J. Agric. Sci. Mansoura Univ., 34(9): 9589 - 9611, 2009

EFFECT OF SILICON AND PUTRESCINE FOLIAR APPLICATIONS ON GROWTH AND YIELD OF GLOBE ARTICHOKE PLANTS

Ahmed, A.H.*; H.M. Hassan*; Afaf T.M. Kasim and S.M. Sayed****

*** Plant Physiology Section, Plant Botany Department, Faculty of Agriculture, Cairo University, Egypt**

**** Potato and Vegetatively Propagated Vegetable Dept., Hort. Res. Inst., A.R.C**

ABSTRACT

Field experiments were carried out to investigate the effect of silicon (500 and 1000 ppm SiO_2) or Putrescine (1 and 2 ppm) sprayed twice at 45 and 60 days after planting on the growth, yield and chemical composition of the two local cultivars of globe artichoke plant in Egypt i.e., Balady and French (Hyrious) cultivars. Generally, French (Hyrious) cultivar which sprayed by silicon (1000 ppm SiO_2) was the best treatment on growth characters and yield components and recorded the highest values of early and total yield increases in the two successive seasons when compared with non- sprayed plants, followed by French (Hyrious) cultivar sprayed by putrescine (1 ppm). French cultivar sprayed by silicon (1000 ppm SiO_2) was the best for significant increased in P concentration of leaves and it was the best interaction treatment led to increase on total sugar concentration in the tow successive seasons when compared with control- untreated plants followed by French cultivar sprayed by putrescine (2 ppm). While, French cultivar sprayed by putrescine (2 ppm) followed French cultivar with sprayed by silicon (1000 ppm SiO2) were the best treatments which caused significant increased in total free amino acids in the two successive seasons. But French cultivar sprayed by putrescine at the rate of (1ppm) was the best caused a significant decreased in total soluble phenol when compared with control plants of both successive seasons followed by French cultivar sprayed by silicon (1000 ppm SiO_2).The higher level of silicon caused a significant increased in IAA and CK while, the lower level led to significant increased in GA_3 and CK.

INTRODUCTION

Globe artichoke (*Cynara scolymus* L.) belongs to composite family (Asteraceae). It is one of the important vegetable crops grown in Egypt for local markets and exportation. The period from December to February is the best time for exportation to European countries, this represents a vital importance since production is low and prices are high. Silicon was reported to reduce the hazard effects of various abiotic and biotic stresses including salt stress, metal toxicity, drought stress, radiation damage, various pests and diseases caused by both fungi and bacteria, nutrients imbalance , high temperature and freezing (Ma , 2004). Silicon has emerged as an important nutrient for a wide variety of crops including rice, sugarcane, wheat, barely and a range of horticultural crops i.e., cucumber, strawberry and tomato. Moreover, Cohen *etal*.(1998) reported that, Diamine Putrescine (Put) have been implicated in a wide range of biological processes in plant growth and development, including i.e., cell division, embryogenesis, reproductive organ development, fruit development and ripening as well as leaf senescence, abiotic and biotic stresses. Therefore, the present work was conducted to through some light on optimal means that may induce earliness and improve yield of artichoke heads for both local consumption and exportation. The effect of Silicon (Sodium meta silicate) or putrescine on the earliness yield of local cultivars i.e., Balady and French (Hyrious) was studied.

MATERIALS AND METHODS

Field experiments were conduced during the two successive seasons of 2005/2006 and 2006/2007 at Kaha farm (Qalubia Governorate), Horticulture Research Institute, Agriculture Research Center (A.R.C), Egypt to study the effect of foliar applications with Silicon (Sodium meta silicate) or Putrescine on growth characters, early and total yield ton /fed. as well as yield components of globe artichoke plant. The artichoke cultivars used in this experiment were Balady and French (Hyrious) cultivars.

Field experimental area was divided into plots (21 m^2). Each plot contained four rows each one was 7 m length X1m width. Each row included 7 plants. The experiment included 10 treatments which two concentrations of Silicon (Sodium meta silicate 100 and 500 ppm SiO_2) and Putrescine (1 and 2 ppm), and control (untreated plants) for each two cultivars of artichoke.

The soil type of the experimental area was clay loamy. Chemical analysis and physical properties of soils determined according to methods reported by Jackson (1973) (Table 1).

Table1: Physical and chemical analysis of soil.

Season	Clay%	Silt%	Sand %	Soil type	pH	Available N(ppm)	Available P (ppm)	Available K(ppm)
2005	63.7	22.4	17.6	Clay loam	8.4	87.9	26.2	85.2
2006	63.8	22.6	17.4	Clay loam	8.6	64.2	28.2	77.0

Foliar application treatments were as follow in both seasons, at 45 and 60 days after planting, foliar application of artichoke plants with Silicon as Sodium meta silicate ($Na_2SiO_35H_2O$) was used at the rates of 500 and 1000 ppm SiO_2. Foliar application of artichoke plants with Putrescine (tetramethylendiamine $C_4H_{12}N_2$, F.W.88.15, produced by Sigma chemical CO., St. Louis, Missouri, and U.S.A); was used at the rates of 1 and 2 ppm.

In both successive seasons, seven plants were randomly taken after 75 and 90 days from planting to determining the following growth characters: plant height (cm), numbers of leaves per plant, fresh and dry weight (g) of shoot as well as total leaves area (m^2).

At harvest, yield was determined as heads weight (ton/ fed.) including early yield and total yield, and head characters were estimated of early yield as following: head diameter (cm), fresh head weight (g), head length (cm),fresh weight of edible part (g), and dry matter of the edible part (g).

Chemical composition:

Determination of N, P and K were carried out on dry material of leaves and receptacle. Nitrogen concentration was determined by Nesslar method according to AOAC (1960). Phosphorus was estimated calorimetrically using the reduced molybdophosphoric blue color method according to Jackson

(1973). Potassium was determined using the flame photometer (CORNING, M 410).

Ethanol extract of leaves and receptacle were used for the determination of total sugar, total free amino acids and total soluble phenols. Total sugars were determined by using the phenol sulphoric acid reagent (Dubois *et al.,* 1956). Total free amino acids were determined by using ninhydrin reagent (Moore and Stein, 1954). Total soluble phenols were determined by using the Folin –Denis calorimetrically method (Swain and Hillis, 1959).

Extraction of plant hormones was only done in the second sample of the second season according to Sadeghian (1971). The alkaline fraction was used for the determination of cytokinins according to El-Ghamrawy and Neumann (1977) while the acidic fraction was used for determination of gibberelic acid, abscisic acid and indole-3- acetic acid according to Vogel (1975) using Gas- liquid chromatography (GLC).

Data of the experiment was statistically analyzed using a split plot design in which treatments foliar application were the main plot and cultivars was the sub- plot. The means were compared using the least significant difference test (LSD) at 5 % level (Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION

Growth characters and yield components:

Concerning the effect of silicon or putrescine foliar applications treatments on growth characters, data presented in tables (2 and 3) reveal that, silicon caused significant increases in all of the studied growth characters, as well as on early and total yield and its components when compared with control non-sprayed plants in the two successive seasons. While, putrescine lead to significant and non significant increases in most of the studied growth characters, with few exceptions, as well as caused significant increases in early and total yield and its components of the two successive seasons when compared with control-untreated plants.

Concerning the effect of cultivars, data in Tables(2 and 3) indicated that, no significant different could be detected between the two cultivars on the most of the studied growth characters and yield components, with some exceptions by French (Hyrious) cultivar which caused significant increased in plant height and shoot fresh weight only in the second sample of the second season as well as significant increased in head length and receptacle dry weight only in the second season when compared with Balady cultivar. On the other hand, Balady cultivar lead to significant increased in shoot dry weight only in the second sample of the second season and caused a significant increased in head diameter and head length only in the first season when compared with French (Hyrious) cultivar.

Concerning the effect of interaction between treatments (silicon or putrescine) and cultivars (Balady and French (Hyrious)) on growth characters and yield components, data in tables (2 and 3) revealed that, there were significant differences on all of the studied growth characters and yield components in the two successive seasons when compared with control non-sprayed plants.

Table (2): Shoot height (cm), leaf area (m^2) , leaf number, shoot fresh weight (g) and shoot dry weight (g) of globe artichoke plants sprayed by different levels of silicon (500 ppm and 1000 ppm SiO_2) or putrescine (1 ppm and 2 ppm) at 75 and 90 days after planting in (2005-2006) and (2006-2007) seasons .

