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THE IMPACT OF ORGANIC AND MINERAL FERTILIZATIONS, PLANT SPACING AND FOLIAR APLICATON OF YEAST AND GARLIC EXTRACT ON SEED PRODUCTION OF SUMMER SQUASH (*Cucurbita pepo* L.)

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ABSTRACT: *This study was carried out during two summer seasons of 2011 and 2012 at Sakha Horticultural Research Station Farm, Kafr El-Sheikh Governorate, on summer squash (Cucurbita pepo L.) Eskandarani cultivar to study the impact of plant spacing (30, 40 and 60cm between plants), nitrogen fertilizer sources (organic and mineral) and foliar spray with biostmulants (garlic or yeast extracts) and their interactions on vegetative parameters, mature fruit characteristics, seed yield and chemical constituents of seeds. Results indicated that, the highest values of vegetative growth characters; i.e., stem length, number of leaves, fresh and dry weight, leaf area and chlorophyll contents in leaves, mature fruit characteristics (number of fruits plant^{-1}, fruit length and diameter), seed yield and its components as well as chemical constituents of seeds (N, P, K, Fe, Zn and Mn) were recorded when plants growing at 60 cm between plants. Plants sprayed with 2.5cm/L garlic extracts recorded better growth performance and higher values of chemical constituents of seeds than unsprayed plants. Fertilized plants with 50% organic + 50% inorganic recorded the highest significant values of most formentioned parameters compared with control. The best results of vegetative growth parameters, mature fruit characteristics, seed yield and chemical constituents of seeds were recorded when plants growing at 60cm between them and fertilized by 50% organic as compost + 50% inorganic as ammonium nitrate (100 kg/fed.) and sprayed with garlic or yeast extracts at 2.5cm/L in both seasons .Therefore, this treatment could be recommended for improving squash plants performance under similar condition of this study.*

Key words: *Cucurbita pepo L., plant spacing, nitrogen fertilizer sources, garlic extract, yeast extract.*

INTRODUCTION

Summer squash (*Cucurbita pepo* L.) is one of the important vegetable crops grown in Egypt. Seed production studies on summer squash in Egypt did not have great attention, although seed production is considered one of top money product not only for sowing but also for eating seeds. Seeds of squash are rich in protein (34%), oil (46%), carbohydrates (10%) and fibers (2.8%) (Whiatker and Davis, 1962). The production of seeds to supply the needs of the growers and seed trade has become a very specialized industry. The successful seed production program should facilitate the production on high and good yield in an economical way. Plant density is one of the main factors determining seed yield. Most studies showed that relatively high plant densities were required to obtain the highest seed yield and quality (Edesltein and Nerson, 2002) and (Kanwar *et al*., 2000).The excessive use of nitrogen fertilizer represents the major factor of plant production cost. Increasing soil salinity, lead to serious health hazards and creates some pollution of agro-ecosystem (Fisher and Richter, 1984).The optimum fertilizer requirements for summer squash production can be realized not only with the recommended quantity, but also through using proper sources that is considered an important factors affecting the vegetative growth and yield. Organic matter such as animal manure, green manure, plant residue and composted organic matter is accepted

as a good soil management practice in sustainable crop production, because, it enhances soil fertility through the modification of soil physical, chemical and biological properties (Asuegbu and Uzo, 1984 and El-Gizy, 1994). Moreover, organic manures play an important role in nutrients solubility and the activation of physiological and biochemical processes in plant, leading to an increase in plant growth and nutrients uptake (Dahdouh *et al*., 1999) . Recently, great attention has been focused on the possibility of using natural and salty substitute: i.e.; dry yeast and garlic extracts as a substitute for artificial chemical fertilizers which have pollutant effects in the soil and plants and in turn, cause damage of the human health. Foliar sprays of yeast or garlic extracts are used in vegetable crops production for stimulating and hastening plant growth, flowering and fruit set. Consequently increasing fruit physical characters and seed yield (El-Ghamriny *et al*., 1999 , Shafshak *et al*. 2004, El-Sawy, 2007, Shehata *et al*. 2012). Hence, the objective of this work was to study the impact of nitrogen fertilizer sources (organic and mineral) fertilizers, plant spacing and foliar application of garlic and yeast extracts on vegetative growth, fruit yield and quality and seed production of summer squash.

MATERIALS AND METHODS

This work was carried out at Sakha Horticultural Research Station, Farm during two summer seasons of 2011 and 2012 (Latitude 31°, 4 N and Longitude 30°, 56E), on summer squash (*Cucurbita pepo*, L.) Eskandarani cultivar to study the impact of plant spacing, nitrogen fertilizer sources (organic and inorganic) and foliar spray with biostmulants and their interactions, on vegetative parameters, mature fruit properties and seed yield.

The physical and chemical properties of the experimental soil are reviewed in Table (1).

The experimental layout was split-split plots system in a randomized complete block design with three replicates. Plant spacing (30, 45 and 60 cm between plants) were randomly distributed in the main plots which were subdivided to three sub-plots, each one contained foliar application, i.e., control(water spray), yeast at rate 2.5cm/L and garlic extract at rate 2.5cm/L sprayed at three times (after two, four and six weeks from seed sowing date). While the nitrogen fertilizer sources (mineral and organic) were assigned to the sub-sub plots (Table 2). Mineral fertilizer as ammonium nitrate (33.5% N) was added in three equal portions after 2, 4 and 6 weeks from seed sowing date. Organic fertilizer (compost) was determined according to nitrogen percentage input (chemical analysis for total nitrogen) to provide 60 kg N/fed. The chemical analysis of compost is presented in Table (3).

This experiment included 45 different treatment combinations. Each plot was comprised of three ridges 5 m length, 1 m width, the sub-sub plot area was 15 m^2. Seeds were sown on 7th and 10th March in the first and second seasons, respectively

The normal cultural practices for the commercial summer squash production were followed according to the instructions advised by the Ministry of Agriculture.

Table (1): Physical, chemical and properties of experimental soil in 2011 and 2012 seasons.

Season	Mechanical analysis			Texture	pH*	EC** dSm^{-1}	OM %	Available elements (ppm)		
	Sand %	Silt %	Clay %					N	P	K
1st	33.63	23.92	42.45	Clay	7.7	4.96	1.96	26	9.5	650
2nd	32.58	24.20	43.22	Clay	7.5	4.60	2.12	37	11.0	683

* 1:2.5 soil: water suspension.
** Soil past extract.

Table (2): Quantity of organic and mineral fertilizers for the different nitrogen source treatments in 2011 and 2012 seasons.

Fertilizer treatments	Quantity of fertilizer		
	Compost ton fed.$^{-1}$		Mineral fertilizer kg fed.$^{-1}$ ammonium nitrate
	1st	2nd	
100% organic (compost)	5	4.60	-
100% mineral	-	-	200
75% organic + 25% mineral	3.75	3.45	50
75% mineral + 25% organic	1.25	1.15	150
50% organic + 50% mineral	2.5	2.3	100

Table 3: Chemical analysis of compost during 2011 and 2012 seasons.

Season	Macro-elements (%)			O.M (%)
	N	P	K	
1st	1.2	0.48	0.75	37.5
2nd	1.3	0.49	0.76	38.2

Data recorded:

Growth parameters:

A random sample of five plants were taken from each plot at 50 days after sowing in both seasons of the study for measuring the growth parameters of summer squash plants, i.e.; Plant fresh and dry weight (g), number of leaves plant^{-1}, leaf area plant^{-1} (cm^2) (according to Koller, 1972) and total chlorophyll (measured by A Minolta SPAD chlorophyll meter, Yadava, 1986).

Mature fruit properties:

Average number of mature fruits plant^{-1}, fruit length and diameter (cm) were taken after fruits ripening in both seasons.

