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SOME AGRONOMICAL PRACTICES FOR IMPROVING TOMATO (*Lycopersicon esculentum,* Mill*)* PRODUCTIVITY UNDER HIGH TEMPERATURE CONDITIONS.

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ABSTRACT

Two field experiments were conducted at EL-Baramon Research Station, Dakahlia Governorate, Egypt. during summer seasons of 2007 and 2008 to study the effect of some foliar applications, i.e., calcium at 2000 mg/L, magnesium at 2000 mg/L, zinc at 100 mg/L, boron at 50 mg/L, selenium at 5o mg/L + vitamin E at 150 mg/L, yeast extract at 100 ml/L and salicylic acid at 100 mg/L on vegetative growth, flowering and fruit yield of Castle Rock and Super Strain-B tomato cvs under high temperature conditions. Seedlings were transplanted on 9 th and 15 th of May in the first and the second seasons, respectively.

The results showed that Castle Rock plants had more leaves and branches, heaviest fresh and dry weight and gave the best flowering parameters, i.e., number of clusters/plant, number of flowers/plant, fruit set percentage (%) and total fruit yield(ton/fed.) compared with Super Strain-B cultivar which had the longest plants in the two seasons. Moreover, all foliar applications (Ca, Mg, Zn, B, Se + VE, Yeast and SA) increased plant height, number of leaves and branches/plant and fresh and dry weight of leaves and increased all studied flowering parameters and total fruit yield(ton/fed.) compared to the control treatment. However, Super Strain-B plants sprayed with SA had the longest plants, while Castle Rock plants treated with SA and B gave more leaves and branches, respectively. Moreover, plants of Castle Rock sprayed with B had the most records in fresh and dry weight, fruit setting (%), number of fruits/plant and total fruit yield(ton/fed.). whereas Castle Rock plants treated with Ca had more clusters and flowers/plant.

From the obtained results it could be concluded that spraying Castle Rock cv plants with boron at 50 mg/L, calcium at 2000 mg/L, salicylic acid at 100 mg/L and selenium at concentration of 50 mg/L mixed with vitamin E at concentration of 150 mg/L as foliar application three times, i.e., 15 days after transplanting then repeated each 15 days interval improve tomato vegetative growth, flowering and fruit yield(ton/fed.)

INTRODUCTION

Tomato (*Lycopersicon esculentum*, Mill) represents one of the most important vegetable crops all over the world, due to its high nutritional value and various uses. In Egypt it is considered the first rank among the vegetable crops for local consumption and exportation. High temperature in summer seasons is one of the most important abiotic factors affect tomato plant growth and fruit set (Rivero *et al.*, 2004). It was reported that the reproductive developments in tomato was more sensitive to high temperatures than the vegetative developments (Soylu and Çömlekçioğlu, 2009). The direct injuries due to high temperature include protein denaturation and aggregation as well as increased fluidity of membrane lipids. Indirect or slower heat injuries include inactivation of enzymes in chloroplast and mitochondria, inhibition of protein synthesis, protein degradation and loss of membrane integrity (Howarth, 2005). These injuries eventually lead to starvation, inhibition of growth, reduced ion flux, production of toxic compounds and reactive oxygen species (ROS) (Schöffi *et al*., 1999 and Howarth, 2005). These ROS (H_2o_2 , oH, o_2-,…) damaged chloroplast, reduced carbohydrate synthesis and exportation and hastened oxygen senescence, attack cell membranes, led to their degradation and leakage of cell solutes, denaturation of proteins and enzymes, damage of nucleic acids, degradation of chlorophyll and suppression of all metabolic processes and finally senescence and death of cells and tissues (Dicknson *et a*l., 1991). The most noticeable effect of high temperatures on reproductive processes in tomato is the production of an exerted style (i.e., elongation of stigma beyond the anther cone), which may prevent self-pollination (Kinet and Peet, 1997).

