Effect of location and fertilization on fruit yield and quality of some tomato cultivars

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ABSTRACT

Two open field experiments were performed during the two successive summer seasons of 2013and 2014 at El- Bosily,El-Behaira government and El-Fayuom, to investigate the growth and productivity of two tomato cultivars under different climatic conditions and different levels of NPK fertilizers. The experimental treatments were arranged by applying the split split plot design where, location treatments were arranged in the main plots, tomato cultivars treatments were arranged in the sub plots and fertilizer levels were arranged in the sub sub plots. Cultivated the tomato plants cv. Super Strain B in El Fayoum location combined with using 100% level from the recommended N.P.K doses exhibited the highest values of all fruit yield characteristics expressed as number of fruits/plant, fruit yield/ plant, total fruit yield/ fed., fruit/weight, length, diameter, shape and fruit set% compared with the other interaction treatments during the two seasons. On the other hand, using cv. Castel Rock and 80% from the recommended dose treatments in El Behaira location gave the lowest values. Meanwhile, cultivating the tomato plants in El Behaira by using cv. Super Strain B and 120 % from the recommended NPK doses exhibited the highest values of all of chemical fruit quality of tomato plant (Nitrogen%, Phosphorus%, Potassium%, total carbohydrates, T.S.S and total acidity, compared with the other interaction treatments during the two seasons. On the contrary, using Cv. Castle Rock and 80% from the recommended NPK dose in El Fayoum location gave the lowest values.

Keywords: Location, NPK fertilizers, fruit yield, quality, tomato cultivars.

Introduction

Tomato can grow under a wide range of temperature however; fruit set is limited in a narrow range. Relatively low or high temperature lead to poor fruit set. The critical factor in tomato fruit setting is the night temperature, the optimal range being 15-20 C̊ **(Went, 1945)**. Fruit set is also low when the average maximal night/day temperature is above 32◦ C and the average minimal night temperature is above 21 ◦C **(Moore and Thomas, 1952).**

Plant production in developed countries has increased due to the use of high yielding cultivars and enhanced consumption of inorganic fertilizers, especially the nitrogenous once. Tomato is one of the most important horticultural crops for which a large amount of nitrogen is applied, **(Parisi *et al*. 2006).** With the rapid increase in this crop, we needs new hybrids and cultivars with high yield, quality and tolerance to stress environments.

The excessive use of nitrogen fertilizers represents the major cost in plant production and creates pollution of agro ecosystem, as well as deterioration of soil fertility **(Fisher and Richter, 1984)**.

There is a widely-held scientific conviction that the global climate is changing as a result of the combined anthropogenic forcing due to greenhouse gases, aerosols, and land surface changes. Many evidences have concluded with a high degree of probability that human activities have exerted a substantial net warming influence on climate since 1750 **(IPCC,** 2007). Recent climatological studies found that the global surface air temperature increased from 1850 to 2005 by 0.76° C. Moreover, the linear warming trend over the last 50 years is recorded by 0.13° C per decade **(IPCC,** 2007).

The present investigation was imposed to study the impact of climate change on tomato productivity, and to find out the best suitable adaptation option to mitigate the negative impacts of climate change on tomato production.

In order to achieve this objective, several sequence steps were followed including selective of measure current data of tomato crop through field experiment, choses two governorates (Behira and Faioum), captivation two tomato cultivars (supper strain B and castle Rock), three fertilizer levels were used and finally examining the different adaptation options to mitigate the negative impacts of climate changes on tomato production.

Materials and Methods

2. Experimental layout:

Two open field experiments were performed during the two successive summer seasons of 2013and 2014 at El- Bosily, EL- Behaira government and El-Fayuom. To investigate the growth and productivity of two tomato cultivars under different climatic conditions and different levels of NPK fertilizers. Experiment farm sites are sandy soil in texture with average pH of 7.85, 7.82 and EC of 1.30, 1.33 ds/m, of both experimental yiers at EL-bosily and EL-Fayuom respectively. Chemical analysis of soil is shown in Table 1 as average for both seasons of study.