Seed yield measurements:

A random sample of five plants were taken from each plot at harvest time in both seasons of the study for measuring the seed parameters of summer squash plants, i.e.; number of seeds fruit^{-1}, seed weight fruit^{-1}, number of seed plant^{-1}, seeds weight plant^{-1}, seed index (weight of 100-seeds) (g), total seed yield kg fed.$^{-1}$ and Seed germination (%).

Chemical constituents of seeds:

Samples of seeds were randomly taken for estimating minerals content. In addition, nitrogen was determined y using Micro-Kjeldahl method (Piper, 1950). Phosphorus was determined using spectrophotometer (King, 1951). Potassium was determined according to Jackson, 1967. Iron, manganese and zinc were determined according to Chapman and Pratts (1987).

Statistical analysis:

Data were analyzed by analysis of variance according to Little and Hills,1975. Duncan's Multiple Range test was used for comparison among treatment means (Duncan, 1955).

RESULTS AND DISCUSSION

I. Growth parameters

a. Effect of plant spacing

Data in Table (4) showed that, growth parameters were significantly affected by plant spacing in the two growing seasons. The results indicated that increasing plant spacing from 30 to 60 cm increased values of plant growth parameters. The decrease in plant growth due to decreased plant spacing might be attributed to the high competition for nutrients and water among plants with the adjoining plants in the row (Kultur *et al.*,

2001). In the same time, Dimitroy and Kanzirska (1997), Saad (2002), Ban *et al.* (2006), Fayed (2010), Islam *et al.* (2011) and Babayee *et al.* (2012) reported that, growth parameters of summer squash plants were increased with increasing plant spacing.

b. Effect of foliar application

Comparing the effect of foliar application treatments (yeast and garlic extracts), showed that, all growth parameters were increased in response to all foliar spraying in the two growing seasons, compared to the check treatment (control). Data in Table (4) clearly showed that, the highest significant values of the aforementioned parameters were recorded by spraying plant with garlic extracts followed by spraying yeast extract. While, the check treatment (control) recorded the lowest values of vegetative parameters in both seasons. Regarding the growth enhancing potential of garlic or yeast extract that might be attributed to its content of many natural sources growth promoting substances (macro, micronutrients and IAA) (Nagodawithana, 1991). These results are in harmony with the findings of Helmy (1992) on summer squash; El-Ghamriny *et al.* (1999) on tomato; El-Sawy (2007), Shehata *et al.* (2012) on cucumber and Swelam (2012) on pepper.

Table (4): Effect of plant spacing, foliar application and nitrogen fertilizer sources on vegetative growth characters of summer squash plants during 2011 and 2012 seasons.

Treatments		Plant fresh weight (g)		Plant dry weight (g)		No. of leave Plant^{-1}		Leaf area Plant^{-1} (cm^2)		Total chlorophyl (SPAd) unit	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Plant spacing (cm) (A)											
30		334.39b	324.36 c	39.34 b	38.21 c	21.71 b	21.06 b	2843.26b	2735.71b	35.13 c	33.51c
45		356.28a	345.57 b	41.93 a	40.72 b	23.03 a	22.42 a	3027.21a	2914.28a	40.33 b	39.42b
60		361.59a	350.85 a	42.63 a	41.54 a	23.12 a	22.35 a	3075.04a	2985.09a	45.42 a	44.08a
F. test		**	**	**	**	**	**	**	**	**	**
Foliar application (B)											
Control		315.85c	308.55 c	37.13 c	36.03 c	21.66 b	21.05 c	2684.76c	2606.46c	38.53 c	36.88c
Yeast extract		358.46b	347.86 b	42.28b	41.14 b	22.82 a	22.16 b	3046.23b	2954.23b	40.65 b	39.46b
Garlic extract		377.97a	364.38 a	44.49a	43.41 a	23.29 a	22.61 a	3214.52a	3073.88a	41.68 a	40.67a
F. test		**	**	**	**	**	**	**	**	**	**
N fertilizer sources (C)											
100% inorganic		350.14c	339.63bc	41.21c	40.32 b	22.60bc	21.99bc	2983.41c	2860.61bc	40.11bc	39.12 c
75% inorganic + 25% organic		358.74b	347.97ab	42.22b	40.98 b	23.01 b	22.36b	3050.02b	2958.65ab	40.73 b	39.41b
75% organic + 25% inorganic		343.11d	332.95c	40.45d	39.31 c	22.18 c	21.50c	2914.69d	2790.27c	39.82c	38.47d
50% organic + 50% inorganic		365.82a	351.11a	43.06a	41.75 a	23.97 a	23.28a	3107.78a	3014.58a	41.78a	40.16a
100% organic		336.01 e	329.64c	39.58e	38.41 d	21.18 d	20.57 d	2853.30e	2767.74c	39.01d	37.88e
F. test		**	**	**	**	**	**	**	**	**	**
Interaction	**A X B**	**	**	**	**	**	**	**	*	**	**
	A X C	**	NS	**	**	NS	NS	**	NS	NS	**
	B X C	**	NS	**	**	NS	NS	**	*	NS	**
	A X B X C	**	**	**	**	NS	NS	**	*	NS	**

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

c. Effect of fertilizer treatments

Data presented in Table (4) revealed that, the highest values of plant growth parameters (plant fresh and dry weight, number of leaves, plant leaf area and total chlorophyll content) were produced by plants fertilized with 50% organic + 50% inorganic fertilizer treatment, followed by 75% inorganic + 25% organic. While, the lowest values were obtained by 100% organic fertilizer treatment. Improvement vegetative growth parameters due to applying of compost plus chemical N fertilizer compared with the use of any single form might be attributed to that applying mineral N, stimulated the rate of compost decomposition, which, produced higher humus substances that improved soil physical and chemical properties, as well as, increased exchangeable water soluble nutrients and their uptake (Cooke, 1972). In this concern, Mafadi and Gohar (1975) attribute this action to the adsorption of $NH4^+$ ion on the surface of compost, consequently, became available to plant uptake. Similarly, Jha *et al.* (1996) stated that applying chemical fertilizer with organic manures increased both N mineralization and nitrification which in turn enhance the access to NH_4-N and result in greater number of viable cells of nitrifying bacteria, especially with chemical fertilization. The superiority of 50% inorganic N + 50% compost treatment in enhancing vegetative growth of summer squash plants might be due to that such organic manure is a source of many essential macro and micronutrients to plants. Also, to serve as a good natural soil texture conditioner being rich in organic matter and increase availability and uptake of NPK which positively reflected on plant cell elongation and division as well as stimulate photosynthesis and metabolic processes (Remington and Frances, 1955). The obtained results are in accordance with those of Abd El-Kawy (2003), Saad (2002), Ghoname and Shafeek (2005), Hanna *et al.* (2005), Farrag (2009) and Swelam (2012), Baghdadi *et al.* (2012), Shehata *et al.* (2012) and Mahmoud *et al.* (2013).

d. Effect of plant spacing and foliar application interaction

Data presented in Table (5) illustrated that the highest values of growth parameters were recorded by planted spacing at 60 cm and sprayed with garlic extract followed by yeast extract treatment.

Table (5): Effect of plant spacing and foliar application interaction on vegetative growth characters of summer squash plants during 2011 and 2012 seasons.

