbs as compared with the third date. These results agreed with Shahien (1992) on garlic who reported that early planting gave higher values of T.S.S. as compared with late planting.

Percentage of total soluble solids was affected by ecotypes and the interaction between planting dates and ecotypes. Results indicated significant differences among ecotypes in the second season only. Generally, most Chinese ecotypes gave higher values as compared with ecotypes of Balady. These results are in agreement with the findings of Maksoud and El-Oksh (1983) and Shahien (1992). The highest percentage of total soluble solids were detected from Chinese ecotype (Sids 40), while the Balady ecotypes (Qena, El-Menia (Malawey)) produced the highest values.

Who found that the highest total soluble solids were produced in the Chinese cultivars as compared with Egyptian cv.

Plant density did not show any significant effect on total soluble solids. In general, the closest spacing gave the highest values of T.S.S.

The interaction between varieties and density did not reveal any significant effect on total soluble solids.

3-Determination of sulphur.

Data on percentage of sulphur (g/100g) in bulbs are presented in Table (4), determination was carried out at 4 weeks after harvest. It is clear from the table, planting at the first and second date enhanced the content of sulphur in most ecotypes as compared with the third date in the second and third season. Generally, early planting showed the highest content of sulphur in most ecotypes.

Table (3): Effect of planting dates, ecotypes and plant density on total soluble solids (T.S.S.) of bulbs during the two winter seasons of (2005/2006 and 2006/2007).

Ecotypes	2005-2006							2006-2007						
	Planting dates													
	Sept., 1		Oct., 1		Nov., 1		Avg.	Sept., 1		Oct., 1		Nov., 1		Avg.
	5 cm	10 cm	5 cm	10 cm	5 cm	10 cm		5 cm	10 cm	5 cm	10 cm	5 cm	10 cm	
1	39.75	39.25	36.38	36.38	36.05	36.75	37.17	38.75	38.38	38.25	38.00	37.38	36.25	37.74
2	38.88	38.38	36.75	34.38	36.25	36.88	36.70	37.50	36.38	38.13	38.50	35.25	34.25	36.63
3	37.50	38.13	37.50	37.63	38.50	36.50	37.60	38.88	37.13	37.25	38.88	36.75	36.63	37.53
4	37.75	39.50	36.38	36.50	36.13	38.13	37.24	36.88	37.25	37.00	37.25	36.25	36.50	36.83
5	39.38	38.75	37.25	37.13	35.88	36.88	37.35	38.63	37.25	38.88	36.75	36.75	37.25	37.54
6	38.25	36.75	35.88	34.50	34.63	35.63	35.74	39.38	38.38	36.63	36.50	37.25	34.75	36.93
7	40.63	39.38	37.50	36.63	36.13	37.63	37.73	38.13	38.50	39.00	38.75	36.75	36.75	37.94
8	39.50	40.00	36.75	36.13	35.00	35.33	36.79	37.25	39.00	37.13	37.38	35.63	36.63	37.05
9	39.75	40.38	38.00	38.25	38.13	37.88	38.56	38.88	38.88	38.75	38.88	34.63	36.88	37.68
10	40.00	40.13	38.25	38.13	36.50	36.75	38.07	39.50	39.38	37.75	35.75	37.13	35.50	37.26
11	40.75	39.50	37.00	38.88	36.50	37.00	38.04	37.13	38.75	39.75	38.00	34.75	34.63	37.07
12	38.88	39.50	36.63	37.13	36.13	36.63	37.27	38.50	39.75	37.75	35.63	38.25	35.50	37.37
13	40.88	40.88	39.00	38.08	36.00	36.75	38.31	39.00	39.13	39.00	39.25	38.25	37.50	38.64
14	39.13	39.25	37.50	35.88	37.50	36.88	37.50	38.88	39.75	37.88	37.25	37.25	38.75	38.16
15	40.13	38.38	36.13	36.38	37.38	30.75	36.18	39.38	38.88	40.00	35.75	37.00	37.75	38.00
Avg.	39.41	39.21	37.13	36.80	36.45	36.42		38.44	38.45	38.21	37.50	36.62	36.37	

L.S.D. at (0.05)		2005/2006	2006/2007
Planting dates (A)	=	1.10	0.95
Ecotypes (B)	=	0.93	n.s.
(AB)	=	1.61	n.s.
Plant density (C)	=	n.s	n.s.
(AC)	=	n.s	n.s.
(BC)	=	1.29	n.s.
(ABC)	=	n.s.	n.s.

Table (4): Effect of planting dates and ecotypes on content of Sulphur in (g/100g) in bulbs during the two winter seasons of (2005/2006 and 2006/2007).