Table 1. Chemical analysis of soil.

	PH	EC ds/m	Anions (Meq/L)				Cations (Meq/L)			
			Cl^-	HCO_3^-	CO_3^{--}	SO_4^{--}	Na^+	K^+	Ca^{++}	Mg^{++}
El- Bosily	7.85	1.30	2.3	2.7	-	39.8	12.7	1.2	21	12
El- Fayoum	7.82	1.33	2.1	2.7	-	33.3	11.8	0.2	24	10.3

2.1. Nursery materials:

Seeds of tomato (*Solanum Lycopersicom L.*) Castle Rock and Super strain-B were sown on 1st of February during both seasons of 2013 and 2014, in multi-pot transplant trays filled with mixture of peat-moss and vermiculite media (1:1 v/v). Chemical fertilizers and fungicides were added to the mixture according to the recommendation of the Ministry of Agriculture. After sowing, trays were covered by black plastic mulching for four days, then moved to high tables and were cared by irrigation, fertilization and pest management in the nursery.

2.2. Transplanting:

After 45 days from seed sowing, transplants were set up in to the field on March 17th during both seasons of 2013 and 2014 on the two sides of ridges 1 m in width and 10 m in length. The distance between transplants was 50 cm apart. The area of the experimental plot was $10m^2$ i.e. 1/400 of feddan.

2.3. The experimental treatments:

This experiment included 12 treatments which were the combinations of two cultivars, two locations and three levels from NPK fertilizers as follows:

2.3.1. tomato cultivars:

Two cultivars of tomato plants were tested in each field (El- Bossily and El- Fayoum).

1-Castle Rock cultivar.

2-Super Strain B cultivar.

2.3.2. Locations:

Two fields were used in this study:

1- El- Bossily experimental farm, El behaira gavernorate, Rashed,Egypt.

2- El- Fayoum.

2.3.3. Fertilizer levels:

Three levels from nitrogen, phosphorus and potassium were used in this experiment:

1- 80% from the recommended doses (134.4,134.4,100.8 Kg /Fed NPK).

2- 100% from the recommended doses (168,168,126 Kg /Fed NPK).

3- 120% from the recommended doses (201.6,201.6,151.2 Kg /Fed NPK).

Ammonium sulphate (20.5%N), calcium super phosphate (16.5%P_2O_5) and potassium sulphate (48-52% K_2o) fertilizers were used as sources for nitrogen, phosphorus and potassium, respectively.

2.4. Climatic conditions:

The micro climate is a major factor in this study, thus the following data were recorded:

2.4.1. Air temperature, relative humidity% and radiation:-

Maximum, minimum and average air temperature (c◦), relative humidity% and radiation of each of the two locations were performed by central laboratory for agriculture climatic change stations; Egypt is presented in Table 2.

2.4.2. Soil temperature:

Maximum, minimum and average soil temperature was measured as follows. (Table, 3).

2.5. Experimental design:

The experimental treatments were arranged by applying the split split plot design where, Location treatments were arranged in the main plots, tomato cultivars treatments were arranged in the sub plots and fertilizer levels were arranged in the sub sub plots. All treatments were applied with three replicates. All other agricultural practices were carried out as commonly followed in the district.

2.6. Data recorded:

2.6.1. Yield and its components:

At red stage of maturity (75days from transplanting) fruits were harvested and recorded as follows:- Number of fruits per plant, yield per plant and total fruit yield per feddan

2.6.2. Fruit characters:

Representative samples of 10 fruits from each experimental plot at marketable stage were collected to determine the averages of the following:

2.6.3. Physical fruit characters

Average fruit weight, Fruit length, Fruit diameter and fruit shape index (Fruit length /Fruit diameter).