Treatment		Plant fresh weight (g)		Plant dry weight (g)		No. of leaves plant^{-1}		Plant leaf area (cm^2)		Total chlorophyll (SPAD)	
Plant spacing (cm)	Foliar application	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
30	Control	304.87 d	295.73 f	35.81 d	34.76 e	19.70 f	19.14 e	2589.18 e	2511.52 d	32.51 h	29.84 h
	Yeast	328.00 c	318.22d	38.58 c	37.43 d	22.88 bcd	22.71 bc	2788.80 d	2704.30 c	35.73 g	34.67 g
	Garlic	370.30 ab	358.14 bc	43.61 ab	42.42 bc	22.56 cde	21.80 cd	3152.35 bc	2991.31 b	37.14 f	36.04 f
45	Control	320.38 c	310.69 e	37.69 c	36.58 d	23.23 abc	22.60 ab	2727.10 d	2645.26 c	39.12 e	37.94 e
	Yeast	367.26 b	356.24 c	43.21 b	42.01 c	22.38 b-e	21.72 cd	3121.80 c	3028.09 ab	40.22 d	39.06 d
	Garlic	381.24 a	369.80 a	44.92 a	43.59 ab	23.48 ab	22.93 a	3232.72 ab	3069.48 ab	41.77 c	41.21 c
60	Control	322.30 c	319.24 b	37.90 c	36.74 d	22.04 e	21.40 d	2738.00 d	2662.60 c	44.12 b	42.85 b
	Yeast	380.13 ab	369.11 a	45.05 a	43.65 ab	23.20 abc	22.56 ab	3228.64 ab	3131.81 a	46.03 a	44.65 a
	Garlic	382.35 a	364.20 ab	44.95 a	44.22 a	23.84 a	23.10 a	3258.49 a	3160.86 a	46.12 a	44.75 a

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

On the other hand, the lowest values recorded by plants at spacing 30 cm and sprayed with water. These results agreed with those obtained by Helmy (1992), Fayed (2010), Islam *et al.* (2011) and Babayee *et al.* (2012) on summer squash.

e. Effect of plant spacing and fertilizer treatments interaction

Data in Table (6) showed that, the plants grown at spacing 60 cm and fertilized with 50% inorganic + 50% organic tended to increase the growth parameters in both seasons. The lowest values in this respect obtained by plants growing at 30 cm and fertilized with 100% organic treatment. These results are in agreement with those obtained by Farrag (2009), Fayed (2010), Islam *et al.* (2011), Babayee *et al.* (2012), Swelam (2012), Baghdadi *et al.* (2012), Shehata *et al.* (2012) and Mahmoud *et al.* (2013).

f. Effect of foliar application and fertilizer treatments interaction

Data in Table (7) showed that, the interactions 50% organic + 50% inorganic with garlic extract had better vegetative growth parameters. The present results matched well with those obtained by Helmy (1992), El-Sawy (2007),Shehata *et al.* (2012), Baghdadi *et al.* (2012) and Mahmoud *et al.* (2013).

II. Mature fruit characters, seed yield and its components

a. Effect of plant spacing

Data in Table (8) revealed that, growing squash plants at the higher spacing increased number of fruits plant^{-1}, fruit length and diameter. Summer squash plants growing at spacing 60 cm gave the highest seed yield, its components and seed germination. The lowest values obtained by with 30 cm spacing. These results might be explained on the basis that, the plants in dense growing suffer considerable competition for light, water and minerals, and this competition depresses the capacity of the plants to synthesize metabolites and finally, ends with low productivity. These results were in harmony with Nerson, (2005). Such results might be explained on the basis that increasing the spacing between plants allowed more favorable growth and pollination conditions. The present study, generally agreed with those reported by Damarany and Farag (1994), Reiners and Riggs (1997), Nerson (1999), Nerson (2002), Ban *et al.* (2006), Babayee *et al.* (2012), Latifi *et al.* (2012) and Abdi *et al.* (2012). They found that, the wider plants spacing increase fruit yield plant^{-1} and seed yield in squash plants compared with those obtained from the dense planting.

b. Effect of foliar application

Data in Table (8) pointed out that, all mature fruit parameters (number of fruits plant^{-1}, fruit length and diameter), seed yield, its components and seed germination were significantly influenced by foliar treatments. Plants sprayed with garlic extracts had the highest values followed statistically in a descending order by yeast extract. Moreover, control plants gave the least effect in both seasons. The superiority of garlic or yeast extracts might be due to its richness in auxins, macro and micro nutrients which lead to improving growth, increased fruit and seed yield. Similar results were showed by Helmy (1992), Shafshak *et al.* (2004) on summer squash; El-Ghamriny *et al.* (1999) on tomato; El-Sawy (2007) and Shehata *et al.* (2010) on cucumber plants.

c. Effect of N fertilizer treatments

With respect to the effect of N fertilizers (organic and mineral) on mature fruit physical characters, seed yield and its components, data in Table (8) show that, the treatment of 50% inorganic + 50% organic gave the highest number of fruits plant^{-1}, length and diameter, number of seeds fruit^{-1}, seed weight fruit^{-1}, No. of seeds plant^{-1}, weight of 100 seed and total seed yield fed.$^{-1}$. The lowest values obtained from 100% organic treatment. Improving mature fruit physical characters, seed yield and its components by using 50% compost +50% mineral N was a reflection to the stimulatory effect of this combination on vegetative growth characters and more availability of

most of the essential plant nutrients in compost. Such findings are in harmony with those reported by Shehata (2001) on summer squash; Aly (2002) on cucumber; Eifediyi and Remison (2010), Sarhan *et al.* (2011) and Swelam (2012) on pepper plant.

Table (6): Effect of plant spacing and nitrogen fertilizer sources interaction on vegetative growth characters of summer squash plants during 2011 and 2012 seasons.

Treatment		Plant fresh weight (g)		Plant dry weight (g)		No. of leaves plant^{-1}		Plant leaf area (cm^2)		Total chlorophyll (SPAD)	
Plant spacing (cm)	N fertilizer source	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
30	100% inorg.	338.81 e	328.63	39.78 d	38.66 c	21.70	21.05	2878.20 c	2680.64	35.09	33.44 L
	75% inorg+25% org.	340.52 e	330.28	40.07 cd	38.90 c	21.92	21.28	2892.02 c	2805.27	35.67	34.11 k
	75% org.+25% inorg.	324.83 f	315.05	38.22 e	37.22 d	21.57	20.95	2769.01 d	2685.31	34.74	33.16 L
	50% org.+50% inorg.	344.95 de	334.54	40.60 cd	39.34 c	22.93	22.14	2932.02 c	2844.28	36.71	34.46 j
	100% org.	323.10 f	313.31	38.02 e	36.91 d	20.43	19.85	2745.38 d	2663.05	33.42	32.43 m
45	100% inorg.	358.41 b	347.64	42.20 b	40.94 b	22.73	22.30	3054.01 b	2962.44	39.63	39.57 g
	75% inorg+25% org.	359.10 b	348.26	42.22 b	41.08 b	23.66	22.98	3052.10 b	2960.38	41.04	39.98 f
	75% org.+25% inorg.	346.72 cd	336.15	40.79 c	39.56 c	22.62	21.87	2942.04 c	2743.04	39.82	38.65 h
	50% org.+50% inorg.	373.12 a	361.95	44.01 a	42.71 a	24.77	24.16	3167.27 a	3072.14	42.14	40.91 e
	100% org.	344.21 de	333.86	40.49 cd	39.34 c	21.36	20.75	2921.01 c	2833.37	39.02	37.93 i
60	100% inorg.	353.30 bc	342.61	41.63 b	41.39 b	23.38	22.63	3018.13b	2937.72	45.61	44.31 b
	75% inorg+25% org.	376.73 a	365.35	44.34 a	42.99 a	23.42	22.82	3206.15 a	3110.15	45.46	44.13 b
	75% org.+25% inorg.	357.84 b	347.72	42.37 b	41.12 b	22.35	21.67	3033.41 b	2942.46	44.90	43.62 c
	50% org.+50% inorg.	379.32 a	356.83	44.58 a	43.20 a	24.21	23.53	3224.03 a	3127.32	46.46	45.11 a
	100% org.	340.91 de	341.75	40.27 cd	39.00 c	21.76	21.12	2894.01 c	2806.80	44.62	43.32 d

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

Table (7): Effect of foliar application and nitrogen fertilizer sources interaction on vegetative growth characters of summer squash plants during 2011 and 2012 seasons.