Many studies pointed out that antioxidant substances increase plant tolerance against adverse effects of heat stress. In this respect, foliar applications of some nutrients, i.e., Ca, Mg, B, Zn, and Se+V.E as well as SA and yeast extract as antioxidant substances were used to improve growth and flowering of tomato and protect it against adverse effects of oxidative stress. These substances intercept free radicals and protect cell from the oxidative damage that lead to aging and diseases (Karadeniz *et al*., 2005). Calcium might act as a second messenger in some signaling pathway limiting heat-induced oxidative damage (Larkindale and Knight, 2002). It involved in plant tolerance to heat stress by regulating antioxidant metabolism (Jiang and Hung, 2001). Ca and Mg known to be activated H+-ATP-ase membrane pump the key active machine and site for cations transport and retention that attributed to alleviation adverse effects of environmental conditions (Palta , 1990).

Also, boron has a role in cell division, hence promoted root elongation and shoot growth via activation the synthesis of RNA and protein within meristematic tissue (Albert and Wilson, 1961; Albert, 1965 and Sarin and Sadgopal, 1967). Zinc act as antioxidants, protect the chloroplasts against the formation of toxic ROS levels thereby prevent degradation of pigments and inhibits the photoxidation of pigments that arise under heat stress condition (Domingo *et a*l., 1990 ; Brown *et al*., 1993). Furthermore, selenium play an important regulatory role in improving the tolerance of plants to high temperature stress through increasing chlorophyll content and activating antioxidant enzymes (Shang Qing Mao *et al*., 2005). Vitamin E is highly effective antioxidant at the membrane site (Hess, 1983).

Concerning Salicylic acid it is a signal transduction or messenger (Klessing and Malamy, 1994). Yeast can induce thermotolerance due to its content of heat shock proteins (HSPS) (Weiderrecht *et al*., 1988). It is a natural source of many growth substances (thiamine, viboflavin, niacin, pyridoxine Hel, panthenate, bioten, cholin, folic acid and vit.B 12) and most nutritional elements (Na, Ca, Fe, Mg, K, P, S, Zn, Si) as well as organic compounds (protein, carbohydrate, nucleic acids and lipids (Nagodawithana, 1991). The objective of this study was to evaluate the effect of foliar spraying of some antioxidants on growth, flowering and fruit yield of tomato plants under high temperature stress.

MATERIALS AND METHODS

Two field experiments were carried out at EL-Baramon Research Station, Dakahlia Governorate, Egypt during summer seasons of 2007 and 2008 to study the effect of foliar applications with calcium, magnesium, boron, zinc, selenium + vitamin E, salicylic acid, yeast extract on plant growth, flowering of tomato (*Lycopersicon esculentum*, Mill) Castle Rock and Super Strain-B cultivars. The monthly average temperature during seasonal growth 2007 and 2008 are shown in table (1). Seedlings were transplanted on 9 th and 15 th of May in the first and the second seasons, respectively. The experimental layout was split-plot system in a randomized complete blocks design with three replicates, i.e., the main plots were cultivars (Castle Rock and Super Strain-B), while the sub-plots were the foliar applications. The sub-plot area was 9.6 m^2 (2 ridges, each 4 m long and 120 cm width). Tomato seedlings were transplanted at 30 cm apart on one side of ridge.

Plants of the two cvs were sprayed three times, 15 days after transplanting and repeated each 15 days with solutions of the following treatments:

1- Ca at 2000 mg/L in form of Ca-citrate (25%).
2- Mg at 2000 mg/L in form of Mg-citrate (14%).
3- Zn at 100 mg/L in form of Zn-citrate (12%).
4- B at 50 mg/L in form of boric acid (16%).
5- Se + Vitamin E (selenium at concentration of 50 mg/L in form of sodium selinate + vitamin E at concentration of 150 mg/L).
6- Yeast extract at (100ml/L).
7- SA at 100 mg/L in form of salicylic acid (95%).
8- Control treatment.

The common recommended cultural practices for the commercial production of tomato were carried out whenever they were necessary.