Season			2005 - 2006						2006 - 2007					
Growth characters	Plant age days	cultivars / Treatments	Cont.	Put.1	Put.2	Si 1	Si 2	Mean (A)	Cont.	Put.1	Put.2	Si1	Si2	Mean (A)
Shoot height (cm)	75	Balady	66.71	62.57	62.29	64.71	68.71	65.00	72.00	71.43	71.14	62.86	68.29	69.14
		French	52.87	62.71	63.29	66.71	63.86	61.89	72.29	67.43	68.57	63.00	74.57	69.17
		Mean (B)	59.79	62.64	62.79	65.71	66.28		72.14	69.43	69.85	62.93	71.43	
		$LSD_{0.05}$	A=N.S B=6.354 A*B=8.986						A=N.S B=2.865 A*B=4.052					
	90	Balady	84.71	89.35	94.14	90.64	91.71	90.11	89.14	93.29	89.14	95.14	99.71	93.28
		French	85.42	90.28	89.14	99.71	92.00	91.31	96.86	102.56	92.57	97.71	100.0	97.94
		Mean (B)	85.06	89.81	91.64	95.17	91.85		93.00	97.92	90.85	96.42	99.85	
		$LSD_{0.05}$	A=N.S B=4.879 A*B= 6.899						A=3.35 B=3.83 A*B=4.720					
Leaf area (m^2)	75	Balady	4.28	4.20	4.93	6.07	4.05	4.71	3.89	3.16	5.36	7.99	5.47	5.17
		French	3.25	4.48	5.45	5.00	4.39	4.51	4.23	5.41	5.88	5.44	5.17	5.23
		Mean (B)	3.77	4.34	5.19	5.53	4.22		4.06	4.29	5.62	6.71	5.32	
		$LSD_{0.05}$	A= N.S B=1.02 A*B=1.44						A=N.S B=0.52 A*B=0.57					
	90	Balady	4.25	6.26	6.82	5.83	7.90	6.23	5.15	7.05	7.72	6.74	7.91	6.91
		French	5.70	4.28	5.52	5.14	5.30	5.19	6.89	4.38	6.61	8.22	7.25	6.67
		Mean (B)	4.98	5.27	6.15	5.48	6.64		6.02	5.71	7.16	7.48	7.58	
		$LSD_{0.05}$	A=N.S B=N.S A*B=0.70						A=N.S B=0.78 A*B=1.10					
Leaf No.	75	Balady	22.14	20.29	21.43	20.70	23.43	21.60	27.00	38.14	29.89	22.14	27.00	28.83
		French	17.29	20.00	25.00	21.57	19.00	20.57	35.00	29.14	23.57	26.43	39.57	30.74
		Mean (B)	19.71	20.14	23.21	21.14	21.21		31.00	33.64	26.73	24.28	33.29	
		$LSD_{0.05}$	A=N.S B=N.S A*B=5.86						A=1.77 B=3.26 A*B=4.61					
	90	Balady	22.71	35.57	35.85	35.00	35.28	32.88	36.00	39.71	31.29	37.14	44.71	37.77
		French	36.28	33.42	36.28	40.14	42.00	37.62	36.29	43.29	38.29	35.86	42.86	39.32
		Mean (B)	29.50	34.50	36.06	37.57	38.64		36.14	41.50	34.79	36.50	43.79	
		$LSD_{0.05}$	A=N.S B=6.52 A*B=9.22						A=1.38 B=1.81 A*B=2.55					
Shoot fresh weight (Kg)	75	Balady	863	628	753	928	887	812	1360	1170	970	711	714	985
		French	500	603	772	937	831	728	1340	882	685	562	1230	940
		Mean (B)	681	615	762	932	859		1350	1026	828	637	972	
		$LSD_{0.05}$	A=N.S B=236.4 A*B=334.2						A=N.S B=202.5 A*B=286.3					
	90	Balady	1410	2170	2680	3960	2760	2596	1750	2240	2050	2080	2240	2072
		French	3460	2860	3240	3260	2900	3144	2870	1960	2460	2200	2780	2454
		Mean (B)	2435	2515	2960	3610	2830		2310	2100	2255	2140	2510	
		$LSD_{0.05}$	A=206.3 B=299.2 A*B=717.0						A=240.5 B=326.4 A*B=462.3					
Shoot dry weight (g)	75	Balady	97.40	66.2	72.8	189.6	93.00	103.8	133.1	152.9	92.9	143.6	78.00	120.1
		French	56.00	61.3	79.00	101.2	91.4	77.80	118.4	107.2	65.7	85.6	126.4	100.7
		Mean (B)	76.7	63.8	75.9	149.4	92.2		125.8	130.1	79.3	114.6	102.2	
		$LSD_{0.05}$	A=9.72 B=28.52 A*B=40.40						A=14.27 B=22.92 A*B=32.41					
	90	Balady	232. 8	151.7	128.9	185.3	157.6	171.3	237.00	248.6	198.9	190.6	193.6	213.7
		French	97.1	111.6	117.8	104.5	163.8	119.0	189.00	214.2	189.8	182.9	222.5	199.7
		Mean (B)	164.0	131.7	123.3	144.9	160.7		213.00	231.4	194.3	186.8	208.1	
		$LSD_{0.05}$	A=23.51 B=35.91 A*B= 50.79						A=N.S B=27.09 A*B=38.31					

(a) Putrescine treatments (Put.1= 1ppm putrescine and Put.2= 2ppm putrescine)
(b) Silicon treatments (Si.1=500ppm SiO_2 and Si.2=1000ppm SiO_2)
(c) N.S=Non significasnt.

Table (3): Diameter (cm), length (cm) and fresh weight (g) of heads & fresh and dry weight (g) of receptacle at early yield and weight of total and early yield (ton/fed.) and (number of heads / fed.) of globe artichoke plants sprayed by different levels of silicon (500 ppm and 1000 ppm SiO_2) or putrescine (1 ppm and 2 ppm) in 2003-2004 and 2004-2005 seasons.

Yield components	cultivars / treatments	Cont.	Put.1	Put.2	Si 1	Si 2	Mean (A)	Cont.	Put.1	Put.2	Si1	Si2	Mean (A)
Diameter of head (cm)	Balady	8.75	11.28	10.50	7.93	8.28	9.35	6.82	7.50	8.02	8.28	7.88	7.70
	French	7.83	9.07	9.37	8.55	7.83	8.53	6.83	7.58	8.02	7.90	8.05	7.67
	Mean (B)	8.29	10.18	9.93	8.24	8.06		6.83	7.54	8.02	8.09	7.97	
	$LSD_{0.05}$	A=0.59		B=0.69		A*B=0.97		A=N.S		B=0.38		A*B=0.54	
Length of head (cm)	Balady	10.57	12.58	11.45	9.92	9.60	10.82	8.10	8.27	9.82	10.33	10.07	9.32
	French	9.30	10.07	10.17	9.67	9.20	9.68	9.47	10.18	10.45	10.18	10.60	10.18
	Mean (B)	9.93	11.33	10.81	9.79	9.40		8.78	9.23	10.13	10.26	10.33	
	$LSD_{0.05}$	A=0.53		B=0.64		A*B=0.90		A=0.20		B=0.29		A*B=0.41	
Fresh weight of head (g)	Balady	247.50	296.67	283.33	240.00	257.50	265.00	258.33	275.83	269.17	288.33	285.50	275.43
	French	217.50	269.16	267.50	265.83	256.66	255.33	248.33	286.67	293.33	295.83	295.00	283.83
	Mean (B)	232.50	282.92	275.42	252.92	257.08		253.33	281.25	281.25	292.07	290.25	
	$LSD_{0.05}$	A=N.S		B=19.26		A*B=27.24		A=N.S		B=10.18		A*B=14.39	
Fresh weight of receptacle (g)	Balady	45.83	81.83	69.83	61.00	68.17	65.33	62.50	69.17	67.50	70.83	70.83	68.17
	French	36.67	77.50	82.67	78.83	78.50	70.83	55.00	70.00	69.17	69.17	70.00	66.67
	Mean (B)	41.25	79.67	76.25	69.92	73.33		58.75	69.58	68.33	70.00	70.42	
	$LSD_{0.05}$	A=N.S		B=8.27		A*B=11.70		A=N.S		B=5.31		A*B=7.51	
Dry weight of recepta-cle (g)	Balady	5.65	8.36	6.94	6.05	7.02	6.80	5.02	6.71	7.27	6.69	7.21	6.58
	French	3.57	8.13	8.60	8.57	8.52	7.48	5.69	7.87	7.83	7.32	7.44	7.23
	Mean (B)	4.61	8.25	7.77	7.31	7.77		5.35	7.29	7.55	7.00	7.32	
	$LSD_{0.05}$	A=N.S		B=0.85		A*B=1.20		A=0.32		B=0.48		A*B=0.68	
Early yield (ton/fed)	Balady	0.686	4.46	4.39	3.90	4.71	3.63	0.626	5.48	4.83	4.50	4.84	4.05
	French	0.677	4.48	4.23	3.93	4.43	3.55	0.818	5.14	4.68	4.95	5.30	4.18
	Mean (B)	0.681	4.47	4.31	3.91	4.57		0.723	5.31	4.75	4.72	5.07	
	$LSD_{0.05}$	A=N.S		B=1.04		A*B=1.37		A=N.S		B=3.22		A*B=3.33	
Early yield (Num of heads/ fed)	Balady	3048	19895	19509	17333	20941	16134	2783	18906	21486	19148	21510	16767
	French	3007	19895	18780	17468	20941	15767	3636	22875	20810	22002	23551	18575
	Mean (B)	3027	19866	19144	17401	20313		3210	20890	21148	20575	22530	
	$LSD_{0.05}$	A=n.s		B=327.00		A*B=462.44		A=214.31		B= 629.18		A*B=889.79	
Total yield(ton/ fed)	Balady	6.38	7.55	7.54	6.97	8.13	7.31	6.94	7.35	8.80	7.67	8.27	7.81
	French	7.58	8.25	8.19	7.58	8.21	7.96	8.26	9.22	8.70	8.94	9.48	8.92
	Mean (B)	6.98	7.90	7.87	7.28	8.17		7.60	8.29	8.75	8.31	8.87	
	$LSD_{0.05}$	A=0.22		B=0.30		A*B=0.33		A=0.09		B=0.12		A*B=0.19	

Generally, French (Hyrious) cultivar which sprayed by silicon (1000 ppm SiO_2) was the best treatment on growth characters and yield components and recorded the highest values of early and total yield increases in the two successive seasons when compared with non- sprayed plants, followed by French (Hyrious) cultivar sprayed by putrescine (1 ppm)

Globe artichoke (*Cynara scolymus L.*) traditionally have been composed of clones or groups of related clones, since virtually all seed populations of artichoke are highly heterogeneous. The Germplasm

Laboratory of the Italian National Research Council maintains a collection of about 140 cultivars assembled from throughout the world. Fewer than 40 of these, however, are grown commercially to any substantial degree. The number of cultivars grown in each of the major producing countries is small. This relatively unimproved cultivar is a composite of genotypes (Porceddu, 1979).

In this respect, Silicon has number of well documented and readily visible and/or measurable beneficial effects. Silicon can stimulate growth and yield by several indirect actions. These include decreasing mutual shading by improving leaf erectness, decreasing susceptibility to lodging, decreasing the incidence of infections with root parasites and pathogens, pests, and preventing manganese or iron toxicity or both. Other beneficial effects of silicon application such as reduced water loss by cuticular transpiration, by decreasing the nonstomatal (cuticular) component of transpiration (Marschner, 1995).