Treatment		Plant fresh weight (g)		Plant dry weight (g)		No. of leaves plant^{-1}		Plant leaf area (cm^2)		Total chlorophyll (SPAD)	
Foliar application	N fertilizer source	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	100% inorg.	318.61 g	309.07	37.42 g	36.33 g	21.77	21.10	2715.01 g	2644.18 g	38.78	37.06 i
	75% inorg+25% org.	319.12g	309.44	37.53 g	36.42 g	22.04	21.43	2710.40 g	2628.75 g	38.95	37.46 h
	75% org.+25% inorg.	309.41h	299.96	36.39 h	35.32 h	21.00	20.35	2629.06 h	2550.05 g	37.87	36.22 j
	50% org.+50% inorg.	323.90 g	314.12	38.04 g	36.91 g	23.24	22.68	2753.22 g	2670.73 fg	40.14	37.74 h
	100% org.	308.42 h	310.17	36.30 h	35.17 h	20.23	19.68	2617.12 h	2538.58 g	36.97	35.92 k
Yeast	100% inorg.	358.50 d	347.75	42.20 de	40.88 de	22.68	22.02	3048.10 d	2956.33 cd	40.68	39.51 e
	75% inorg+25% org.	372.61 c	361.40	43.83 c	42.63 c	23.71	23.12	3167.20 c	3071.85 bc	40.96	39.75 e
	75% org.+25% inorg.	349.54 e	339.68	41.50 e	40.26 e	22.00	21.31	2967.14 e	2877.68 de	40.27	39.09 f
	50% org.+50% inorg.	372.23 c	361.07	43.83 c	42.51 c	23.95	23.30	3164.30 c	3068.80 bc	41.68	40.43 c
	100% org.	339.51 f	329.36	40.06 f	38.88 f	21.75	21.08	2886.05 f	2799.00 ef	39.27	38.53 g
Garlic	100% inorg.	373.32 c	362.05	43.99 c	43.78 b	23.35	22.86	3188.60 c	2981.28 cd	40.86	40.74 b
	75% inorg+25% org.	384.61 b	373.06	45.27 b	43.92 b	23.25	22.54	3273.25 b	3175.20 ab	42.25	41.12 b
	75% org.+25% inorg.	370.44 c	359.27	43.49 c	42.32 c	23.55	22.84	3148.21 c	2943.07 cd	41.33	40.11 d
	50% org.+50% inorg.	401.35 a	378.13	47.31 a	45.83 a	24.72	23.85	3406.28 a	3304.22 a	43.57	42.31 a
	100% org.	360.21 d	349.38	42.42 d	41.21 d	21.57	20.95	3057.24 d	2965.64 cd	40.37	39.22 f

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

Table 8

d. Effect of plant spacing and foliar application interaction

Data presented in Table (9) revealed that, the highest number of mature fruits plant^{-1}, fruit length and diameter, seed yield and its components were recorded by 60 cm spacing and garlic extract sprayed followed by yeast extract treatment. On the other hand, the lowest values recorded by plants at 30 cm spacing and water sprayed (control). Similar results were recorded by Helmy (1992), Shafshak *et al.* (2004), Ban *et al.* (2006), El-Sawy (2007), Shehata *et al.* (2010), Babayee *et al.* (2012), Latifi *et al.* (2012) and Abdi *et al.* (2012).

e. Effect of plant spacing and fertilizer treatments interaction

Data in Table (10) showed that, 60 cm spacing and 50% inorganic + 50% organic tended to increase the mature fruit physical characters and percentage of seed germination, in both seasons. The lowest values obtained by from 30 cm spacing and 100% organic treatment. Meanwhile, 30 cm spacing and 50% inorganic + 50% organic fertilizers gave the highest total seed yield fed.$^{-1}$ in both seasons. These results are in agreement with those obtained by Shehata (2001), Aly (2002), Nerson (2002), Ban *et al.* (2006), Eifediyi and Remison (2010), Sarhan *et al.* (2011), Swelam (2012) Babayee *et al.* (2012), Latifi *et al.* (2012) and Abdi *et al.* (2012).

f. Effect of foliar application and fertilizer treatments interaction

Data in Table (11) showed the interactions between foliar application and fertilizer treatments. Data showed that, 50% organic+ 50% inorganic and garlic extracts enhanced mature fruit physical characters. The interaction between foliar application and N fertilizer sources was significant for number of seeds fruit^{-1} and average fruit weight in the first and second seasons, respectively. However, it was highly significant for average fruit weight in the first season and average fruit diameter in both seasons. On the other hand, the differences were not significant for number of seeds fruit^{-1} in the first season and number of seeds plant^{-1} in both seasons. Summer squash plants fertilized by 50% inorganic + 50% organic fertilizers and sprayed with garlic or yeast extract tended to have increased parameters of seed yield. These results are in the same line with those obtained by Helmy (1992), Shehata (2001), Shafshak *et al.* (2004) on squash ; Aly (2002), El-Sawy (2007), Shehata *et al.* (2010) on cucumber.

III. Chemical constituents of seeds

a. Effect of plant spacing

Chemical constituents (N, P, K, Fe, Zn and Mn) concentrations of summer squash seeds were significantly ascending with increasing plant spacing in both seasons. Table (12) showed that, 60 cm spacing gave the highest element percentages in seeds followed by 45 cm spacing. The lowest percentage resulted by 30 cm spacing treatment. Increasing plant density decreased N, P, K, Fe, Zn and Mn content. This might be due to the increased competition between and within plants. In this concern, Sander *et al.* (1993), Saad (2002) found that increasing plant spacing improved the elements content in leaves of pumpkin plants.

b. Effect of foliar application

Foliar garlic extract application increased seed mineral contents followed by foliar yeast extract. The lowest values obtained from control treatment (Table 12). Improving leaves and seed mineral contents of by garlic or yeast extract treatment might be due to presence of macro and micro-nutrients in the extracts of garlic or yeast. Similarly, El-Ghamriny *et al.* (1999) on tomato; Shafshak *et al.* (2004) on summer squash plants; El-Sawy (2007) and Shehata *et al.* (2012) on cucumber plants, found that, the spraying of garlic or yeast extract improved leaves and seed mineral contents.

Table 9

Table 10

Table 11

Table 12

c. Effect of N fertilizer treatments

Data in Table (12) showed that, 50% organic + 50% inorganic treatment gave the highest N, P, K, Fe, Zn and Mn seed contents. The lowest mineral contents resulted from 75% organic + 25% inorganic fertilizers or 100% organic treatments, in both seasons. In this concern, Alphons and Saad (2000) on cucumber; Adam *et al*. (2002), Farrag (2009) on cantaloupe, Taha *et al.* (2011) on squash, found that, fertilizing plants with organic plants increased macro- and microelements contents in leaves and seeds.

d. Effect of plant spacing and foliar application interaction

Regarding the effect of interaction between plant spacing and foliar application data in Table (13) showed that, there were highly significant differences in those parameters in both seasons, except for P% in seed, in the first season. The interaction between 60 cm plant spacing and foliar garlic extracts gave the highest percentage of macro and micro elements in seed. The lowest values obtained from 30 cm spacing without spraying (control). These results are in agree with those obtained by Sander *et al*. (1993), Saad (2002) on pumpkin plants; Shafshak *et al.* (2004) on squash plants; El-Sawy (2007) and Shehata *et al.* (2012) on cucumber plants.

e. Effect of plant spacing and fertilizer treatments interaction

Data in Table (14) showed that the highest values of N, P, K, Fe, Zn and Mn contents in seeds were achieved 60 cm spacing plus applying 50% organic + 50% inorganic fertilizers in both seasons, except for, P in the first season, Fe in the second season and Zn in both seasons.

These results are in agreement with those obtained by Sander *et al*. (1993), Alphons and Saad (2000), Saad (2002); Adam *et al*. (2002); Farrag (2009), Taha *et al.* (2011)

f. Effect of foliar application and fertilizer treatments interaction

Data in Table (15) showed that, the combined interaction between 50% organic + 50% inorganic plus garlic extract foliar gave the highest values. Seed mineral content were significantly influenced by, except too, P% in the first season, Fe in the second one and Zn in both seasons. The present results matched well with those obtained by Alphons and Saad (2000), Adam *et al*. (2002), Shafshak *et al.* (2004), El-Sawy (2007), Farrag (2009), Taha *et al.* (2011) and Shehata *et al.* (2012).