At 65 days after transplanting five plants were randomly taken from each plot for determining the vegetative growth parameters, i.e., plant height, number of leaves and branches/plant and fresh and dry weight (gm). The flowering parameters recorded were: number of clusters/plant, number of flowers/plant and fruit set percentage (%).

$$\text{Fruit set \%} = \frac{\text{No. of fruits/plant}}{\text{No. of flowers/plant}} \times 100$$

Fruit yield: number of fruits/plant and total yield (ton/fed.).

All collected data on plot basis were subjected to the statistical analysis according to the method mentioned by Snedecor and Cochran (1968). The data of treatment means were compared using least significant difference (LSD) method as mentioned by Gomez and Gomez (1984).

Table (1): Monthly average maximum and minimum temperature during 2007 and 2008 seasons at experimental region.*

Months	Temperature (ºC)			
	2007		2008	
	Max.	Min.	Max.	Min.
May	31.37	17.17	31.39	16.39
June	33.74	20.93	34.34	22.31
July	34.33	23.33	33.68	23.33
August	34.21	23.40	33.46	23.03

*** Data were taken by Shawa weather station.**

RESULTS AND DISCUSSION

Vegetative growth characters:

Plant height and number of leaves and branches/plant:

Effect of cultivars:

Data presented in table (2) showed that Super Strain-B cultivar had higher values than Castle Rock cultivar only in plant height in both seasons, whereas Castle Rock cultivar was superior and higher than Super Strain-B on number of leaves and branches/plant.

The differences between the studied cultivars were significantly in plant height, number of leaves/plant in both seasons and in number of branches/plant in the second season. Similar results obtained by El-Desouky *et al*. (2000); Abdelmageed *et al*. (2003) and Glala *et al*. (2005) they showed that tomato cultivars differed significantly in vegetative growth habits.

Table (2): Effect of tomato cultivars and foliar applications on vegetative growth during 2007 (S1) and 2008 (S2) summer seasons.

	Character / Treatments	Plant height(cm)		No. of leaves/plant		No. of branches/ plant		Fresh weight(gm)		Dry weight (gm)	
		S1*	S2	S1	S2	S1	S2	S1	S2	S1	S2
Cvs	Castle Rock	66.16	67.27	113.46	114.31	12.56	13.78	463.73	481.16	83.00	85.81
	Super Strain-B	70.50	72.37	109.19	110.33	12.37	12.91	389.65	395.75	79.50	81.79
L.S.D. at 5%		**0.44**	**0.61**	**0.49**	**0.36**	**NS**	**0.15**	**1.22**	**0.98**	**0.60**	**0.52**
Treatments	Ca at 2000 mg/l	69.00	70.83	113.75	118.00	13.00	13.66	468.43	490.41	90.80	94.27
	Mg at 2000 mg/l	67.83	69.08	112.79	115.62	12.16	13.50	406.87	424.83	80.52	86.09
	Zn at 100 mg/l	66.16	68.43	105.54	105.58	12.25	12.83	394.25	402.00	73.05	74.69
	B at 50 mg/l	69.83	72.11	115.91	116.75	13.50	14.50	490.18	499.83	91.62	93.83
	Se at 50 mg/l +V.E 150 mg/l	68.83	70.50	111.87	109.25	12.58	13.80	427.62	441.25	88.34	89.60
	Yeast at 100 ml/l	66.75	68.54	104.08	105.04	11.66	12.50	386.25	390.41	70.34	72.64
	SA at 100 mg/l	72.25	72.58	125.00	125.50	13.00	14.00	465.83	470.83	87.12	88.40
	control	66.00	66.50	101.70	102.83	11.58	12.00	374.12	388.08	68.21	70.89
L.S.D. at 5%		**1.09**	**1.17**	**1.14**	**1.21**	**1.12**	**0.94**	**1.42**	**1.38**	**1.09**	**1.36**

***S1: 2007 summer season. S2: 2008 summer season.**

Effect of foliar applications:

Data in table (2) clearly showed that all foliar treatments (Ca, Mg, Zn, B, Se + VE, Yeast and SA) increased the values of vegetative growth parameters, i.e., plant height and number of leaves and branches/plant compared with the control treatment. The highest values of plant height and number of leaves/plant were obtained from salicylic acid application followed by boron and calcium applications, respectively in both seasons. Also, the results declared that boron application was the most superior treatment as for number of branches/plant in both seasons.