In this connection, Yoshida *et al*. (1969) noticed that increased silicon absorption maintain erect leaves. They added that the importance of leaf angle to photosynthesis by a crop canopy is well recognized. The maintenance of erect leaves as a result of silicate application can easily account for a 10% increase in the photosynthesis of the canopy.

Silicon has been related to the depression of excessive loss of water by transpiration (Savant *et al.,* 1997) or with silicate crystals deposition beneath the epidermal cells of leaves and stems (Matoh *et al.,* 1998)

Lee *et al.* (1991) stated that cucumber plants cv. Eunsungbackdadgi were grown in recirculating nutrient solution contains SiO_2 at the rate of 0.85, 1.7 and 3.4 mM Si and foliar sprays of 17 **m**M Si lead to enhance leaf fresh weight and enhanced the rigidity of mature leaves at the highest rate of silicon concentration treatment.

Gharibe and Hanafy Ahmed (2005) stated that spraying pea (*Pisum sativum,* L.) plants cv. Master B twice, 40 and 60 days after sowing with foliar spraying of sodium meta silicate with 1 and 2 g/l. at any different doses caused significant increase in plant height, number of leaves/ plant as well as the total leaves area, while significant decreased number of days from sowing to anthesis of the flowers. Lu and Cao (2001) regarded that in hydroponic system containing 1.0 mmol Si (as sodium silicate) / l. obtained a significant increase in an earlier flowering, lower fruiting node and decreasing fruit abortion of melon plants.

Schmidt *et al*. (1999) noted that Si can positively affect the activity of some enzymes involved in the photosynthesis in rice and turf grass.

Liang *et al.* (2005) working on barley reported that, Si application increase antioxidative defense and reduce membrane lipid oxidative damage in barely under salt stress.

Gong *et al*. (2005) noted that application of Silicon (2.11 mM of sodiumsilicat /kg soil) increased the fatty acid instauration of lipids and contents of photosynthetic pigments and soluble proteins as well as total thiols under stress, whereas the content of hydrogen peroxide, activity of acid phospholipase and oxidative stress of proteins were decreased by applying silicon. In addition, application of silicon also increased the net CO_2 assimilation rate of leaves of drought stressed wheat plants.

Hanafy Ahmed *et al*. (2008) on wheat reported that all measured yield components increased significantly by using all levels of silicon (250,500,1000ppm SiO_2)with some exceptions, Moreover, the result indicated that the lowest level of silicon had the superiority effect followed by the highest level, while the middle level of silicon had the superiority increasing straw weight when compared with control non-sprayed plants.

Paprotka-Kuhne (1989) reported that sprayed apple trees 12 times with a 1% suspension of Silkaben (84% finely ground silica) between 18 Apr. and 28 Aug. leaf chlorophyll increased by 22% and Si content by 80% by June. But by 8 Sep.there was no difference in chlorophyll content compared with controls.

Lee *et al.* (1990) proposed that CaO, SiO_2, lignin and hemicellulose contents increased with increasing applications of silica of rice plants. Also, Liang *et al* (1996) deduced that silicon could increased CO_2 assimilation of barley leaves.

Kim *et al*. (2003) studied that the increase in the application rate of silicate increased the silicon content of the fruit. In relation, the silicon content of the fruit was highest at 34 days after fruit set (3.89- 5.63 mmol /g) and lowest at 48 days after fruit set (1.85- 2.92 mmol/g). The activities of sucrose phosphate synthase and sucrose synthase were maximum at 34 days after fruit set.

Concerning the favourable effects of putrescine on plant growth and yield components, Atlman and Bachrach (1981) proved that putrescine play an important regulatory role in plant growth and development. Egea-Cortines and Mizrahi (1991) assumed that there is a close correlation between high polyamine titers and high rates of cell division in plant cells. When diamine (putrescine) and polyamine (spermine and spermidine) used, the increase in shoot growth could be due to enhanced cell division activity as it was observed that increased putrescine level accompanies higher cell division activity in plants (Galaston, 1983). In this respect, PAs are involved in many plant developmental processes, including cell division, embryogenesis, reproductive organ development, root growth, tuberization, floral initiation and development fruit development and ripening as well as leaf senescence and a biotic stresses (Galaston *et al*., 1997; Bais and Ravishankar, 2002 and Tiburcio and Altabella, 2002).Changes in free and conjugated PAs and their biosynthetic enzymes have been found to occur during these developmental processes. Feirer and Lituay (1984) on carrot found that increased in PAs and their biosynthetic enzymes are associated with rapid cell division in many plant systems; Such as tomato ovaries (Heimer and Mizrahi, 1982) and fruit development (Kakar and Rai, 1993). PA_S and their conjugates have also been found in apical shoots and meristems prior to flowering (Cabbanne *et al*., 1981) and flower parts of many plants (Martin-Taguy, 1985). Generally, these results were in agreement with Hanafy Ahmed *et al.* (2002) on *Myrtus communis* plants, Talaat (2003) on sweet pepper and Gharibe and Hanafy Ahmed (2005) on pea they reported that, sprayed putrescine caused a significant increased in plant height, number of leaves/plant, the total leaves area, as well as fresh and dry weights of shoot, especially at the lower rate of putrescine. These results were in agreement with Lu and Cao (2001) on melon. In this connection,the polyamine biosynthesis enzymes, ornithine decaroxylase and arginine decarboxylase, show high activities during the early stages of development in several fruits. Moreover, polyamined seem to play a regulatory role in morphogenetic processes preceding fruit set that is, in the formation of the flowers, (Kyriakidis *et al*., 1983, Chillemi *et al*., 1999 and Kaur-Sawhney *et al*. 1990). Generally, presented results were in agreement with Wang and Faust (1994) on apple, Talaat (2003) on sweet pepper they reported that, putrescine led to significant increased in early and total yield.

Gharibe and Hanafy Ahmed (2005) showed that foliar spraying of Putrescine at the dose of 1 or 2 ppm obtained a significant increased in the plant yield (on weight and number of pods basis) and total fresh yield per fadden of pea (*Pisum sativum,* L) plants cv. Master B when compared to the non-treated control plants.

Moreover, the levels of free PAs and the activities of arginine decarboxylase (ADC), ornithine decarboxylase (ODC), and S-adenosylmethionine decarboxylase (SAMDC) were measured in pericarp tissues of tomato (cv. Indalo) fruits during development and ripening. Fruits were harvested from greenhouse-grown plants at the immature green, mature green, breaker, turning, pink, light red and red stages. Putrescine (Put) was the predominant PA_S during the early stages of growth (fruits <1 g in weight), while contents of spermidine (Spd) and spermine (Spm) were low. The PA_S concentration clearly increased during early development, reaching a peak in fruits weighing 10 mg. ADC, ODC, and SAMDC activities also all peaked in fruits weighting 10 mg. The initial increase in PA_S levels occurred concomitantly with a rise in these decarboxylases. During ripening, levels of Spd declined, Spm decreased slightly, but no pronounced changes in Put occurred. Given that these variations did not reflect decarboxylase activities, which increased slightly at the pink stage, PA_S catabolism or conjugation might be involved in the ripening of this tomato cultivar,(Morilla *et al*., 1996)

Biasi *et al*. (1991) by experiments to determine the role of polyamines in fruit set and growth were carried out on 7-year-old cv. Topred apple trees on M.26 rootstock. Results indicated a correlation of polyamine content, biosynthetic enzyme activities and fruit growth during the initial stages of fruit development. Putrescine application at the rate 0.1 mM significantly increased fruit set, fruit length and fruit spermidine content.

Costa and Bagni (1983), Biasi *et al.* (1988) recorded that the application of exogenous putrescine was sprayed 9 days after full bloom on open and self pollinated flowers of a super-type apple (*Malus domestica* Bork.cv. Ruby Spur) considerably increased apple fruit set per tree, particularly during the cell division stage. Flower bud differentiation was also, increased by higher concentration of putrescine.

The polyamine biosynthesis enzymes, ornithine decaroxylase and arginine decarboxylase, show high activities during the early stages of development in several fruits. In tomato (Kyriakidis *et al* ., 1983) and tobacco (Chriqui *et al.,* 1986) overies the activity of ornithine decarboxylase is low during anthesis and increases during the mitotic stages of the ovaries. The pattern of ornithine decarboxylase and arginine decarboxylase activities is identical to that in pollinated fruits; although the activity of orinithine decarboxylase is slightly lower (Icekson *et al*., 1985). Crisosto *et al*., (1988) noticed that putrescine at 10^{-3} M applied at anthesis increased ovule longevity and fruit set of 'Comice' pear (*Pyrus communis,* L.*)* to delay senescence of the ovules and to enhance pollen germination and fertilization.

Kaur-Sawhney *et al*. (1990) demonstrated that polyamined seem to play a regulatory role in morphogenetic processes preceding fruit set; that is, in the formation of the flowers.

Concerning the presented results for cultivars, it could be noted that, there were a few or nonsignificant differences between Balady and French (Hyrious) on the most of the studied growth characters and yield components may be that the local artichoke cultivar cultivated in Egypt is heterogeneous. Moreover, El-Baz *et al*. (1979)demonstrated that, mass selection in Egyptian Balady cv. and French artichoke varieties was continued for several years, the selected Balady and French varieties are characterized by better qualities. French and selected French varieties took shorter time to reach maturity.

Chemical composition:

Inorganic components:

Concerning the effect of treatments, silicon or putrescine, on N,P and K concentrations in leaves and receptacle, data presented in tables (4and 5) indicate that , silicon caused significant increases on P and K concentrations in the leaves and receptacle especially at the higher level of silicon . While, only the lower level of silicon led to significant increased in N concentrations in the leaves of the second sample of the second season when compared with control untreated plants. Putrescine lead to significant increased on N, P and K, concentrations in leaves and receptacle when compared with untreated plants of the both seasons.

Concerning the effect of cultivars on N, P and K concentrations in the leaves and receptacle, data in tables (4 and 5) indicated that, Balady cultivar significantly increased N concentrations in the leaves and receptacle when compared with French (Hyrious) cultivar. While French (Hyrious) cultivar caused significant increase in P and K concentrations when compared with Balady cultivar of both successive seasons.