Table 13

Table 14

Table 15

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تأثير التسميد العضوى ومسافة الزراعة والرش الورقى بمستخلصات الخميرة والثوم على انتاج بذور قرع الكوسة

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الملخص العربى

أجريت هذه الدراسة فى مزرعة محطة بحوث البساتين بسخا . محافظة كفرالشيخ خلال الموسمين الصيفيين ٢٠١١م ، ٢٠١٢م على محصول قرع الكوسة صنف اسكندرانى بهدف دراسة تأثير مسافات الزراعة (٣٠ ، ٤٠ و٦٠ سم بين النباتات) والتسميد النيتروجينى (عضوى ومعدنى) بالإضافة إلى الرش بالمنشطات الطبيعية (الثوم والخميرة)على النمو الخضرى وصفات الثمار ومحصول البذور ومكوناتة وكذا المحتوى الكيماوى لبذور نباتات الكوسة.

ويمكن تلخيص اهم النتائج المتحصل عليها كالتالى:-

أعطت معاملة زراعة النباتات على مسافة ٦٠سم بين النباتات أعلى القيم لصفات النمو الخضرى والممثلة فى طول النبات وعدد الاوراق للنبات والوزن الرطب والجاف للنبات، وكذا المساحة الورقية والمحتوى الكلى من الكلوروفيل وصفات الثمار والممثلة فى طول وقطر الثمرة وعدد الثمار للنبات و محصول البذور ومكوناتة وكذلك المحتوى الكيماوي للبذور مثل النيتروجين والفوسفور والبوتاسيوم والحديد والزنك والمنجنيز .كذلك أدى رش النباتات بمستخلص الثوم الى زيادة معنوية فى كل القياسات مقارنة بالنباتات الغير معاملة، فى حين سجلت النباتات التى تم تسميدها ٥٠%سماد عضوى (كمبوست)+٥٠%سماد معدنى (نترات نشادر) أعلى زيادة معنوية فى معظم الصفات المدروسة مقارنة بالكنترول.

من هذا نستخلص ان افضل النتائج بالنسبة لصفات النمو الخضرى وصفات الثمار الناضجة ومحصول البذور وكذا المحتوى الكيماوي للبذور نتج من زراعة النباتات على مسافة ٦٠سم والتى تم تسميدها بـ٥٠%سماد عضوى (كمبوست) +٥٠%سماد معدنى (نترات نشادر) وتم رشها بمستخلص الثوم بتركيز ٥ر٢سم/لتر ٣ مرات بعد ٢، ٤، ٦ اسابيع من الزراعة.

Table (8): Effect of plant spacing, foliar application and nitrogen fertilizer sources on mature fruit physical characters and seed yield and its components of summer squash plants during 2011 and 2012 seasons.

Treatments		No. of fruits plant^{-1}		Av. fruit length (cm)		Av. fruit diameter (cm)		No. of seeds fruit^{-1}		Seeds weight fruit^{-1} (g)		No. of seeds plant^{-1}		Seeds weight plant^{-1} (g)		Weight of 100 seed (g)		Seed germination (%)		Total seed yield (kg fed.$^{-1}$)	
Plant spacing (cm)		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
30		1.36c	1.29c	26.71c	25.94c	6.74c	6.62c	152.66c	148.25c	18.93b	18.30b	209.79c	203.75c	25.92c	25.19c	12.33b	12.06b	82.62	80.51b	345.82a	331.11a
45		1.47b	1.38b	31.32b	30.78b	7.23b	7.17b	159.31b	154.36b	20.12b	19.45b	235.01b	227.95b	29.85b	29.12b	12.56b	12.30b	83.80	81.93b	265.31b	257.62b
60		1.58a	1.75a	33.34a	32.54a	8.66a	8.41a	168.22a	163.17a	24.22a	23.81a	261.96a	254.15a	37.61a	36.46a	14.29a	13.98a	84.73	84.47a	251.93b	241.34b
F. test		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	NS	**	**	**
Foliar application																					
Control		1.38c	1.31c	27.28c	26.86c	7.17c	7.11c	157.73c	153.17c	18.12c	17.72b	220.59c	214.03c	25.16c	24.56c	11.39c	11.17c	80.66b	78.80c	234.63c	227.63c
Yeast extract		1.44b	1.36b	30.74b	29.88b	7.58b	7.49b	159.65b	154.64b	23.03a	22.27a	228.92b	222.15b	33.14b	32.24b	14.32a	13.97a	85.63a	85.51a	304.42b	293.12b
Garlic extract		1.57a	1.47a	33.32a	32.52a	7.88a	7.74a	162.83a	157.97a	22.16b	21.56a	257.25a	249.68a	35.08a	33.97a	13.47b	13.21b	84.82a	82.82b	324.11a	309.41a
F. test		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
N fertilizer sources																					
100% inorganic		1.45c	1.37b	30.25b	29.36c	7.38c	7.32c	160.18c	155.52c	21.11c	20.42c	233.31c	226.35c	30.61c	29.82c	13.04b	12.73b	80.66b	83.18b	282.72c	267.33c
75% inorganic + 25% organic		1.52b	1.43a	31.15ab	30.32b	7.85b	7.67b	161.41b	156.82b	22.73b	21.96b	243.22a	235.97b	34.33b	33.35b	13.99a	13.67a	84.03b	84.07b	318.04b	304.72b
75% organic + 25% inorganic		1.43c	1.33bc	30.12b	29.25c	7.13d	7.18cd	158.65d	153.71d	19.79d	19.38c	227.46c	221.02c	28.24d	27.42d	12.41c	12.13c	82.25b	80.22c	260.43d	252.21d
50% organic + 50% inorganic		1.59a	1.46a	32.05a	31.26a	8.31a	8.05a	163.25a	157.92a	23.76a	23.39a	260.54a	252.76a	37.95a	36.71a	14.46a	14.11a	90.27a	87.85a	352.61a	341.14a
100% organic		1.34d	1.28c	28.68c	28.57d	7.05d	7.02d	156.83e	152.34e	18.08e	17.45d	213.41d	206.99d	24.51e	24.02e	11.41d	11.27d	77.11c	76.18d	224.72e	218.05e
F. test		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	*	*
Interaction	**A X B**	**	**	**	**	**	*	**	**	**	**	**	**	**	**	**	**	*	**	**	**
	A X C	NS	NS	NS	**	**	**	NS	NS	NS	NS	**	*	*	NS	NS	NS	NS	**	**	**
	B X C	NS	NS	NS	**	**	**	*	NS	**	*	NS	NS	**	**	**	**	NS	NS	**	**
	A X B X	NS	NS	NS	**	**	**	**	*	NS	NS	*	*	NS	NS	NS	NS	NS	*	**	**

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

Table (9): Effect of plant spacing and foliar application interaction on mature fruit physical characters and seed yield and its components of summer squash plants during 2011 and 2012 seasons.