These results agreed with those of Khedr and Farid (2000); Hamsaveni *et al*. (2003); Manoj-Raghav and Sharma (2003); Oyinlola (2004); Abou-Aly (2005); Glala *et al*. (2005); Jayakumar *et al*. (2006); Jyolsna and Usha Mathew (2008); Patil *et al*. (2008) and Yildirim and Dursun (2009).

Effect of interaction between tomato cultivars and foliar applications:

The two cvs had superior responses to all treatments compared with control in the two seasons as shown in table (3). Super Strain-B cultivar had the longest plants when treated with SA followed by B and Ca, while Castle Rock cv had more leaves and branches than Super Strain-B cv when sprayed with SA.

Fresh and dry weight of plant:

Effect of cultivars:

Data presented in table (2) indicated that there were significant differences between the two studied cultivars as for fresh and dry weight of tomato plants in the two growing seasons. However, Castle Rock cultivar surpassed Super Strain-B cultivar in this respect. Also, El-Desouky *et al*. (2000) found that tomato genotypes exhibited significant variations regarding their shoots fresh and dry weights. In general, tomato genotypes mostly showed different growth responses under stressful temperature of field conditions.

The evidenced fact is that the plant growth affected by genotype, therefore the studied cvs differed significantly in most plant growth characters under the same conditions.

Effect of foliar applications:

Data in table (2) clearly showed that all foliar treatments (Ca, Mg, Zn, B, Se + VE, Yeast and SA) significantly increased the fresh and dry weight of tomato plants compared with the control, in both seasons. The most stimulatory and potent effects in diminshed order were of B followed by Ca and SA treatments as for fresh weight, and B, Ca and Se+VE as for dry weight then SA, Mg, Zn and at least yeast extract, respectively. These results coincide with those of Amer (1981); Khedr and Farid (2000); Yadav *et al*. (2001); Abou-Aly (2005); Glala *et al*. (2005) and Jayakumar *et al*. (2006).

Effect of interaction between tomato cultivars and foliar applications:

Data in table (3) demonstrated that all interactions between tomato cultivars and foliar applications increased fresh and dry weight of plant in the two seasons. Plants of Castle Rock cv. treated with boron foliar application had the heaviest fresh and dry weight followed by calcium application and the least one was untreated of Super Strain-B (control). Similar results were obtained by Abd El-Aziz (1997); Fathy *et al*. (2000); Eata (2001); Hanafy Ahmed *et al*. (2007); Wanas (2007) and Abd-El-All (2009).

Table (3): Effect of interactions between tomato cultivars and foliar applications on vegetative growth during 2007 (S1) and 2008 (S2) summer seasons.