Concerning the interaction between treatments and cultivars on inorganic components, data in tables (4 and 5) revealed that, generally, Balady cultivar sprayed by putrescine (1 ppm) was the best for significant increased in N concentrations of leaves, while, French cultivar sprayed by silicon (1000 ppm SiO_2) was the best for significant increased in P concentration of leaves, but, French cultivar sprayed by silicon (500 ppm SiO_2) led to significant increased in K concentration of leaves when compared all of these interaction treatments with control- untreated plants.

Moreover, it is interesting to notice that the high accumulated of dry matter contents in leaves as well as nitrogen, phosphorus and potassium in treated plants with silicon or putresciene which, enhanced photosynthesis and carbohydrates accumulator. So, it might the developing buds and heads had a competition for nutrients and carbohydrates supplied form the leaves. It could be suggested that these reasons effect of early flowering as well as early yield when compared with untreated plants.

Generally, these results were in agreement with Lal and Dravid (1991) on mostered as well as Gharibe and Hanafy Ahmed (2005) on pea they reported that, Si led to significant increased on N and P. Moreover, Elawad *et al.* (1982) on sugarcane and reported that, Si caused a significant increased in N, P and K concentration in plants. In this respect, it can be suggest that Si could act as beneficial element under conditions of nutrient imbalance, (Marschner *et al*. 1990). Mousa (2006) working on maize mentioned that, addition of Si at 3 mM Si to the nutrient solution enhanced superoxide dismutase and catalase activities and total protein. Moreover, Hanafy Ahmed *et al*.(2008) on wheat suggested that foliar application treatments, all level of silicon (250,500,1000ppm SiO_2) tended to increased significantly N and K concentrations in shoots and roots as well as P and Mg in roots.

As mentioned befor , putrescine foliar application at the rates of 1 and 2 ppm caused significant increases on N, P and K concentrations in the leaves as well as P and K concentrations of receptacle in the two successive seasons when compared with control untreated plants .These results were in agreement with Crisosto *et al*. (1988) on *Purus comunis* Moreover,Talaat (2003) stated that spraying Putrescine at two levels i.e. 1 or 2 ppm on four sweet peppers at three successive times with two month intervals staring at 45 days after transplanting obtained a significantly enhancement in N and Mg concentrations in the shoots, roots, and fruits with especially concentrations to Putrescine at higher rate (2 ppm) but exogenous supply at 1 or 2 ppm achieved a pronounced enhancement in P, K and Ca concentrations in all organs (shoots, roots, and fruits) of sweet pepper plants under both non-saline or saline soil conditions.

Gharibe and Hanafy Ahmed (2005) stated that pea (*Pisum sativum,* L.) plants cv. Master B were sprayed twice, 40 and 60 days after sowing with foliar spraying of putrescine at 2 ppm caused significant increase in N concentration and protein % of pea seeds. Also, at the higher dose of putrescine enhanced N concentration in shoots as compared to the non-treated control plants.

Crisosto *et al*. (1992) mentioned that Putrescine (10^{-3} M, applied at flowering) on 'Comice' pear (*Pyrus communis* L.) found that, flowers had greater polyamine levels than unpollinated ones. Putrescine-treated flowers had lower endogenous polyamine levels and higher N contents than untreated flowers.

In this respect Srivastava and Smith (1982) cited that due to their polycationic nature, polyamines could be involved in the cellular ionic balance.

Concerning the effect of high potassium concentration increases on early yield production Hanafy Ahmed (1986) pointed out that potassium has an important role in the development of floral apex of sweet pepper plant.

Table (4): Nitrogen, phosphorus and potassium concentrations (%). total sugars, total soluble phenol and total free amino acids concentrations (mg/g F.W.) in the shoots of globe artichoke plants sprayed by different levels of silicon (500 ppm and 1000 ppm SiO_2) or putrescine (1 ppm and 2 ppm) at 75 and 90 days after planting in 2005- 2006 and 2006-2007 seasons.

Season			2005 - 2006						2006 – 2007					
Chemical composition	**Plant age days**	**cultivars / treatments**	**Cont.**	**Put.1**	**Put.2**	**Si 1**	**Si 2**	**Mean (A)**	**Cont.**	**Put.1**	**Put.2**	**Si1**	**Si2**	**Mean (A)**
Nitrogen	75	Balady	2.17	3.02	2.36	2.14	2.05	2.35	2.19	3.26	2.38	2.15	2.11	2.42
		French	2.04	2.26	2.17	2.01	1.60	2.02	2.10	2.34	2.25	2.14	2.08	2.18
		Mean (B)	2.10	2.64	2.26	2.07	1.82		2.14	2.80	2.31	2.14	2.09	
		$LSD_{0.05}$	A=0.09 B=0.16 A*B=0.22						A=0.10 B=0.19 A*B=0.29					
	90	Balady	2.14	2.91	2.78	2.53	2.25	2.52	2.63	3.05	2.82	2.31	2.22	2.66
		French	2.19	2.33	2.29	2.08	2.07	2.19	2.27	2.35	2.31	2.11	2.31	2.27
		Mean (B)	2.16	2.62	2.53	2.30	2.16		2.45	2.70	2.56	2.21	2.26	
		$LSD_{0.05}$	A=0.28 B=0.37 A*B= 0.52						A=0.21 B=0.24 A*B=0.29					
Phosphorus	75	Balady	0.21	0.19	0.18	0.20	0.23	0.20	0.19	0.23	0.21	0.22	0.24	0.22
		French	0.18	0.24	0.25	0.20	0.29	0.23	0.22	0.25	0.26	0.23	0.30	0.25
		Mean (B)	0.19	0.21	0.21	0.20	0.26		0.20	0.24	0.23	0.22	0.27	
		$LSD_{0.05}$	A= 0.02 B=0.04 A*B=0.06						A=0.02 B=0.03 A*B=0.05					
	90	Balady	0.21	0.25	0.23	0.27	0.29	0.25	0.23	0.66	0.24	0.28	0.30	0.42
		French	0.19	0.35	0.27	0.25	0.28	0.27	0.21	0.26	0.28	0.26	0.29	0.26
		Mean (B)	0.20	0.30	0.25	0.26	0.28		0.22	0.46	0.26	0.27	0.29	
		$LSD_{0.05}$	A=N.S B=0.06 A*B=0.09						A=N.S B= N.S A*B=0.75					
Potassium	75	Balady	3.27	4.55	4.26	5.29	4.95	4.46	3.07	3.57	3.17	4.76	3.79	3.67
		French	4.70	5.26	5.04	5.89	4.76	5.13	3.30	3.60	3.50	3.67	3.27	3.47
		Mean (B)	3.98	4.90	4.65	5.59	4.85		3.18	3.58	3.33	4.21	3.53	
		$LSD_{0.05}$	A=0.25 B=0.36 A*B=0.39						A= N.S B=0.35 A*B=0.49					
	90	Balady	4.35	5.50	5.32	5.97	5.50	5.33	3.80	4.77	4.57	5.59	5.26	4.80
		French	5.77	6.15	5.98	6.49	5.44	5.97	5.17	5.53	5.32	6.43	5.01	5.49
		Mean (B)	5.06	5.82	5.65	6.23	5.47		4.48	5.15	4.94	6.01	5.13	
		$LSD_{0.05}$	A=0.16 B=0.24 A*B=0.27						A=0.15 B=0.22 A*B=0.25					
Total sugars	75	Balady	1.82	3.20	4.20	2.82	4.52	3.31	1.69	3.04	4.24	3.13	4.67	3.35
		French	1.90	4.32	6.33	3.06	3.95	3.99	1.98	4.53	6.95	3.31	4.40	4.23
		Mean (B)	1.86	3.78	5.47	2.94	4.23		1.84	3.78	5.59	3.22	5.53	
		$LSD_{0.05}$	A=0.55 B=0.78 A*B=0.79						A=0.45 B=0.50 A*B=0.64					
	90	Balady	1.21	5.40	6.39	3.96	5.38	0.45	1.39	5.46	6.57	4.49	5.98	4.78
		French	2.83	5.23	7.23	3.93	6.09	0.51	3.28	5.71	7.21	4.16	4.19	4.91
		Mean (B)	0.20	0.53	0.68	0.39	0.57		2.33	5.58	6.89	4.33	5.09	
		$LSD_{0.05}$	A=N.S B=0.57 A*B= 0.81						A=N.S B=0.40 A*B=0.57					
Total soluble phenol	75	Balady	74.26	73.17	75.74	74.00	72.80	73.99	74.81	74.35	76.07	75.59	73.65	74.89
		French	75.23	71.28	71.56	73.15	72.69	72.79	73.65	71.73	71.13	71.24	72.53	72.12
		Mean (B)	74.75	72.22	73.65	73.58	72.75		74.39	73.04	73.60	73.41	73.09	
		$LSD_{0.05}$	A=N.S B=N.S A*B=0.57						A=N.S B=N.S A*B=0.92					
	90	Balady	74.55	73.90	81.14	74.47	72.05	75.28	75.89	74.67	83.35	75.68	73.24	76.57
		French	74.16	71.77	71.08	73.20	74.15	72.89	76.66	71.45	71.64	73.68	75.92	73.87
		Mean (B)	74.36	72.83	76.11	73.97	73.10		76.28	73.06	77.50	74.68	74.58	
		$LSD_{0.05}$	A=N.S B=0.04 A*B=.006						A=N.S B=0.10 A*B=0.18					
Total free amino acids	75	Balady	22.20	27.14	24.53	21.68	25.23	24.15	23.21	37.05	26.60	21.11	28.23	27.24
		French	33.33	23.50	39.66	33.63	14.52	28.93	37.90	55.11	42.24	14.32	16.97	33.31
		Mean (B)	27.76	25.32	32.09	27.65	19.87		30.55	46.08	34.42	17.71	22.60	
		$LSD_{0.05}$	A=N.S B=9.25 A*B=13.08						A=1.34 B=3.66 A*B=5.18					
	90	Balady	31.70	40.52	29.63	22.74	28.63	30.64	27.50	40.79	26.54	23.97	27.44	29.25
		French	48.92	57.24	50.59	18.10	15.67	38.10	41.41	57.02	42.54	13.50	17.26	34.35
		Mean (B)	40.31	48.88	40.11	20.42	22.15		34.45	48.90	34.54	18.73	22.35	
		$LSD_{0.05}$	A= N.S B=4.22 A*B=5.97						A=N.S B=2.30 A*B=3.26					

Table (5): Nitrogen, phosphorus and potassium concentrations (%), total sugars, total soluble phenol and total free amino acids concentrations (mg/g F.W.) in receptacle of globe artichoke plants at the early yield sprayed by different levels of silicon (500 ppm and 1000 ppm SiO_2) or putrescine(1 ppm and 2 ppm) in 2005-2006 and 2006-2007 seasons.