Treatment		No. of fruits Plant^{-1}		Av. fruit length (cm)		Av. fruit diameter (cm)		No. of seeds Fruit^{-1}		Seed weight Fruit^{-1} (g)		No. of seeds Plant^{-1}		Seeds weight Plant^{-1} (g)		Weight of 100 seeds (g)		Seed germination (%)		Total seed yield (kg fed.$^{-1}$)	
Plant spacing	Foliar application	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
30	Control	1.27 f	1.20 e	25.32 e	24.55 i	6.46 e	6.40 e	149.66 i	145.71 g	17.79 f	17.24 d	191.97 f	186.29f	22.57 f	21.92f	11.82 e	11.54 g	77.62 c	75.26f	301.12c	292.23c
	Yeast	1.28 f	1.22 e	26.31 e	25.58 h	6.88 d	6.85 d	153.18 h	148.64 f	20.06cd	19.36 c	197.43 f	191.64f	25.88 e	25.17e	13.02cd	12.77 de	85.33 a	83.33b	345.41b	328.41b
	Garlic	1.55 bc	1.46 ab	28.50 d	27.72 f	6.88 d	6.94 d	155.12 g	150.42 e	18.96 d	18.31cd	239.98cd	233.32cd	29.32 d	28.47d	12.14 e	11.89fg	84.94 ab	82.93c	391.04a	372.62a
45	Control	1.40 e	1.34 d	28.75 d	29.04 e	6.96 d	6.98 d	157.61 f	152.99 d	15.74 f	15.18 e	223.34 e	216.64e	22.19 f	21.94f	9.91 f	9.81 h	79.81 bc	78.34e	197.32e	191.43e
	Yeast	1.46 de	1.38 cd	30.63 c	29.74 d	6.97 d	7.02 d	158.64 e	153.87 d	22.67 b	21.98 b	236.46 d	229.42d	34.02 c	33.09c	14.32 b	13.92 c	87.06 a	84.92a	302.44c	293.92
	Garlic	1.52bcd	1.42 bc	34.54 b	33.56 c	7.78 c	7.51 c	161.68 d	156.22 c	21.95 b	21.22 b	245.23bc	237.81bc	33.34 c	32.34c	13.46 c	13.17 d	84.53 ab	82.83cd	296.45c	287.54c
60	Control	1.48 cd	1.35 cd	27.79 d	27.01 g	8.09 b	7.96 b	165.92 c	160.82 b	20.77 c	20.73 b	246.47bc	239.15bc	30.71 d	29.81d	12.44 de	12.18ef	84.62 ab	82.81cd	205.33e	199.15e
	Yeast	1.58 ab	1.48 ab	35.28 b	34.36 b	8.90 a	8.61 a	167.08 b	161.41 b	26.35 a	25.48 a	252.85 b	245.39b	39.54 b	38.46b	15.62 a	15.22 a	84.63 ab	82.26d	265.42d	256.91d
	Garlic	1.65 a	1.53 a	36.94 a	36.27 a	9.05 a	8.76 a	171.69 a	167.26 a	25.56 a	25.19 a	286.55 a	277.91a	42.59 a	41.11a	14.81 b	14.55 b	85.12 a	83.33b	284.81cd	268.02cd

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

Table (10): Effect of plant spacing and nitrogen fertilizer sources interaction on mature fruit physical characters and seed yield and its components of summer squash plants during 2011 and 2012 seasons.

Treatment		No. of fruits Plant^{-1}		Av. fruit length (cm)		Av. fruit diameter (cm)		No. of seeds Fruit^{-1}		Seed weight Fruit^{-1} (g)		No. of seeds Plant^{-1}		Seeds weight Plant^{-1} (g)		Weight of 100 seeds (g)		Seed germination (%)		Total seed yield (kg fed.$^{-1}$)	
Plant spacing	N fertilizer sources	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
30	100% inorg.	1.35	1.27	26.22	25.42 h	6.63 gh	6.68 gh	152.48	148.21	19.10	18.51	207.41 fg	201.25 fg	25.68 h	24.98	12.46	12.32	83.55	82.11 de	342.82 c	321.62 c
	75% inorg+25% org.	1.43	1.35	27.31	26.53 g	6.88 g	6.93 g	154.21	149.96	20.54	19.83	216.13 f	209.67 fg	28.64 g	27.82	13.24	12.95	83.65	80.65 e	382.06 b	359.23 b
	75% org.+25% inorg.	1.32	1.25	26.62	25.88 h	6.43 hi	6.52 hi	150.90	146.38	17.95	17.35	203.70 g	198.71 g	23.60 i	22.89	11.83	11.48	82.22	80.22 e	314.52 de	305.11 cd
	50% org.+50% inorg.	1.52	1.36	28.08	27.28 f	7.48 f	7.26 f	155.91	151.35	21.14	20.39	239.50 cd	232.35cd	32.38 f	31.45	13.51	13.18	88.11	86.13 bc	431.91 a	419.12 a
	100% org.	1.21	1.22	25.32	24.60 i	6.26 i	6.28 i	149.80	145.33	15.95	15.44	182.24 h	176.78 h	19.32 j	18.81	10.62	10.38	75.55	73.67 f	258.04 fg	250.43 fg
45	100% inorg.	1.44	1.38	31.04	30.12 e	7.30 f	7.30 f	159.53	154.82	19.74	19.02	229.81 de	222.85de	28.26 g	27.56	12.26	11.86	84.13	82.33 de	251.32 gh	244.72 fgh
	75% inorg+25% org.	1.53	1.44	32.14	31.26 d	7.76 e	7.43 f	160.64	155.93	21.78	21.77	247.82 c	240.44 c	33.94 ef	32.94	13.57	13.21	86.24	84.21 cd	301.63 e	292.62 de
	75% org.+25% inorg.	1.37	1.30	31.18	30.29 e	6.72 g	6.94 g	157.76	153.04	18.62	18.03	219.45 ef	212.77ef	25.81 h	25.08	11.76	11.62	83.22	80.88 e	299.54 ij	222.71 ij
	50% org.+50% inorg.	1.61	1.52	33.27	32.27 c	8.11 d	7.82 e	162.58	156.63	22.88	22.11	262.84 b	254.85 b	36.96 cd	24.19	13.97	13.57	89.55	87.55 ab	328.41 cd	318.53 c
	100% org.	1.35	1.26	28.88	30.01 e	6.28 i	6.45 i	156.05	151.38	17.60	17.04	215.30 fg	208.75fg	24.29 hi	35.86	11.24	11.26	76.23	74.62 f	215.92 jk	209.42 jk
60	100% inorg.	1.56	1.43	33.48	32.56 c	8.23 d	7.98 de	168.53	163.55	24.48	23.73	262.73 b	254.92 b	37.92 c	36.92	14.41	14.02	87.25	85.22 bc	254.22 fgh	235.51 ghi
	75% inorg+25% org.	1.62	1.51	34.01	33.20 b	8.92 b	8.66 b	169.38	164.57	25.87	24.98	265.82 b	257.81 b	40.42 b	39.24	15.16	14.84	82.21	87.34 ab	270.31 f	262.23 f
	75% org.+25% inorg.	1.56	1.45	32.54	31.60 d	8.24 d	8.12 d	167.28	161.72	22.82	22.73	259.31 b	251.58 b	35.32 de	34.28	13.62	13.32	81.55	79.55 e	237.13 hi	229.24 hi
	50% org.+50% inorg.	1.65	1.50	34.80	34.26 a	9.32 a	9.07 a	171.39	165.67	27.26	27.65	279.37 a	270.98 a	44.50 a	42.79	15.92	15.57	93.11	90.12 a	297.62 e	285.82 e
	100% org.	1.46	1.37	31.85	31.12 d	8.61 c	8.38 c	164.65	160.32	20.68	19.88	242.72 c	235.43 c	29.91 g	29.07	12.35	12.15	79.56	80.24 e	200.25 k	194.21 k

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

Table (11): Effect of foliar application and nitrogen fertilizer sources interaction on mature fruit physical characters and seed yield and its components of summer squash plants during 2011 and 2012 seasons.