Treatments	Character	Plant height (cm)		No.of leaves/ plant		No.of branches/ plant		Fresh weight(gm)		Dry weight(gm)	
		S1*	S2	S1	S2	S1	S2	S1	S2	S1	S2
Castle Rock	Ca at 2000 mg/l	66.66	68.33	116.16	120.00	13.33	14.33	515.00	548.33	93.98	98.67
	Mg at 2000 Mg/l	65.33	67.00	113.00	116.00	11.66	14.00	422.50	458.00	81.67	88.37
	Zn at 100 Mg/l	63.33	65.00	108.75	108.00	12.66	13.66	420.16	430.00	73.96	74.42
	B at 50 mg/l	68.50	70.66	117.66	117.50	13.66	15.00	568.08	579.66	95.37	99.16
	Se at 50 mg +V.E 150 m	67.00	67.33	114.25	110.50	13.00	14.60	444.66	466.66	89.54	90.82
	Yeast at 100 ml/l	64.50	65.00	106.00	108.25	11.66	12.33	416.66	420.83	70.02	71.59
	SA at 100 mg/l	71.00	71.16	127.50	128.25	13.00	14.33	515.00	526.66	90.07	92.40
	control	63.00	63.66	104.41	106.00	11.50	12.00	407.83	419.16	69.36	71.08
Super Strain-B	Ca at 2000 mg/l	71.33	73.33	111.33	116.00	12.66	13.00	421.87	432.50	87.61	89.87
	Mg at 2000 mg/l	70.33	71.16	112.58	115.24	12.66	13.00	391.25	391.66	79.36	83.80
	Zn at 100 mg/l	69.00	71.86	102.33	103.16	11.83	12.00	368.33	374.00	72.14	74.97
	B at 50 mg/l	71.16	73.55	114.16	116.00	13.33	14.00	412.29	420.00	87.86	88.51
	Se at 50 mg +V.E 150 m	70.66	73.66	109.50	108.00	12.16	13.00	410.58	415.83	87.14	88.39
	Yeast at 10(ml/l	69.00	72.08	102.16	101.83	11.66	12.66	355.83	360.00	70.66	73.70
	SA at 100 mg/l	73.50	74.00	122.50	122.75	13.00	13.66	416.66	415.00	84.18	84.40
	control	69.00	69.33	99.00	99.66	11.66	12.00	340.41	357.00	67.06	70.70
L.S.D. at 5%		**1.55**	**1.65**	**1.62**	**1.71**	**NS**	**NS**	**2.01**	**1.96**	**1.55**	**1.93**

***S1: 2007 summer season.**
S2: 2008 summer season.

Flowering parameters:
Effect of cultivars:

Data presented in table (4) revealed that tomato cultivars were significantly differed between each other in flowering parameters, i.e., number of clusters/plant, number of flowers/plant and fruit set percentage (%) in both seasons under heat stress conditions. Castle Rock tomato cultivar had the highest number of clusters/plant, number of flowers/plant and fruit set percentage (%) compared with Super Strain-B cultivar. The differences between tomato cultivars in fruit setting under high temperature may be due to their variation in viable pollen grains (Phookan *et al*., 1997), stigma tube elongation and antheridial cone splitting (Saeed *et al*., 2007). The number of pollen grains produced by the heat tolerant genotypes were higher than those of sensitive genotypes (Abdelmageed *et al*., 2003). Also, Rainwater *et al*. (1996) found that different cultivars of tomato exhibited considerable variation in their sensitivity to heat stress. These results are in harmony with those reported by Phookan *et al*. (1997); Lohar and Peat (1998); El-Desouky *et al*. (2000); Saleba *et al*. (2004); Saeed *et al*. (2007) and Kabura *et al*. (2009) who found that tomato cultivars differed in flowering parameters. Also Comlekcioglu and Soylu (2010) reported that the production of seeded fruit (SF) was significantly reduced with high temperature (HT) and the amount of reduction varied among tomato genotypes.

Effect of foliar applications:

Results in table (4) indicated that all foliar treatments(Ca, Mg, Zn, B, Se + VE, Yeast and SA) enhanced number of clusters, number of flowers and fruit setting percentage (%) compared with the control, in the two studied seasons. Plants treated with calcium had the best records as for number of clusters and flowers/plant followed by boron and salicylic acid treatments, whereas boron treatment achieved fruit setting followed by calcium and salicylic acid applications in the two seasons, respectively. Similar results were obtained by Oyewole and Aduayi (1992); Agwah and Mahmoud; (1994 Abd El-Aziz (1997); El-Sheikh (1998); Kalarani *et a*l. (2002); Naresh-Babu (2002); Khedr *et al*. (2004) on eggplant and Jyolsna and Usha Mathew (2008).

The most noticeable effect of high temperatures on reproductive processes in tomato is the production of an exerted style (i.e., stigma is elongated beyond the anther cone), which may prevent self-pollination (Kinet and Peet, 1997).