Ecotypes	2005-2006				2006-2007			
	Planting date							
	Sept., 1	Oct., 1	Nov. 1	Avg.	Sept., 1	Oct., 1	Nov., 1	Avg.
1	1.25	1.43	1.06	1.25	1.37	1.54	1.12	1.34
2	1.40	1.51	1.33	1.41	1.44	1.74	1.34	1.51
3	1.37	1.58	1.30	1.42	1.06	1.36	1.24	1.22
4	1.37	1.30	1.21	1.29	1.44	1.44	1.13	1.34
5	1.53	1.27	1.18	1.33	1.63	1.10	1.45	1.39
6	1.23	1.36	1.06	1.22	1.27	1.30	1.11	1.23
7	1.35	1.25	0.97	1.19	1.61	1.00	1.16	1.26
8	1.56	1.22	1.43	1.40	1.56	1.24	1.38	1.39
9	1.32	1.39	1.33	1.35	1.25	1.28	1.12	1.22
10	1.15	1.06	1.01	1.07	1.04	0.83	0.75	0.87
11	1.19	1.12	0.98	1.09	1.27	1.17	1.00	1.15
12	1.29	1.00	1.21	1.17	1.22	1.05	1.37	1.21
13	0.94	0.84	0.75	0.84	0.86	0.82	0.89	0.86
14	0.86	1.10	0.70	0.89	1.11	1.03	1.00	1.05
15	1.08	1.02	1.17	1.09	1.07	0.98	1.18	1.08
Avg.	1.17	1.23	1.11		1.28	1.19	1.15	

The concentration of sulphur showed that the Balady ecotypes contained a higher content of sulphur than Chinese ecotypes. The highest percentage of sulphur were detected from Balady ecotypes (Assiut (Moasha), Beni-Suef), while the Chinese ecotype (Assiut (Arab El-Awamer)) produced the highest values.

4- Ascorbic acid.

Vitamin C was determined according to Bajiaj and Kour, 1981.Data on percentage of vitamin C (mg/100g) in bulbs are presented in Table (5), determination was carried out at 4 weeks after harvest. It is clear from the table that planting at the first and second date enhanced the percentage of ascorbic acid as compared with the third date in the second and third season. Generally, early planting showed the highest percentage in vitamin C in most ecotypes. The values of vitamin C showed that the Balady ecotypes contained a higher percentage of vitamin C than the Chinese ecotypes. The highest percentage of vitamin C were detected from Balady ecotypes (El-Behairah, El-Gharbia), while the Chinese ecotype (Assiut (Arab El-Awamer)) produced the highest values.

Table (5):Effect of planting dates and ecotypes on percentage of Vitamin C (mg/100g) in bulbs during the two winter seasons of (2005/2006 and 2006/2007).

Ecotypes	2005-2006				2006-2007			
	Planting date							
	Sept., 1	Oct., 1	Nov. 1	Avg.	Sept., 1	Oct., 1	Nov., 1	Avg.
1	25.4	27.0	23.3	25.2	26.0	30.0	24.1	26.7
2	23.4	29.1	26.0	26.2	25.0	31.5	24.0	26.8
3	27.7	30.6	27.1	28.5	28.0	28.9	26.0	27.6
4	32.3	34.0	29.0	31.8	34.0	33.7	31.8	33.2
5	31.2	28.6	27.0	28.9	25.2	30.0	28.5	27.9
6	23.6	29.0	25.3	26.0	23.0	27.3	27.0	25.8
7	30.3	33.0	31.0	31.4	31.8	34.0	29.6	31.8
8	31.3	35.5	27.1	31.3	32.1	33.0	29.5	31.5
9	30.3	29.6	25.6	28.5	31.6	31.0	27.0	29.9
10	31.3	28.7	26.0	28.7	26.0	30.2	24.4	26.9
11	29.6	34.8	32.4	32.3	29.8	36.0	31.0	32.3
12	24.4	30.0	29.5	28.0	28.0	31.0	23.2	27.4
13	23.0	27.3	23.7	24.7	23.0	23.0	24.0	23.3
14	26.2	27.7	24.6	26.2	27.0	31.0	23.0	27.0
15	28.3	28.7	25.6	27.5	28.0	29.0	25.1	27.4
Avg.	27.9	30.2	26.9		27.9	30.6	26.5	

5-Volatile oil percentage in bulbs:

Table (6) presents the values of the amount of volatile oil in bulbs, determination was carried out at 4 weeks after harvest. Planting at the second and third date enhanced the percentage of volatile oil as compared with the first date in third season. Generally, late planting showed the highest percentage in oil contents for all ecotypes. This may be attributed to the environmental conditions prevailing at maturity. These results agree with Nassar *et al.* (1972).

It is clear from the table (5) that the Chinese ecotypes contained a higher oil percentage than the Balady ecotypes. This results agrees with the findings of Nassar *et al.* (1972), Omar and Abou-Hadid (1992), Shahien (1992) and Hussein *et al.* (1995), who found that garlic bulbs of Chinese cultivar had a slightly higher volatile oil percentage as compared with Balady. The highest volatile oil percentage in bulbs were detected from Chinese ecotypes (Assiut{Arab El-Awamer}), while the Balady ecotype (Qena) produced the highest values.

Table (6):Effect of planting dates on content of volatile oil in bulbs during the season (2006/2007).