Season		2005 - 2006						2006 – 2007					
Chemical composition	cultivars / treatments	Cont.	Put.1	Put.2	Si 1	Si 2	Mean (A)	Cont.	Put.1	Put.2	Si1	Si2	Mean (A)
Nitrogen %	Balady	2.59	3.44	2.86	2.26	1.97	2.62	2.90	3.46	2.91	1.83	2.08	2.64
	French	2.39	2.26	2.42	2.26	2.20	2.30	2.51	2.19	2.46	2.23	2.25	2.33
	Mean (B)	2.49	2.85	2.64	2.26	2.08		2.71	2.83	2.69	2.03	2.17	
	$LSD_{0.05}$	A=N.S B=0.49 A*B=0.70						A=0.07 B=0.09 A*B=0.10					
Phosphorus %	Balady	0.25	0.25	0.25	0.24	0.51	0.30	0.25	0.26	0.26	0.25	0.30	0.26
	French	0.17	0.17	0.18	0.22	0.25	0.20	0.19	0.22	0.22	0.24	0.26	0.23
	Mean (B)	0.21	0.21	0.22	0.23	0.38		0.22	0.24	0.24	0.25	0.28	
	$LSD_{0.05}$	A=N.S B=0.15 A*B=0.21						A=N.S B=0.02 A*B=0.03					
Potassium %	Balady	3.47	4.09	3.87	5.32	3.80	4.11	4.64	5.71	5.38	6.32	5.74	5.56
	French	3.50	3.87	3.80	3.77	3.20	3.63	5.68	6.35	5.95	6.83	5.60	6.08
	Mean (B)	3.49	3.98	3.84	4.55	3.50		5.16	6.03	5.66	6.57	5.67	
	$LSD_{0.05}$	A=0.17 B=0.25 A*B=0.35						A=0.11 B=0.32 A*B=0.46					
Total sugars mg/g fw.	Balady	10.46	9.68	10.72	10.23	11.36	10.49	5.36	10.22	10.01	10.16	11.50	9.45
	French	10.27	10.95	9.62	10.45	10.64	10.45	8.57	8.66	10.32	10.06	10.99	9.72
	Mean (B)	10.37	10.32	1017	10.34	11.15		6.96	9.44	10.17	10.11	11.25	
	$LSD_{0.05}$	A=N.S B=N.S A*B=N.S						A=N.S B=1.30 A*B=1.84					
Total soluble phenol mg/g fw.	Balady	78.30	75.98	79.41	77.65	72.90	76.85	77.35	79.50	74.96	77.69	73.58	76.62
	French	72.58	72.88	75.06	77.04	84.51	76.41	72.42	73.85	72.61	78.03	83.96	76.17
	Mean (B)	75.44	74.43	77.24	77.35	78.71		74.88	76.68	73.78	77.86	78.77	
	$LSD_{0.05}$	A=N.S B=N.S A*B=10.57						A=N.S B=1.08 A*B=1.54					
Total free amino acids mg/g fw.	Balady	6.59	15.77	12.03	12.40	8.10	10.10	6.36	17.87	17.59	10.77	13.56	13.23
	French	10.48	15.45	14.56	10.35	9.23	12.01	6.58	14.63	15.22	7.79	11.26	11.10
	Mean (B)	8.54	15.61	13.29	11.37	8.66		6.47	16.25	16.40	9.28	12.41	
	$LSD_{0.05}$	A=0.58 B=1.36 A*B=2.77						A=0.62 B=2.13 A*B=3.01					

Organic components:

Concerning total sugar concentration in the leaves and receptacle, data presented in tables (4 and 5) indicate that either levels of Silicon (500 ppm and 1000 ppm SiO_2) or putrescine (1 ppm and 2 ppm) caused significant increases on total sugar concentration in leaves and receptacle of the two seasons. While, there were no significant difference on total sugar concentration in the leaves or receptacle between the tow different cultivars in the two seasons, with some exceptions.

Moreover, French cultivar sprayed with silicon (1000 ppm SiO_2) was the best interaction treatment led to increase on total sugar concentration in the two successive seasons when compared with control- untreated plants followed by French cultivar sprayed by putrescine (2 ppm).

Concerning total free amino acids concentration in the leaves and receptacle, data in Tables (4 and 5) revealed that Silicon or putrescine lead to significant increased in total free amino acids concentration on receptacle but only putrescine caused a significant increased in total-free amino acids in the leaves of the both seasons. While, French cultivar sprayed by putrescine (2 ppm) followed French cultivar which sprayed by silicon (1000 ppm SiO_2) were the best treatments which caused significant increased in total free amino acids in the two successive seasons when compared with control-untreated plants.

Concerning total soluble phenol concentration in the leaves and receptacle, data presented in table (4 and 5) indicate that, both levels of silicon and only the first level of putrescine caused significant decreased on total soluble phenol concentration in the leaves and receptacle in the two successive seasons. French cultivar sprayed by putrescine at the rate of (1ppm) was the best caused a significant decreased in total soluble phenol when compared with control plants of both successive seasons followed by French cultivar sprayed by silicon (1000 ppm SiO_2).

In this respect, it is clear from the results in Table (4) that high amount of total sugar and total free amino acids as well as low amount of total soluble phenol in leaves of treated plants with silicon or putrescien when compared with non-treated plants might effect of early flowering as well as early yield ton / fed. This developing buds and heads had a competition for nutrients (P and K) and carbohydrate supplying from the leaves. Thus, the development of buds, heads during the second sample at 90 days from planting might be a result of early yield ton / fed. It could be a cause of the poll size of nutrients (K and P) and carbohydrates in vegetative parts.

These results were in agreement with those reported by Okamoto (1959) on rice. The author reported that, Si led to significant increased on total sugars concentration. While on the contrary, Wang and Galletta (1998) on strawberry reported that, Si caused a significant decreased in fructose, glucose, sucrose.Moreover,Gharibe and Hanafy Ahmed (2005) reported that when peas (*Pisum sativum* L. cv Master B) plants sprayed with 1 and 2 g/L sodium meta silicate (Silicon) noted that the two rates of Silicon significantly increased organic components (total sugars ,total free amino acids and total soluble phenols)concentrations in the first season. Meanwhile , only the higher dose of sodium meta silicate enhanced each of total sugars as well as total soluble phenols in the second season.

However, Hanafy Ahmed *et al* (2008) on wheat reported that total sugars significantly decreased by all silicon treatments (250,500,1000 ppm SiO_2) when compared with silicon non-sprayed control plants, while, no constant trend could be detected on total soluble phenols and total free amino acids in both shoot and roots at the two different age (70 and 90 days after sowing) by the different levels of silicon treatments.

Rani *et al*. (1997) working on rice mentioned that, addition of 100 mg SiO_2 kg^{-1} soil changed the content of carbohydrates, protein and phenol and these changes varied slightly with stage of the crop and plant part.

Islam and Saha (1969) reported that the application of silicon generally increases carbohydrate content of rice plants.

Concerning the favorable effects of putrescine foliar application on organic components formation, many investigators reported that, polyamines are important factor regulating growth and carbohydrate biosynthesis (Smith, 1985). Moreover, putrescine levels had important relationship with biosynthesis enzymes (Taylor *et al*., 1993).These results were in agreement with those obtained by Chenwei *et al*. (2000) on rose flowers, Hanafy Ahmed *et al*. (2002) on *Myrtus communis*, and Gharibe and Hanafy Ahmed (2005) on pea, they reported that, putrescine led to significant increased on total sugars and total free amino acids concentration. Özturk and Demir (2003) working on spinach leaves mentioned that putrescine increased polyphenol oxidase activity in leaves.

Moreover, in pots experiment, Talaat (2003) recorded that spraying putrescine at two levels (1 or 2 ppm) on four sweet pepper starting at 45, 105 and 165 days after transplanting obtained a significant increase the fruit dry weights and obtained low value of total sugar concentrations and high values of total amino acids concentrations.

Chenwei *et al*. (2000) mentioned that the treatment with 0.1 mM/l spermine could maintain high contents of reduced sugars and soluble proteins during the early stages of vase life in cut roses.

Hanafy Ahmed *et al*. (2002) suggested that putrescine is a diamine which is involved in important biological processes, such as ionic balance and DNA, RNA and protein stabilization, hence, leading to the enhancement of free amino acids synthesis and accumulation under salinity stress conditions of *Myrtus communis* plants.