Treatment		No. of fruits Plant^{-1}		Av. fruit length (cm)		Av. fruit diameter (cm)		No. of seeds Fruit^{-1}		Seed weight Fruit^{-1} (g)		No. of seeds Plant^{-1}		Seeds weight Plant^{-1} (g)		Weight of 100 seeds (g)		Seed germination (%)		Total seed yield (kg fed.$^{-1}$)	
Foliar application	N fertilizer sources	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	100% inorg.	1.36	1.27	27.14	26.36 j	7.02 fg	6.91 f	157.60 g	153.22	17.86 gh	17.25ef	214.77	208.30	24.14 j	23.45gh	11.26 hi	10.97 gh	81.33	80.12	224.72 g	218.01 h
	75% inorg+25% org.	1.43	1.34	27.92	27.10 i	7.33 de	7.32 de	159.12ef	154.68	19.10 ef	18.35 e	227.01	220.23	26.91 h	26.11 f	11.85 fgh	11.61 fg	82.21	79.13	252.61 f	245.13 f
	75% org.+25% inorg.	1.35	1.25	27.03	26.21 j	6.76 g	6.85 f	156.34 h	151.75	16.83 hi	16.31 f	220.61	214.10	23.44 k	22.74gh	10.72 i	10.52 h	78.87	76.88	216.33 g	209.82 h
	50% org.+50% inorg.	1.48	1.40	29.24	28.38 h	7.83 c	7.66 c	161.01 d	156.55	20.17 e	20.63d	240.76	233.76	29.97 g	29.09 e	12.44 f	12.11 f	87.11	85.12	282.24 e	273.71 e
	100% org.	1.27	1.22	25.10	26.30 h	6.91 g	6.83 f	154.72 i	149.64	16.57 i	16.04 f	199.83	193.72	21.33 L	21.41 h	10.68 i	10.67 h	73.77	72.77	197.01 h	191.22 i
Yeast	100% inorg.	1.43	1.35	30.20	29.30 g	7.56 d	7.55 cd	159.31 e	154.51	23.36 c	22.63bc	227.78	221.07	33.07 e	32.37 d	14.47 cd	14.11 cd	87.11	85.12	303.22 d	295.33 d
	75% inorg+25% org.	1.50	1.41	31.57	30.78 f	7.93 c	7.61 c	161.13 d	156.53	24.64 b	23.86ab	237.73	230.74	36.64 c	35.58 c	15.32 ab	14.93 ab	82.88	88.17	336.35 c	314.92 c
	75% org.+25% inorg.	1.40	1.31	30.50	29.62 g	7.17 ef	7.25 e	158.11fg	152.58	22.38 cd	21.62cd	218.11	211.75	30.89 f	30.11 e	14.07 d	13.67 de	84.82	82.77	283.21 e	273.71 e
	50% org.+50% inorg.	1.56	1.44	32.58	31.67de	8.41 b	8.13 ab	162.75 c	157.08	25.91 a	24.97 a	251.63	244.04	39.83 b	38.65 b	15.84 a	15.53 a	94.13	92.15	369.62 b	358.52 b
	100% org.	1.32	1.28	28.85	28.08 h	6.83 g	6.91 f	157.17gh	152.52	18.86 fg	18.31 e	209.31	203.15	25.30 i	24.61fg	11.96 fg	11.62 fg	79.33	79.55	229.73 g	222.83 gh
Garlic	100% inorg.	1.56	1.46	33.41	32.44 c	7.57 d	7.52cde	163.72bc	158.84	22.12 d	21.38cd	257.35	249.67	34.64 d	33.64cd	13.41 e	13.13 e	86.34	84.44	320.42 c	288.52 de
	75% inorg+25% org.	1.64	1.55	33.96	33.11 b	8.31 b	8.10 b	164.12 b	159.26	24.47 b	23.68ab	264.95	256.95	39.46 b	38.32 b	14.82 bc	14.46 bc	87.15	85.12	365.04 b	354.01 b
	75% org.+25% inorg.	1.51	1.44	32.82	31.93 d	7.45 d	7.41 de	161.65 d	156.82	20.17 e	20.21 d	243.66	237.21	30.41 fg	29.51 e	12.41 f	12.22 f	83.12	81.16	281.63 e	273.22 e
	50% org.+50% inorg.	1.73	1.54	34.33	33.76 a	8.67 a	8.36 a	166.01 a	160.05	25.22 ab	24.57 a	289.22	280.50	44.03 a	42.35 a	15.14 abc	14.70 bc	89.55	86.33	406.11 a	391.05 a
	100% org.	1.43	1.35	32.11	31.34 e	7.42 de	7.32 de	158.72ef	154.87	18.82 fg	18.02 e	231.08	224.06	26.89 h	26.07 f	11.57 gh	11.52 fg	78.26	76.24	247.45 f	240.03 fg

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

Table (12): Effect of plant spacing, foliar application and nitrogen fertilizer sources on chemical constituents of seeds during 2011 and 2012 seasons.

Treatments		N (%)		P (%)		K (%)		Fe (ppm)		Mn (ppm)		Zn (ppm)	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Plant spacing (cm) (A)													
30		3.513 c	3.411 c	0.440 c	0.427 c	1.309 c	1.271 c	231.22 c	225.37 c	44.92 c	43.65 c	41.73 c	40.72 c
45		3.601 b	3.494 b	0.446 b	0.433 b	1.345 b	1.305 b	246.15 b	238.78 b	52.24 b	50.78 b	46.88 b	45.46 b
60		3.644 a	3.533 a	0.457 a	0.441 a	1.387 a	1.347 a	259.31 a	251.62 a	57.81 a	56.31 a	52.56 a	51.01 a
F. test		**	**	**	**	**	**	**	**	**	**	**	**
Foliar application (B)													
Control		3.546 c	3.441 c	0.443 c	0.429 c	1.337 c	1.298 c	240.44 c	233.21 b	49.61 c	48.17 c	45.54 c	44.19 c
Yeast extract		3.592 b	3.487 b	0.447 b	0.433 b	1.347 b	1.307 b	246.51 b	240.42 a	51.32 b	50.08 b	47.05 b	45.64 b
Garlic extract		3.621 a	3.509 a	0.454 a	0.438 a	1.358 a	1.318 a	249.73 a	242.15 a	54.07 a	52.49 a	48.58 a	47.35 a
F. test		**	**	**	**	**	**	**	**	**	**	**	**
N fertilizer sources (C)													
100% inorganic		3.581 c	3.473 c	0.447 ab	0.433 c	1.347 c	1.308 c	245.59 c	238.55bc	52.26 b	50.78 b	46.97 c	45.62 c
75% inorganic+25% organic		3.602 b	3.492 b	0.449 ab	0.436 b	1.349 b	1.311 b	248.07 b	240.37 b	52.37 b	50.87 b	48.02 b	46.58 b
75% organic+25% inorganic		3.567cd	3.462cd	0.445 b	0.431 d	1.344 d	1.304 d	243.18 d	235.66cd	50.88 c	49.34 c	46.08 d	44.68 d
50% organic+50% inorganic		3.622 a	3.516 a	0.452 a	0.438 a	1.352 a	1.313 a	250.22 a	244.45 a	54.21 a	53.08 a	49.24 a	47.76 a
100% organic		3.558 d	3.452 d	0.447 ab	0.430 e	1.343 e	1.302 e	240.85 e	233.92 d	48.58 d	47.15 d	44.98 e	43.99 d
F. test		**	**	*	**	**	**	**	**	**	**	**	**
Interaction	**A X B**	**	**	NS	*	**	**	**	**	**	**	**	**
	A X C	**	**	NS	*	**	**	**	NS	**	**	*	NS
	B X C	**	**	NS	*	**	**	**	NS	**	**	NS	NS
	A X B X C	**	**	NS	*	**	*	*	NS	**	**	*	NS

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

Table (13): Effect of plant spacing and foliar application interaction on chemical constituents of seeds during 2011 and 2012 seasons.