Continuous exposure of tomato (Trust) plants to high temperatures has two major effects on pollen grains. First, it reduces the total number of grains and secondly, it leads to a marked reduction in germination and a more moderate reduction in the viability of those grains. The failure of viable pollen grain production under high temperature conditions may also be associated with hindered sugar metabolism. Under heat stress, the concentration of starch and soluble sugar in the pollen grains (and that of sugars in the anther walls) were markedly lower than that under control conditions (Pressman *et al*., 2002).

The favorable effect of boron on fruit setting under heat stress might be due to its effect on fertilization by increasing the pollen producing capacity of the anthers and pollen grain ability (Agarwala *et al*., 1981) and affect pollen germination, pollen tube growth and fertilization (Vaughen, 1977). Also, SA stimulates flowering in a range of plants, increases flower life, controls ion uptake by roots and stomatal conductivity (Raskin, 1992 and Bhupinder and Usha, 2003).

Table (4): Effect of tomato cultivars and foliar applications on flowering and fruit setting percentage during 2007 (S1) and 2008 (S2) umme rseasons.

Character / Treatments		No.of clusters/plant		No.of flowers/plant		No.of Fruits/plant		Fruit setting (%)		Total yield (ton/fed.)	
		S1*	S2	S1	S2	S1	S2	S1	S2	S1	S2
Cvs.	Castle Rock	26.24	26.44	69.76	69.77	19.35	20.10	27.59	28.71	18.325	19.488
	Super Strain-B	26.01	25.66	67.52	66.50	13.55	14.71	19.86	21.96	12.450	13.740
L.S.D. at 5%		0.17	0.65	0.55	0.39	0.26	0.39	0.20	0.30	0.002	0.001
Treatments	Ca at 2000 mg/l	29.24	28.45	73.74	71.66	19.38	20.00	26.22	27.85	18.942	19.770
	Mg at 2000 mg/l	27.74	26.75	68.18	68.33	15.73	17.41	22.85	25.35	14.320	15.966
	Zn at 100 mg/l	23.73	23.95	65.20	65.25	14.08	14.83	21.51	22.63	12.707	13.790
	B at 50 mg/l	28.36	28.10	73.03	70.91	19.68	20.50	26.98	28.74	19.168	20.162
	Se at 50 mg/l +V.E 150 mg/l	27.10	27.16	68.63	69.50	17.23	18.58	24.81	26.70	16.102	17.806
	Yeast at 100 ml/l	23.20	23.50	64.96	65.75	14.01	15.33	21.36	23.21	12.794	14.413
	SA at 100 mg/l	27.15	27.37	71.12	69.25	18.26	18.93	25.65	27.04	17.126	18.316
	control	23.00	23.12	64.25	64.41	13.20	13.66	20.46	21.16	11.941	12.689
L.S.D. at 5%		0.95	0.94	1.12	1.09	0.79	0.86	0.62	0.68	0.008	.008

***S1: 2007 summer season.**
S2: 2008 summer season.

Effect of interaction between tomato cultivars and foliar applications:

Data in table (5) indicated that the interaction between tomato cultivars and different foliar application take the same trend of foliar applications. In addition, (Ca x Castle Rock) was the best interaction in number of clusters and flowers/plant followed by (B x Castle Rock) in both seasons, whereas (B x Castle Rock) was the superior as for fruit set percentage (%) followed by (Ca x Castle Rock). These results are in accordance with those obtained by Agwah and Mahmoud (1994); Arisha *et al*. (1999); El-Ghamriny *et al*. (1999); Fathy *et al*. (2000); Eata (2001); Wanas (2007) and Abd-El-All (2009).

Fruit yield:

Effect of cultivars:

The results in table (4) showed that there were significant differences between Castle Rock and Super Strain-B cultivars in number of fruits/plant and total yield(ton/fed.). It can be suggested that Castle Rock cv was the superior in number of fruits/plant and total yield(ton/fed.). The differences in yield between tomato cultivars under high temperature conditions may be due to their variation in growth, fruit set and number and weight of fruits/plant.

Table (5): Effect of interactions between tomato cultivars and foliar applications on flowering and fruit setting percentage during 2007 (S1) and 2008 (S2) summer seasons.