Plant hormones

Concerning the effect of silicon or putrescine foliar application on endogenous plant hormones concentration, data presented in Table (6) reveal that, the higher level of silicon caused a significant increased in IAA and CK while, the lower level led to significant increased in GA_3 and CK. In this respect, it can be assumed that the increase in cytokinin activity in globe artichoke plant treated with silicon especially the higher level (100 ppmSiO_2) which produced early yield may reflect many features exhibited by this treatment. In this connection, as mentioned before, high values of dry matter accumulation and content of different organic (total sugars and free amino acids) and inorganic (N,P and K) components with silicon if compared with control-untreated plants. Therefore, such increases may be attributed to the role played by cytokinins in increasing sink potential. This fraction might be implicated in enhancing early flowering as well as early yield. Thus, it can be assumed that, the high values of total sugars concentrations in the leaves of globe plants treated with Si or put. foliar applications may be implicated in the induction of early flowers and early yield production In this respect, Hanafy Ahmed *et al*. (1995) working on globe artichoke mentioned that the transition to flowering may involve complex system of interacting factors including among others, cytokinins , gibberellins and carbohydrates, Moreover, Bruinsma (1977) stated that cytokinins play a particular role in flower initiation. Leonard and Kint (1982) found that cytokinins play a major role in the control of early stages of reproductive development in tomato. Sachs (1977) demonstrated that cytokinins are strong mobilizes of assimilates to the site of application and redistribution of metabolites is involved in the regulation of flowering.

Table (6) : IAA, GA_3, ABA and CK concentrations (μ g /g F.W.) of the shoot of globe artichoke plants sprayed by different levels of putrescine (1 ppm and 2 ppm) or silicon (500 ppm and 1000 ppm SiO_2) at 90 days after planting in 2005 -2006 season.

Season							2006 - 2007					
Treatments	Cont.	Put.1	Put.2	Si 1	Si 2	Mean (A)	Cont.	Put.1	Put.2	Si1	Si2	Mean (A)
Cultivars	IAA						GA_3					
Balady	0.030	0.039	0.048	0.025	0.036	0.035	0.038	0.124	0.122	0.045	0.051	0.076
French	0.030	0.031	0.036	0.018	0.053	0.034	0.097	0.108	0.097	0.108	0.051	0.092
Mean (B)	0.030	0.035	0.042	0.021	0.044		0.067	0.116	0.109	0.076	0.051	
$LSD_{0.05}$	A=N.S B=0.017 A*B=0.024						A=N.S B=0.054 A*B=0.081					
Cultivars	ABA						CK					
Balady	0.125	0.158	0.090	1.610	1.423	0.681	6.370	5.881	5.652	7.301	7.971	6.635
French	3.444	2.952	3.281	2.918	3.011	3.121	4.918	4.931	5.354	6.632	7.514	5.870
Mean (B)	1.784	1.555	1.685	2.264	2.217		5.644	5.406	5.503	6.966	7.742	
$LSD_{0.05}$	A=N.S B=0.698 A*B=0.986						A=0.604 B=1.201 A*B=1.699					

Moreover, Bernier (1988) mentioned that the translation to flowering may involve a complex system of interacting factors including, among others, cytokinins and carbohydrates. In this respect, the high values of cytokinins activity may be attributed to the effect of phosphorus in RNA and DNA synthesis (Scott and Possingham, 1983). Furthermore, Garcia-Martinenz and Garcia-Papi (1979) suggested that the increase in fruit set after GA_3 application is due to increased mobilization of nutrients from the leaves. In this connection, the early flowering and heading when compared with control untreated plants may be due to promoting effect of higher gibberellins activity on increasing nutrients mobilization.

Moreover, as it has been mentioned before, the reducing sugar concentration in treated plants increased with silicon. In this connection, Bernier (1988) reported that the transition to flowering may involve a complex system of interacting factors including among others carbohydrates, gibberellins and cytokinnins. Some of these factors may act in sequence since some of the cellular changes seem to occur before the floral stimulus arrives at the apex. Moreover, Evenari (1984) suggested that cytokinnins may influence the movement of metabolites in the plant, resulting in localized accumulation at the site of application. Moreover, Sachs (1977) demonstrated that cytokinnins are strong mobilizers of assimilates to the site of application and redistribution of metabolites is involved in the regulation of flowering. Aleshin (1988) mentioned that nucleic acid preparations from rice tissues contain large amount of Si. In this respect, it may be suggested that, the enhancement in shoot height of globe artichoke plants sprayed with the higher rate of Si might be induced due to the role played by this element in both cell division and cell expansion might be through its effect on RNA and DNA synthesis, which may be enhanced the phytohormone levels in treated plants into a suitable concentration. Lenoel and Jouanneau (1980) reported that tRNA by natural degradation in the cells might be souece of endogenous cytokinnins in the free State .they also mentioned that cytokinnins may act physiologically through a regulatory role in some reactions involving RNA formation. Thus, it can be suggested that the effect of Si or put. on RNA and DNA synthesis may affect indirectly cytokinnins synthesis. Taiz and Zeiger (1991) pointed out that application of abscisic acid modified the flowering response in some plants, but endogenous abscisic acid dose not appear to play amajor role in the control of flowering.

Data in Table (6) indicated that the tow levels of putrescine led to significant increased in IAA, GA_3 and CK when compared with untreated plants of the both successive seasons.

In this respect, Galaston and Kaur-Swhney (1990) noted that, many plant growth and development processes known to be regulated by plant hormones, such as 2, 4 D, GA, IAA, IBA, CBB and ethylene, have also been correlated with changes in PA metabolism. These changes occur in both endogenous levels of PA_S and their biosynthetic enzymes and appear to be tissue specific.Of the major plants hormones; ethylene has been most intensively investigated with respect to PAs metabolism. The low metabolism, PAs and ethylene, play anagonistic roles in plant processes. While PA_S inhibit senescence of leaves (Kaur-Sawhney *et al.,* 1982), and fruit ripening (Kaur and Rai, 1993).

PAs inhibit ethylene biosynthesis, perhaps by blocking the conversion of (SAM) to ACC and of ACC to ethylene (Apel baum *et al.,* 1981).

Kaur Sawhney *et al*., (1990) 1 **µ**M putrescine decreased ethylene production and increased the number of flowers per plant with a complete induction of terminal flowering. Of the polyamines, only putrescine applied 8 h after dark induction reversed flowering inhibition induced by auxin applied immediately before dark induction, although putrescine, spermidine and spermine all reversed auxin-induced flowering inhibition when applied immediately after dark induction. Auxin application during the dark period did not inhibit flowering response when polyamines had been pre-applied. These results indicated that inhibition of the photoperiodic flower induction by auxin in *P*. *nil* cv. Violet is not mediated by ethylene and that polyamines and auxins act antagonistically on the flowering response.

Crisosto *et al.* (1992) found that Putrescine (10^{-3} M, applied at flowering) enhanced pollen tube ovule penetration and delayed ovule senescence, extending the effective pollination period of Doyenne du Comice pear by at least 2 days and 4 days in 1985 and 1986, respectively, without reducing post-pollination flower ethylene levels. Earlier pollen tube penetration, delayed ovule longevity and extended effective pollination period resulting from applying putrescine at flowering were not associated with reduced post-anthesis ethylene levels. A correlation exists between ACC level, distribution of polyamines and longevity of cut carnation flowers.

Generally, from the experimental results and their interpretion, it can be suggested that there are similarity between the early flowering and yield production induced by the two different foliar spray treatments; Si or put applications .In this respect, it can be assumed that these two treatments appear to influence some processes involved in the metabolism and activity of endogenous plant hormones which consequently affect the induction and development of reproductive organs. Therefore, it can be suggested that the disturbance in the normal balance between endogenous plant hormones due to foliar application of Si or put may be responsible for the early flowing and yield production.

Conclusion

In conclusion, the results of this study highlight on the role of Silicon and the role of Putrescine in improving globe artichoke early and total yield. We suggest that sprayed Silicon at the rate of 1000 ppm SiO_2 or Putrescine at the rate of 1 ppm after 45 and 60 days from planting under investigation were significantly increased early and total artichoke yield (ton /fed.). Moreover, the best interaction between treatments and cultivars were French (Hyrious) cultivar which sprayed by silicon at 1000 ppm SiO_2 followed by French (Hyrious) cultivar sprayed by putrescine at 1 ppm of both early and total yield (ton/ fed.) of two successive seasons.

Furthermore, it can be assumed that the increase in cytokinnin values in globe artichoke plants treated with Si or put may reflect many features exhibited by these treatments. In this connection, as mentioned before high values of dry matter accumulation and concentration of different organic (sugars and free aminos acids) and inorganic (N ,P and K) components were recovered by the plants sprayed with Si or put if compared with control-untreated plants. Therefore, such increases may be attributed to the role played by cytokinnins in increasing sink potential.

REFERENCES

A.O.A.C. (1960).Official Methods of Analysis (9^{th} Ed). Association of Official Analytical Chemists. Washington D.C., USA

Aleshin, N.E. (1988).On the biological role of silicon in rice .Vestnik sel, Skokhozyaistvennoi Nauki Moskna Vesesoynznyl Institute Risa, Krasnodar, NSSR,10:77-85.

Agarie, S.; Agata, W. and Kaufman, P.B. (1998) .Involvement of silicon in the senescence of rice leaves. Plant Prod. Sci., 1:104-105.

Altman, A.and Bachrach, U. (1981). Involvement of polyamine in plant growth and senescence. In: Caldarea, C.M. *etal* (Eds.): Advances in polyamine Research, Vol.3, Raven Press, New York,pp .365-375.

Apelbaum,A.; Burgoon, A.C.; Anderson,J.D.; Lieberman, M.; Ben-Aire, R. and Mattoo ,A.K. (1981).Polyamines inhibit biosynthesis of ethylene in higher plant tissue and fruit protoplasts. Plant Physiol.,68:453-456.

Bais,H.P. and Ravishankar, G.A. (2002). Role of polyamines in the ontogeny of plants and their biotechnological applications. Plant Cell, Tissue and Organ Culture, 69:1-34.

Bernier, G. (1988). The control of floral evocation and morphogenesis. Ann. Rev. Plant Physiol. Plant Mol. Boil., 39:175-219.

Biasi,R.; Bagni, N.and Costa, G.(1988).Endogenous polyamines in apple and their relatioshipe to fruit set and fruit growth. Plant Physiol., 73:201-205.

Biasi,R; Costa,G. and Bagni,N. (1991). Polyamine metabolism as related to fruit set and growth .Plant. Physiol. and Biochemistry,Paris, 29 (5) : 497-506.