2.6.4. Chemical fruit properties:

- **Total soluble solids (T.S.S) %:** was determined using Abbee refractometer **(A.O.A.C., 1984)**.
- **Total acidity** was determined as mg/ liter of juice by titration with NaOH as described in the **A.O.A.C.(1990)**
- **Total carbohydrates:**

The carbohydrates content was determined on fruit dry weight base according to **A.O.A.C. (1990).**

- **Total N, P and K content:**

Dry samples of fruits were grounded and then 0.2 g of each was digested in sulfuric and percloric acids at ratio 2:1 by volume and then used for N,P,K determination according to the same methods described in case of plant foliage.

2.7. Statiscal analysis procedures:

The obtained data were statistically analyzed using the analysis of variance method according to **Snedecor and Cocharn (1980)**. L.S.D values at the 5% level of probability was used to compare means of treatments.

Table 2. Monthly Maximum, minimum and average air temperature (c°) as well as relative humidity% and radiations at El- Bosily and El- Fayoum region during the two growing seasons.

Months	2013									2014								
	El- Fayoum					El- Bosily					El- Fayoum					El- Bosily				
	Air temperature			Relative humidity	Radiation	Air temperature			Relative humidity	Radiation	Air temperature			Relative humidity	Radiation	Air temperature			Relative humidity	Radiation
	max	min	average			max	min	average			max	min	average			max	min	average		
March	23.45	8.12	15.78	58.87	16.26	21.85	8.64	15.24	80.36	17.36	30.31	10.08	٢٠.١٩	59.30	15.75	23.47	9.87	١٦.٦٧	78.12	15.69
April	31.36	13.04	22.2	49.26	16.22	27.08	12.09	19.58	74.40	18.67	31.47	12.61	٢٢.٠٤	49.63	16.46	25.29	11.09	١٨.١٩	75.36	18.63
May	34.89	17.52	26.20	42.67	16.90	30.66	15.62	23.14	73.77	20.98	38.8	18.4	٢٨.٦	42.90	16.13	29.91	16.15	٢٣.٠٣	77.58	22.39
June	37.96	20.95	29.45	44.53	17.65	31.91	19.59	25.75	80.23	22.07	38.68	20.93	٢٩.٨٠	43.80	17.09	31.70	18.80	٢٥.٢٥	72.30	22.90
July	40.58	23.21	31.89	47.09	20.10	33.84	22.13	27.98	80.12	20.99	38.36	29.87	٣٤.١2	48.08	15.29	29.90	21.5	٢٥.٧	81.10	19.50

Table 3: Monthly Maximum, minimum and average soil temperature at El- Bosily and El- Fayoum location region during the two growing seasons.

months	2013						2014					
	El- Fayoum			El- Bosily			El- Fayoum			El- Bosily		
	max	min	average	max	min	average	max	min	average	max	min	average
March	18.49	14.97	16.73	25.10	10.53	17.82	25.61	24.2	24.91	29.14	11.44	20.29
April	25.48	20.72	23.10	34.66	15.51	25.09	29.21	27.75	28.48	33.70	13.31	23.51
May	30.42	25.23	27.83	39.16	19.20	29.18	33.94	32.39	33.17	39.18	17.10	28.14
June	31.38	27.15	29.27	40.74	23.17	31.96	36.59	35.16	35.88	41.20	20.70	30.95
July	38.17	34.07	36.12	43.13	25.49	34.31	39.74	36.32	38.03	44.82	21.00	32.91

Table 4. Effect of different locations, Cultivars, fertilizer levels treatments and their interactions on fruit yield components of tomato plants in the first season 2013.