Treatments		N (%)		P (%)		K (%)		Fe (ppm)		Mn (ppm)		Zn (ppm)	
Plant spacing	Foliar application	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
30	Control	3.457 g	3.356 f	0.436	0.423 i	1.299 i	1.261 i	220.86 i	214.13 f	42.53 g	41.37 g	39.71 i	38.56 g
	Yeast	3.509 f	3.404 e	0.440	0.427 h	1.308 h	1.269 h	234.53 h	230.93 e	44.21 f	43.06 f	41.64 h	40.41 f
	Garlic	3.574 e	3.472 d	0.444	0.431 f	1.320 g	1.281 g	238.26 c	231.07 e	48.03 e	46.62 e	43.86 g	43.18 e
45	Control	3.584 de	3.481 cd	0.443	0.428 g	1.335 f	1.295 f	242.73 f	235.67 d	53.11 c	51.59 c	45.18 f	43.80 e
	Yeast	3.601 c	3.502 b	0.446	0.432 e	1.348 e	1.308 e	246.27 e	239.53 c	51.27 d	49.93 d	47.24 e	45.78 d
	Garlic	3.620 b	3.502 b	0.451	0.437 c	1.352 d	1.312 d	249.46 d	241.13 c	52.35 cd	50.81 cd	48.25 d	46.81 c
60	Control	3.589 cd	3.486 c	0.450	0.436 d	1.376 c	1.338 c	257.73 c	249.80 b	53.16 c	51.56 c	51.74 c	50.22 b
	Yeast	3.668 a	3.557 a	0.455	0.441 b	1.385 b	1.345 b	258.74 b	250.81 b	58.44 b	57.29 b	52.28 b	50.73 b
	Garlic	3.667 a	3.555 a	0.467	0.446 a	1.399 a	1.359 a	261.46 a	254.27 a	61.85 a	60.06 a	53.64 a	52.06 a

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

Table (14): Effect of plant spacing, foliar application and nitrogen fertilizer sources interaction on chemical constituents of seeds during 2011 and 2012 seasons.

Treatments		N (%)		P (%)		K (%)		Fe (ppm)		Mn (ppm)		Zn (ppm)	
Plant spacing	N fertilizer sources	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
30	100% inorg.	3.510 g	3.408 h	0.439	0.426 L	1.310 L	1.271 m	230.71 L	224.22	43.84 h	42.74 j	41.69 m	40.57
	75% inorg+25% org.	3.537 f	3.437 g	0.443	0.431 jk	1.313 k	1.274 L	233.42 k	226.67	45.71 g	44.48 i	42.88 L	41.61
	75% org.+25% inorg.	3.490 h	3.387 i	0.437	0.423 m	1.306 m	1.268 n	228.61 m	221.55	43.19 hi	41.98 jk	40.76 n	39.48
	50% org.+50% inorg.	3.547 f	3.441 g	0.445	0.432 i	1.315 j	1.275 k	236.80 j	234.11	49.51 e	47.97 g	44.04 k	42.66
	100% org.	3.482 h	3.379 i	0.436	0.423 m	1.304 n	1.265 o	226.72 n	220.33	42.38 i	41.16 k	39.31 o	39.24
45	100% inorg.	3.604 d	3.494 de	0.446	0.447 a	1.345 h	1.305 h	246.01 g	239.12	54.52 c	52.94 de	46.79 h	45.36
	75% inorg+25% org.	3.621 cd	3.511 bcd	0.448	0.434 h	1.347 g	1.307 g	248.42 f	240.77	51.97 d	50.59 f	47.91 g	46.45
	75% org.+25% inorg.	3.582 e	3.482 ef	0.444	0.431 j	1.344 h	1.303 i	244.03 h	236.88	52.61 d	51.24 f	45.77 i	44.42
	50% org.+50% inorg.	3.623 cd	3.516 bc	0.451	0.436 g	1.350 f	1.309 f	250.73 e	242.78	54.01 c	52.51 e	49.26 f	47.75
	100% org.	3.576 e	3.472 f	0.443	0.429 k	1.341 i	1.301 j	241.71 i	234.33	48.12 f	46.62 h	44.72 j	43.34
60	100% inorg.	3.630 c	3.518 bc	0.456	0.441 d	1.387 c	1.349 c	260.11 b	252.35	58.42 a	56.68 b	52.44 c	50.92
	75% inorg+25% org.	3.647 b	3.531 b	0.456	0.442 c	1.390 b	1.351 b	262.32 a	253.68	59.45 a	57.57 b	53.28 b	51.68
	75% org.+25% inorg.	3.630 c	3.522 bc	0.453	0.439 e	1.384 d	1.343 d	256.70 c	248.56	56.83 b	54.80 c	51.69 d	50.14
	50% org.+50% inorg.	3.696 a	3.589 a	0.459	0.445 b	1.393 a	1.355 a	263.21 a	256.44	59.14 a	58.81 a	54.42 a	52.87
	100% org.	3.617 cd	3.507 cd	0.463	0.438 f	1.382 e	1.341 e	254.20 d	247.11	55.24 c	53.72 d	50.96 e	49.40

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.

Table (15): Effect of foliar application and nitrogen fertilizer sources interaction on chemical constituents of seeds during 2011 and 2012 seasons.

Treatments		N (%)		P (%)		K (%)		Fe (ppm)		Mn (ppm)		Zn (ppm)	
Foliar application	N fertilizer sources	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	100% inorg.	3.537 g	.430 e	0.443	0.428 j	1.339 j	1.300 j	240.11 i	233.22	51.22 fg	49.77 ef	45.23	43.88
	75% inorg+25% org.	3.557 f	3.454 d	0.445	0.432 h	1.339 j	1.301 j	243.90 g	236.13	49.10 hi	47.67 hi	46.52	45.15
	75% org.+25% inorg.	3.518 h	3.413 e	0.440	0.427 k	1.334 k	1.295 k	237.92 j	230.55	49.67 h	48.21 gh	44.81	43.45
	50% org.+50% inorg.	3.588 de	3.482 bc	0.448	0.434 f	1.343 i	1.303 i	245.81 f	238.16	52.11 def	50.56 de	47.62	46.22
	100% org.	3.528 gh	3.424 e	0.439	0.425 L	1.331 L	1.293 L	234.62 k	228.13	45.92 j	44.72 j	43.55	42.25
Yeast	100% inorg.	3.593 de	3.489 bc	0.446	0.433 g	1.346 g	1.307 g	247.01 e	240.33	51.07 fg	49.68 ef	47.04	45.77
	75% inorg+25% org.	3.595 cde	3.482 bc	0.449	0.436 e	1.350 f	1.311 f	248.82 cd	241.43	53.21 cd	51.73 c	47.97	46.53
	75% org.+25% inorg.	3.582 e	3.487 bc	0.445	0.431 h	1.345 h	1.304 h	243.40 g	236.34	50.33 gh	48.84 fg	46.05	44.65
	50% org.+50% inorg.	3.631 b	3.526 a	0.452	0.438 d	1.352 e	1313 e	251.31 b	249.45	53.66 bc	53.26 b	49.12	47.56
	100% org.	3.561 f	3.455 d	0.443	0.429 i	1.345 h	1.304 h	242.01 h	234.56	48.27 i	46.89 i	45.06	34.67
Garlic	100% inorg.	3.613 c	3.501 b	0.452	0.442 a	1.358 c	1.318 c	249.72 c	242.11	54.51 b	52.92 b	48.64	47.20
	75% inorg+25% org.	3.653 a	3.541 a	0.453	0.439 c	1.360 b	1.319 b	251.61 b	243.57	54.78 b	53.22 b	49.56	48.06
	75% org.+25% inorg.	3.602 cd	3.489 bc	0.449	0.435 ef	1.355 d	1.315 d	247.92 de	240.12	52.63 cde	50.99 cd	47.35	45.94
	50% org.+50% inorg.	3.647 ab	3.542 a	0.455	0.441 b	1.364 a	1.324 a	253.61 a	245.88	56.91 a	55.46 a	51.12	49.51
	100% org.	3.586 de	3.478 c	0.460	0.435 ef	1.351 e	1.311 f	246.02 f	239.15	51.56 efg	49.89 e	46.36	46.06

Means designated by the same letter at each column are not significantly different at the 0.05 level, according to Duncan's Multiple Range Test.