Bruinsma, J. (1977). Roll der cytokinine bei Bluten-und Fruchtententwicklung Z. Pflanzenernahr Bodenked, 140: 15-23.

Cabanne, F.; Dalebroux, M.A. and Martin, C. (1981).Hydroxycinniamic acid amides and ripening to flower of *Nicotiana tabacum* L. var. Xanthin. Physiol. Plant., 53:399-404.

Chenwei, Y.; Shenggen, H. and Su, Y. (2000). Effect of polyamines on biochemical and physiological changes and life of rose flowers during senescence. J. Tropical and Subtropical Bot., 8(2):104-108.

Chillemi, G.; Lazzarin, R; Pimpini, F.; Gianquinto,G.; Sambo,P. and Lunardi, G. (1999) Tomato in NFT: Salinity of the nutrient solution, yield and intrinsic fruit quality. Colture Protette, 28(8):40-46.

Chriqui, D.; Orazi D. D. and Bagni,N. (1986).Ornithine and arginine decarboxylases and polyamine involvement during *in vivo* differentiation and *in vitro* differentiation of *Datura innoxia* leaf explants. Physiol. Plant., 68:589-596.

Cohen, M.; Tabor, C.W.andTabor, H. (1998).Regulatory mutations affecting ornithine decarboxylase activity in *S. cereviseae*.J.Bacteriol., 42:792-799.

Costa, G.M.and.Bagni M. (1983). Effect of polyamines on fruit set of apple. Hort.Sci., 18:59-63.

Crisosto, C.H.; Lombard, P.B.; Richardson, D.G.andTetley, R. (1992).Putrescine extends effective pollination period in 'Comice' pear (*Pyrus communis* L.) irrespective of post-anthesis ethylene levels. Scientia-Horticulturae, 49: (3-40, 211-221).

Crisosto,C.H.;Lombard,P.B.;Sugar,D.and Polito,V.S.(1988).Putrescine influences ovule senescence, fertilization time and fruit set in " Comice " pears. J.Amer. Soc. Hort. Sci., 113:708-711.

Dubois, M.; Smith,F.; Gilles,K.A.; Hamilton, J.K. and Rebers, P.A.(1956). Colorimetric method for determination of sugars and related substances. Annal. Chem., 28(3):350-356.

Egea-Cortines,M. and Mizrahi,Y.(1991).Effect of difluoromethylornithine on the growth of pollinated and naphthalene acetic acid- induced tomato ovaries .In: H.E. Flores, *etal*. (Eds.): Polyamines and Ethylene: Biosynthesis. Physiology and Interactions, American Soc.of Plant Physio., Rockeville, Maryland, MSA, pp.325-337.

Elawad, S. H.; Street J. J. and Gascho G. J. (1982). Response of sugarcane to silicate source and rate. II. Leaf freckling and nutrient content. Agro. J., 74(3):484-487.

El-Baz, E.E.; S. Foda and M. Moustapha. (1979). Some studies on globe artichoke. Agric. Res. Rev., 57 (3): 109-116.

El-Ghamrawy, N.K. and Neumann, K.H. (1977). Further studies on the host parasite relationship between *Vicia faba* and *Orobanche crenata* plants.a) Endogenous phytohormones of *Vicia faba* leaves and the plant. Ain Shams Umiv., Fac. Of Agric., Shobra El-Kheima, Cairo, Egypt, Research Bulletin, 776(a):1-16.

Evenari, M. (1984). Seed physiology: From ovule to maturing seed .The Bot. Review, 50:143-170.

Feirer, R. P.and Lituay, J.D. (1984). Arginine decarboxylase and required for embryogenesis in wild carrot. Science, 223:1433-1434.

Galaston, A.W. (1983). Polyamines as modulators of plant development. Bioscience, 33:382-388.

Galaston, A.W.; Kaur-Sawheny. R.; Altabella, T.and Tiburcio, A.F.(1997). Plant Polyamines in reproductive activity and response to a biotic stress. Bot. Acta., 110:197-207.

Galaston, A.W. and Kaur-Sawheny. R. (1990). Polyamines in plant physiology. Plant Physiol., 94:406-410.

Garcia-Martines, J.L. and Garcia-Papi, M.A. (1979). Influence of gibberellic acid on early fruit development, diffusible growth substances and content macronutrients seedless *clamantine mandarin.* Sci. Hort., 11 (4): 337-347.

Gharib, A.A and Hanafy Ahmed, A.H. (2005).Response of pea plants (*Pisum sativum,* L.) to foliar application of putrescine, glucose, folia feed D® and silicon .J. Agric. Sci. Mansorra Univ., 30(12): 7563-7579.

Gong, H.J.; Zhv, X.Y.; Chen, K.M.; Wang, S.M. and Chang, C.L. (2005).Silicon alleviates oxidative damage of wheat plants in pots under drought. Plant Sci., 169(2):313-321.

Hanafy Ahmed, A. H.; Harb, E.M.; Higazy, M.A. and Morgan, Sh. H. (2008). Effect of silicon and boron foliar applications on wheat plants grown under saline soil conditions. International Journal of Agric. Research, 3 (1): 1-26.

Hanafy Ahmed, A. H.; Hassan H. M.; Gad, M. A. and Amin, M. A. (2002). Improving growth and chemical composition of *Myrtus commuins* grown under soil salinity conditions by polyamines foliar application. Proc. Minia 1st Conf. for Agric. & Environ. Sci., Minia, Egypt, March 25-28.

Hanafy Ahmed, A. H.; Badawi, M.A.; El-Fadaly, K. A. and Kasim, A. T. 1995).Physiological factors affecting flowering of globe artichoke plants. Bull. Fac, of Agric., Univ. of Cairo, 46(4): 637-664.

Hanafy Ahmed, A. H. (1986). Some problems of potassium deficiency of sweet pepper (Capsicum annuum,L.) and garlic (Allium Sativum, L.) plants Ph.D.Thesis, Fac, Agric., Cairo Univ.

Heimer, Y.M. and Mizrahi, Y. (1982). Characterization of ornithine decarboxylase of tobacco cells and tomato ovaries. Biochem. J., 201:373-376.

Icekson, I.; Bakhanashvili, M. and Apelbaum, A. (1985). Inhibition by ethylene of polyamine biosynthetic enzymes enhanced lysine decarboxylase activity and cadaverine accumulation in pea seedlings. Plant Physiol., 82:607-618.

Islam, A. and Saha, R.C. (1969). Effects of silicon on the chemical composition of rice plants. Plant Soil, 30(3): 446-458

Jackson, M.L. (1973). Soil Chemical Analysis. Printice-Hall of India. Private Limited, New Delhi.

Kakar, R. J. and Rai, V.K. (1993). Plant polyamines in flowering and fruit ripening. Phytochemistry, 33:1281-1288.

Kaur-Sawhney, R.; Kandpal, G.; Megonigle, B. and Galaston, A.W. (1990). Further experiments on spermidine-mediated floral-bud formation in thin-layer explants of Wisconsion 38 tobacco. Planta, 181:212-217.

Kaur-Sawhney, R.; Shih Fores, H.E. and Galaston, A.W.(1982). Relation of polyamine synthesis and titer to aging and senescence in oat leaves. Plant Physiol., 69:405-410.

Kim, Y.; Kim, K.; Suh, H.; Lee, J. and Lee, S. (2003). Effect of granular silicate application on quality and shelf life of tomato in perlite culture. J. Korean Soc. Hort. Sci., 44(3):321-324(C.F. Hort. Abstr., 73, 10099, 2003).

Kyriakidis, D. A.; Heller, J. S. and Canellakis, E. S. (1983). Purification of ornithine decarboxylase antizymes, Meth. Enz., 94:193-200.

Lal, K. and Dravid, M.S. (1991). Phosphate, sulphate, silicate and FYM interaction on P utilization by mustard. J. of Nuclear Agri. And Bio., 19(4):232-235.

Lee, C.H. and Cheon, S.G. (2000). Effect of silicate fertilizer on paddy garlic (*Allium sativum* L.). Research-Reports-of-the-Rural-Development-Administration,-Soil-and-Fert., 33(2): 61-66.

Lee,Y.B; Kweon, J.S.; Bae, G.Y., and Shin, K.C. (1991). Effects of silicon on mineral nutrient uptake, growth and manganese toxicity of cucumber plants in hydroponics. Journal-of-the-Korean-Society-for-Horticultural-Science, 32(2) 146-156.

Lee, D. B; Kwon, T.O. and Park, K.H. (1999). Influence of nitrogen and silica on the yield and the loding related traits of paddy rice. Research Reports of the Rural Development Administration, Soil Fert., 32(2) :15-32.

Leonard, M. and Kint, J.M. (1982). Edogenous cytokinin and gibberellin leavls in relation to inflorescence development in tomato. Ann. Bot., 50:127-130.

Liang,Y.C.; Chen, Q.; Zhang,W.H.and Ding,R.X. (2005). Effects of silicon on tonoplast H^+ -ATP ase and H^+ -PP ase activity, fatty acid composition and fluidity in roots of salt-stressed barely (*Hordeum vulgare* L.). Environ.Exp.Bot., 53:29-37.

Liang,Y.C.; Shen, Q.R.; Shen, Z. and Ma,T. (1996). Effects of silicon on salinity tolerance of two barely cultivars.J. Plant Nutr., 19(1): 173-183.

Lu, G. and Cao, J. (2001) Effect of silicon on earliness and photosynthetic characteristics of melon. Acta Hort. Sinica, 28(5):421-424.

Ma, J.F. (2004).Role of silicon in enhancing the resistance of plants to biotic and a biotic stress. Soil Sci. Plant Nutr, 50(1):11-18.

Marschner, H. (1995).Mineral Nutrition of Higher Plants.(2nd Ed.), Academic press, Harcout Brace Company .Publishers London, San Diego, New York, Boston, Sydney, Tokyo, Toronto.,pp.786.

Marschner, H.; Oberle, H.; Cakmak, I. and Romheld, V. (1990).Growth enhancement by silicon in cumber (*cumis sativus*) plants depends on imbalance in phosphorus and zinc supply. Plant Soil, 124(2):211-219.