Treatments / Character		No.of clusters/ plant		No.of flowers/ plant		No.of Fruits/ plant		Fruit setting (%)		Total yield (ton/fed.)	
		S1*	S2	S1	S2	S1	S2	S1	S2	S1	S2
Castle Rock	Ca at 2000 mg/l	28.60	28.75	72.66	73.33	22.16	22.66	30.49	30.93	22.141	22.788
	Mg at 2000 mg/l	27.95	27.50	71.70	70.33	19.46	20.50	27.14	29.12	18.116	19.180
	Zn at 100 mg/l	23.73	24.41	66.73	67.00	16.50	17.33	24.72	25.86	14.987	16.264
	B at 50 mg/l	28.33	28.20	72.16	72.00	22.20	23.16	30.76	32.18	21.928	23.160
	Se at 50 mg/l +V.E 15 mg/l	27.93	27.83	71.20	71.00	20.80	21.33	28.94	30.11	19.412	20.748
	Yeast at 100 ml/l	23.26	23.66	66.26	67.50	16.53	18.00	24.93	26.66	15.316	17.248
	SA at 100 mg/l	27.23	27.91	71.36	71.50	21.73	22.00	30.46	30.70	20.548	21.428
	control	22.93	23.25	66.00	65.50	15.40	15.83	23.33	24.17	14.145	15.088
Supper Strain-B	Ca at 2000 mg/l	29.88	28.16	74.81	70.00	16.60	17.33	21.96	24.77	15.740	16.752
	Mg at 2000 mg/l	26.53	26.00	64.66	66.33	12.00	14.33	18.56	21.59	10.524	12.752
	Zn at 100 mg/l	23.73	23.50	63.66	63.50	11.66	12.33	18.31	19.41	10.426	11.316
	B at 50 mg/l	28.40	28.00	73.90	69.83	17.16	17.83	23.21	25.30	16.408	17.164
	Se at 50 mg/l +V.E 15 mg/l	26.26	26.50	66.06	68.00	13.66	15.83	20.67	23.28	12.792	14.864
	Yeast at 100 ml/l	23.13	23.33	63.66	64.00	11.50	12.66	17.78	19.77	10.273	11.577
	SA at 100 mg/l	27.08	26.83	70.88	67.00	14.80	15..86	20.84	23.39	13.703	15.205
	control	23.06	23.00	62.50	63.33	11.00	11.50	17.59	18.15	9.737	10.289
L.S.D. at 5%		**NS**	**NS**	**1.58**	**1.55**	**1.11**	**1.22**	**0.88**	**0.97**	**0.005**	**0.004**

***S1: 2007 summer season.**
S2: 2008 summer season.

Effect of foliar applications:

Results in table (4) show that all foliar applications (Ca, Mg, Zn, B, Se + VE, Yeast and SA) significantly increased number of fruits/plant and total yield(ton/fed.). The highest number of fruits and total yield(ton/fed.) were obtained when tomato plants treated with B foliar application followed by Ca, SA, Se + VE, respectively in both seasons. These results are harmony with those reported by Hao-Xiuming and Papadopoulos (2004); El-Mansi *et al*. (2005); Haque *et al*. (2006); Lee GuangJae *et al*. (2007); Kamal and Abd Al-Gaid (2008); Patil *et al*. (2008) and Yildirim and Dursun (2009).

Effect of interaction between tomato cultivars and foliar applications:

Data in table (5) showed that all the interactions between tomato cultivars and foliar applications increased number of fruits/plant and total yield(ton/fed.). It is evident that plants of Castle Rock cv treated with boron and calcium were the most superior applications on number of fruits/plant and total yield(ton/fed.) in the two studied seasons. These results are in line with those obtained by Agwah and Mahmoud (1994); Arisha *et al*. (1999); El-Ghamriny *et al*. (1999); Eata (2001); Hanafy Ahmed *et al*. (2007); Wanas (2007) and Abd-El-All (2009). It's obviously that the highest yield of the two cultivars was related to the number of clusters, number of flowers and fruit set percentage under high temperature conditions.