Ecotypes	Planting date (2006-2007)			
	Sept., 1	Oct., 1	Nov. 1	Avg.
1	0.04	0.08	0.10	0.07
2	0.07	0.08	0.07	0.07
3	0.04	0.06	0.10	0.07
4	0.06	0.08	0.14	0.09
5	0.03	0.07	0.06	0.05
6	0.02	0.05	0.08	0.05
7	0.07	0.08	0.07	0.07
8	0.08	0.11	0.08	0.09
9	0.09	0.17	0.11	0.12
10	0.03	0.05	0.05	0.04
11	0.09	0.09	0.13	0.10
12	0.09	0.14	0.18	0.14
13	0.08	0.17	0.11	0.12
14	0.06	0.11	0.08	0.08
15	0.03	0.07	0.08	0.06
Avg	0.059	0.094	0.096	

Gas liquid chromatographic analysis:

The main compounds of the volatile oils of two Balady cultivars and two Chinese cultivars that separated by GLC as well as their relative percentages are shown in Table (7).

Eighteen compounds have been identified in garlic volatile oil. The identified compounds represented 84.57 to 95.83% of total compound.

The main compounds was found to be diallyl trisulfide in both Balady and Chinese cultivar which ranged from 18.38 to 38.82% except for Chinese cv. (14) which showed diallyl trisulfide (19.28%) as the 2nd main compound, while the main compound for Chinese cv. (14) showed diallyl disulfide as the 1st main compound. Balady cv. and Chinese cv. (13) showed allyl propyl disulfide (15.56-18.33%) as the 2nd main compound. These results are in agreement with those obtained by Brodnitz *et al.* (1971) stated that allyl and methylmano-, di-, and tri-sulfides are main compounds of garlic oils. El-Hadidy *et al.* (1981) revealed that diallyl sulfide, diallyl disulfide and propyl mercaptan are the sulfer containing compounds in the commercial garlic oil. Tokarska and Kazwowska (1983) reported that mano-, di- and tri-sulfides were found to be the predominant sulfer containing compounds in garlic oil.

Table (7): The main volatile compounds identified in garlic volatile oil.

RT (Mins)	Compounds	Relative area percentages			
		Balady (9)	Balady (5)	Chinese (13)	Chinese (14)
5.77	α-phellandrene	-	-	0.80	0.53
7.28	β-phellandrene	1.64	1.04	0.27	-
9.02	Diallyl thio sulfinate	-	-	12.56	1.32
9.18	Allyl propyl disulfide	16.37	18.33	15.56	4.01
11.58	Linalool	0.55	-	5.70	0.66
12.95	Geraniol	-	-	1.64	0.14
14.10	Citral	6.48	2.21	4.23	1.05
14.28	2-propen-1-ol	0.55	-	1.56	13.58
15.79	Diallyl sulfide	-	0.91	-	1.25
16.04	Methyl allyl sulfide	2.44	2.17	8.63	3.44
19.27	Dimethyl sulfide	2.84	1.92	5.61	1.04
21.39	Diallyl disulfide	10.45	15.03	15.48	29.38
24.09	Dimethyl disulfide	2.23	0.80	0.09	-
24.84	Diallyl trisulfide	38.82	29.05	18.38	19.28
25.76	Dimethyl trisulfide	2.75	5.83	1.65	4.86
29.53	Methyl allyl disulfide	1.19	3.56	0.56	6.03
34.36	Methyl allyl trisulfide	6.25	3.72	0.80	8.09
39.32	3-vinyl-4H-1,2-dithiin	-	-	-	1.17
		92.56	84.57	93.52	95.83

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تحليل بعض المكونات الكيميائية فى خمسة عشر سلالة من الثوم وتأثرها بالظروف البيئية والعمليات الزراعية بالحقل

محمد محمد علي عبد الله ، محمد حسام محمود أبو النصر ،أيمن قطب متولى ، شرين حسين على
قسم البساتين – كلية الزراعة – جامعة أسيوط – أسيوط

أجريت هذه الدراسة بمزرعة التجارب البحثية – كلية الزراعة – جامعة أسيوط – مصر خلال ثلاث مواسم زراعية 2004/2005-2005/2006-2006/2007

استخدمت فى هذه الدراسة 15 سلالة (11بلدى و4 صينى) زرعت بالحقل فى ثلاث مواعيد زراعة عند كثافتين 30 فص و60 فص فى الخط

دلت النتائج المتحصل عليها على أن الزراعة المبكرة أدت الى زيادة نسبة المادة الصلبة الذائبة الكلية وفيتامين سى و نسبة الكبريت فى حين أن الزراعة المتأخرة أدت الى زيادة نسبة الزيوت الطيارة

أظهرت السلالات البلدى تفوقا على السلالات الصينى فى نسبة فيتامين سى و نسبة الكبريت فى حين أظهرت السلالات الصينية تفوقا على البلدى فى نسبة المواد الصلبة الذائبة الكلية و نسبة الزيوت الطيارة فى حين لم تظهر الكثافة النباتية تأثيرا معنويا على الصفات الكيميائية المدروسة .