Martin-Tanguy, J. (1985). The occurrence and possible function of hydroxyl-cinnamoyl acid amides in plant. Plant Growth Regul., 3: 383-399.

Matoh, T. and Kobayash, M. (1998). Boron and calcium, essential inorganic constituents of pectic polysaccharides in higher plant cell walls. J.Plant Res., 111:179-190.

Moore, S. and Stein, W.H. (1954). A modified ninhydrin reagent for the photometric determination of amino acids and related compounds. J. Biol. Chem., 211:907-913.

Morgan, Sh.H. (2007). Some physiological studies on wheat plants growing under salinity stress conditions. MSc. Thesis, Fac. Agric., Cairo Univ., Egypt.

Morilla, A.; Garcia, J. M. and Albi, M.A. (1996). Free polyamine contents and decarboxylase activities during tomato development and ripening. Journal of Agricultural and Food Chem., 44(9): 2608-2611.

Mousa, H.R. (2006). Influence of exogenous application of silicon on physiological response of salt-stressed maize. Int. J. Agric. Biol., 8(2): 293-297.

Okamoto, Y. (1959). Physiological studies on the effects of silica acid upon rice plants. Sci. Soc. Japan, 28:35-40.

Ozturk, L. and Demir, Y. (2003). Effect of putrescine and ethelphon on some oxidative stress enzyme activities and proline content in salt stressed spanich leaves. Plant Growth Regul., 40(1):89-95.

Paprotka, Kuhne, M. (1989).Qualitative effects of a silicon leaf spray. Besseres Obst., 34(7):188-191.

Parry D.W. and Kelso, M. (1975) .The distribution of silicon deposits in the root of *Mclinia Caervlea* (L.)Moench and *Sorghvm bicolor* (L.) Maench., Ann. Bot., 39:995-1001.

Porceddu, E. (1979). The Bari germplasm laboratory. Plant Genetic Resources Newsletter, 38:3-5.

Rani, Y.N.; Narayanan, A. and Subbaramamma, P. (1997).The effect of silicon application on growth and yield of rice plants .Ann. Plant Physiol., 11(2):123-128. symposium on olive growing, Cordoba, Spain, 26-29 Sep. 1989.

Sachs,R.M.(1977). Nutrient diversion: A hypothesis to explain the chemical control of flowering .Hort. Science, 12: 220-222.

Sadeghian, E. (1971). Einfluss von chlorcholinchlorid (CCC) auf den gibberellin gehalt (GA) von Getreideflanzen .Z pflanzenern, Bodenk, 130: 233-241. (Cited by El-Ghamrawy and Neumann, 1997).

Savant, N.K.; Datnoff, L.E. and Snyder, G.H. (1997).Depletion of plant-available silicon in soils: a possible cause of declining rice yields. Communications Soil Sci. Plant Analysis, 28(13/14): 1245-1252.

Schmidt, R.E.; Zhang, X. and Chalmers, D.R. (1999).Response of photosynthesis and superoxide dismutase to silica applied to creeping bentgrass grown under two fertility levels. J. Plant Nutr., 22:1763-1773

scott, N.S and Possingham, J.V. (1983). Changes in chloroplast DNA levels during growth of spinach leaves. J.Exp.Bot.,34(149):1756-1767.

Sergiev, I.G.; Alexieva,V.S. and Karanov, E.N.(1995). Cytokinin and anticytokinin effects on growth and free polyamine content in etiolated and green radish cotyledons. Journal of Plant Physiol., 145: (3): 266-270.

Singh, A. K. and. Parmar, A. K. (2004). Effect of nitrogen and spacing on bio-chemical components in hybrid tomato (*Lycopersicon esculentum* Mill). Progressive Hort.,36(1):118-121 (C.F. Hort. Abstr., 74, 9537, 2004).

Smith T.A. (1985). Polyamines. Ann. Rev. Plant Physiol., 36:117-143.

Snedecor, G.W. and Cochran, W.G. (1980). Statistical Methods (7th Ed.). Iowa Stat. Univ. Press, Ames, Iowa, U.S.A.

Srivastava, S.K. and Smith, T.A.(1982). The effect of some oligo-aminoes and guanidine's on membrane permeability in higher plants. Phytochem., 21(5):997-1008.

Swain, T. and Hillis, W.F. (1959). The quantitative analysis of phenolic constituent. J. Sci. Food Agric., 10:63-69.

Talaat, B. and Neveen. (2003) .Physiological studies on the effect of salinity, ascorbic acid and putrescine on sweet pepper Plant. Ph. D. Thesis, Fac. Agric., Cairo Univ., Egypt.

Taiz, L. and Zeiger, E. (1991). Plant physiology . the Benjamin / Cummings Publishing Company, Inc. 390 Bridge Parkway, Redwood City, California 94065.

Taylor, M.A.; Burch, L.R. and Davies, H.V. (1993). Changes in polyamine biosynthesis during the initial staged of tuberisation in potato(*Solanum tuberosum.*L).Journal of Plant Physiol., 141(3):370-372.

Tiburcio, A.F. and Altabella, T. (2002). Polyamines In: New Developments in Plant Hormone Research Bisseling T and Schell J. (Ed).Springer-Verlag, New Yourk.

Vogel, A.I. (1975). A Text Book of Practical Organic Chemistry.Pupl.by English Language Book Soc. and Longman Group. Lim., 3rd Ed., p. 696.

Wang, S. Y. and Faust, M. (1994).Changes in polyamine content during dormancy in flower buds of Anna" apple. Journal of the American-Society for Hort. Sci., 119(1): 70-73.

Wang, S. Y. and Galletta, G.J. (1998). Physiological function of polyamines during blossoming and fruit setting in apple. J.of Plant Nutr., 21(1):157-167.

Yoshida, S.; Navasero, S.A. and Ramirez, E.A. (1969).Effect of silica and nitrogen supply on some leaf characters of the rice plant. Plant Soil, 31:48-56.

تأثير الرش بالسليكون و البتروسين على النمو والمحصول لنبات الخرشوف

أحمد حسين حنفى أحمد* ، حسن محمود حسن*، عفاف توفيق محمود قاسم** و سيد محمد سيد**
* قسم النبات الزراعى (فسيولوجي النبات) كلية الزراعة – جامعة القاهره
** قسم البطاطس و الخضر خضرية التكاثر – معهد بحوث البساتين- مركز البحوث الزراعية

اجرى هذا البحث فى تجربه حقليه خلال موسمى ٢٠٠٥-٢٠٠٦و ٢٠٠٦-٢٠٠٧ بهدف دراسة تأثير الرش بالسليكون (صوديوم ميتا سليكات) بتركزين مختلفين (٥٠٠ و١٠٠٠ جزء فى المليون أكسيد السليكون) أو البتروسين بتركزين مختلفين (١و٢ جزء فى المليون) و ذلك على صفات النمو والمحصول المبكر والمحصول الكلى والتركيب الكيماوى لنبات الخرشوف حيث تم الرش فى عمرى ٤٥و٦٠ يوم من الزراعه للأصناف المحليه المنتشر زراعتها فى جمهورية مصر العربيه وهما الصنف البلدى و الفرنساوى (هيروس). ولقد أظهرت النتائج ان الصنف الفرنساوى والمعامل بالرش بالسليكون بتركيز ١٠٠٠ جزء فى المليون أكسيد السليكون قد أعطى أفضل النتائج من حيث الصفات الخضرية وصفات المحصول بالاضافه الى انتاجه أعلى محصول مبكر وكلى بالمقارنه بالنباتات الغير معامله ويليه فى ذلك نباتات الصنف الفرنساوى المعامله بالبتروسين بتركيز ١ جزء فى المليون وذلك بالمقارنه بنباتات الكنترول للصنف الفرنساوى على مدار موسمى الزراعه. وبالنسبه للتركيب الكيماوى فقد دلت النتائج على ان نباتات الصنف الفرنساوى المعامله بالسليكون بتركيز ١٠٠٠ جزء فى المليون أكسيد السليكون قد أعطت أكثر النتائج المعنويه فى زيادة تركيز محتوى الأوراق من السكريات الكليه والفوسفوريليها في ذلك نبتات الصنف الفرنساوى المعامله بالبتروسين بتركيز ٢ جزء في المليون والتى بدورها أعطت افضل زياده معنويه لتركيز الأوراق من الاحماض الامينيه الحره ويليها في ذلك نباتات الصنف الفرنساوى المعامله بالسليكون بتركيز ١٠٠٠ جزء في المليون أكسيد السليكون بينما اوضحت النتائج ان اكثر المعاملات التى أعطت معنويه في انخفاض تركيز الاوراق من الفينولات الدا ئبه كانت نباتات الصنف الفرنساوى المعامله بالبتروسين بتركيز ١ جزء فى المليون ويليها في ذلك نباتات الصنف الفرنساوى المعامله بالسليكون بتركيز ١٠٠٠ فى المليون أكسيد السليكون وذلك بالمقارنه بنباتات الكنترول على مدار موسمى الزراعه. بالاضافه الى ذلك فقد أظهرت النتائج تفوق نباتات الصنف الفرنساوى المعامله بالسليكون بتركيز ١٠٠٠ فى المليون أكسيد السليكون فى أعطاء أكثر زيادة معنويه لتركيز كلاً من الاوكسينات و السيتوكينينات للاوراق بينما المعامله بالتركيز الاقل (٥٠٠ جزء فى المليون أكسيد السليكون) لنفس الصنف قد أعطت أفضل النتائج للزيادة المعنويه لتركيز كلا من السيتوكينينات و الجبريلينات للأوراق. لذا فمن الممكن ان يوصى بأ ستخدام كلا من السليكون بتركيز ١٠٠٠ جزء فى المليون أكسيد السليكون وكذلك البتروسين بتركيز ١ جزء فى المليون لكلا الصنفين البلدى و الفرنساوى و خاصة الصنف الفرنساوى للحصول على أعلى محصول مبكر صالح للتصدير للدول الاوروبية فى أوقات الندره.