CONCLUSION

It can be concluded that sprayed Castle Rock cv plants with boron at 50 mg/L, calcium at 2000 mg/L, salicylic acid at 100 mg/L and selenium at concentration of 50 mg/L mixed with vitamin E at concentration of 150 mg/L as foliar application three times, i.e., 15 days after transplanting then repeated each 15 days interval improve tomato vegetative growth, flowering and fruit yield(ton/fed.) under high temperature conditions jn summer season.

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بعض الممارسات الزراعية لتحسين إنتاجية الطماطم تحت ظروف الحرارة المرتفعة

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أجريت تجربتان حقليتان بمحطة البرامون البحثية- محافظة الدقهلية- مصر خلال العروة الصيفية لموسمى الزراعة ٢٠٠٧ و ٢٠٠٨ بهدف دراسة تأثير بعض معاملات الرش بالكالسيوم بتركيز ٢٠٠٠ ملجم/لتر، والمغنسيوم بتركيز ٢٠٠٠ ملجم/لتر، والزنك بتركيز ١٠٠ ملجم/لتر ، والبورون بتركيز ٥٠ ملجم /لتر ، والسيلينيوم بتركيز ٥٠ ملجم/لتر + فيتامين ه بتركيز ١٥٠ ملجم/لتر ، ومستخلص الخميرة بتركيز ١٠٠ مل/لتر ، وحمض السلسيلك بتركيز ١٠٠ ملجم/لتر على النمو الخضرى و الازهار والمحصول لنبات الطماطم صنف كاسل روك و سوبر سترين بى تحت ظروف الحرارة العالية تم زراعة الشتلات فى ٩ و ١٥ مايو فى موسمى التجربة على الترتيب.

أوضحت النتائج أن صنف كاسل روك أعطى أكبر عدد للأوراق والأفرع وأثقل وزن طازج وجاف كما أعطى أفضل القياسات الزهرية مثل عدد العناقيد الزهرية وعدد الأزهار ونسبة العقد % والمحصول الكلى مقارنة بصنف سوبر سترين بى والذى أعطى نباتات أكثر ارتفاعا خلال الموسمين. كما أدت معاملات الرش (الكالسيوم ، المغنسيوم ، الزنك ، البورون ، السيلينيوم + فيتامين ه ، مستخلص الخميرة ، وحمض السلسيلك) الى زيادة ارتفاع النبات ، عدد الأوراق ، الأفرع ، والوزن الطازج والجاف للنبات كما أدت الى زيادة كل القياسات الزهرية والمحصول الكلى مقارنة بالكونترول. كما وجد أن صنف سوبر سترين بى الذى تم رشه بحمض السلسيلك أعطى نباتات أكثر ارتفاعا ، بينما صنف كاسل روك عند رشه بحمض السلسيلك والبورون أعطى أكثر عدد أوراق وأفرع على الترتيب. بينما نباتات صنف كاسل روك المعاملة برش البورون أعطت أعلى وزن طازج وجاف ونسبة عقد لكل نبات وعدد ثمار ومحصول كلى ، بينما صنف كاسل روك المعامل بالكالسيوم رشا أعطى أعلى عدد عناقيد زهرية وأزهار لكل نبات. من الملاحظ من خلال هذه النتائج أن رش نباتات صنف كاسل روك بالبورون ٥٠ ملجم/لتر ، والكالسيوم ٢٠٠٠ ملجم/لتر ، وحمض السلسيلك ١٠٠ ملجم/لتر ، والسيلينيوم ٥٠ ملجم/لتر مخلوطا بفيتامين ه ١٥٠ ملجم/لتر رشا ثلاث مرات بعد ١٥ يوم من الشتل ثم كل ١٥ يوم بعد ذلك أدى الى تحسين صفات النمو الخضرى والزهرى والمحصول لنبات الطماطم تحت ظروف الحرارة العالية فى الموسم الصيفى.

قام بتحكيم البحث

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