Treatments				Fruits No./plant	Yield/plant (kg)	Total yield (ton/fed)	Fruit weight (gm)	fruit length (cm)	Fruit diameter (cm)	Fruit shape index	Fruit set %
Location	EL-Behaira			9.96	1.38	17.34	129.37	6.17	6.00	1.03	75.84
	EL-Fayoum			10.61	1.50	18.89	132.38	6.78	6.63	1.02	77.75
L.S.D				0.60	0.05	0.62	**5.40	0.33	0.34	**0.01	**4.70
Cultivar	Super_strain B			10.94	1.55	19.57	133.11	6.97	6.81	1.02	79.84
	Castle Rock			9.63	1.32	16.67	128.64	5.98	5.83	1.03	73.75
L.S.D				0.60	0.05	0.62	**50.30	0.33	0.34	**0.01	4.69
Fertilizer	80 % R.D			9.63	1.22	15.34	118.17	6.18	6.00	1.03	72.53
	100% R. D			11.37	1.69	21.27	143.98	6.69	6.57	1.02	79.83
	120% R. D			9.86	1.41	17.74	130.48	6.55	6.38	1.03	78.03
L.S.D				0.74	0.06	0.76	6.49	0.41	0.41	**0.01	5.74
EL-Behaira	Super_strain B			10.64	1.48	18.70	131.38	6.81	6.63	1.03	79.27
	Castle Rock			9.28	1.27	15.98	127.37	5.52	5.37	1.03	72.42
EL-Fayoum	Super_strain B			11.23	1.62	20.43	134.84	7.12	6.98	1.02	80.42
	Castle Rock			9.98	1.38	17.35	129.91	6.44	6.29	1.02	75.08
L.S.D				0.85	0.07	0.87	**7.50	0.47	0.47	**0.01	6.64
EL-Behaira	80%			9.40	1.18	14.86	116.95	5.82	5.63	1.03	71.22
	100%			10.98	1.61	20.31	142.12	6.35	6.22	1.02	78.78
	120%			9.50	1.34	16.87	129.05	6.33	6.15	1.03	77.53
EL-Fayoum	80%			9.85	1.26	15.83	119.38	6.55	6.37	1.03	73.85
	100%			11.75	1.77	22.24	145.83	7.03	6.92	1.02	80.88
	120%			10.22	1.48	18.61	131.92	6.77	6.62	1.02	78.52
L.S.D				1.04**	0.08	1.07	9.18	0.58	0.58	**0.01	**8.13
Super_strain B	80%			10.27	1.31	16.45	120.70	6.73	6.55	1.03	73.47
	100%			12.08	1.83	23.00	146.68	7.17	7.03	1.02	86.15
	120%			10.47	1.53	19.25	131.95	7.00	6.83	1.03	79.92
Castle Rock	80%			8.98	1.13	14.23	115.63	5.63	5.45	1.03	71.60
	100%			10.65	1.55	19.55	141.27	6.22	6.10	1.02	73.52
	120%			9.25	1.29	16.23	129.02	6.10	5.93	1.03	76.13
L.S.D				1.04	0.08	1.07	9.18**	0.58	0.58	0.01*	8.13**
EL-Behaira	Super_strain B		80%	10.13	1.28	16.15	119.43	6.53	6.33	1.03	73.07
			100%	11.80	1.75	22.04	144.50	6.97	6.83	1.02	85.40
			120%	10.00	1.42	17.91	130.20	6.93	6.73	1.03	79.33

		80%	8.67	1.08	13.56	114.47	5.10	4.93	1.03	69.37
	Castle Rock	100%	10.17	1.47	18.57	139.73	5.73	5.60	1.02	72.17
		120%	9.00	1.26	15.82	127.90	5.73	5.57	1.03	75.73
		80%	10.40	1.33	16.75	121.97	6.93	6.77	1.03	73.87
	Super_strain B	100%	12.37	1.90	23.95	148.87	7.37	7.23	1.02	86.90
		120%	10.93	1.63	20.59	133.70	7.07	6.93	1.02	80.50
EL-Fayoum		80%	9.30	1.18	14.90	116.80	6.17	5.97	1.03	73.83
	Castle Rock	100%	11.13	1.63	20.53	142.80	6.70	6.60	1.02	74.87
		120%	9.50	1.32	16.63	130.13	6.47	6.30	1.03	76.53
L.S.D			1.47	0.12	1.51	12.98**	0.82	0.82	0.02**	11.50**

**mean: non-significant.

Table 5. Effect of different locations, Cultivars, fertilizer levels treatments and their interactions on fruit yield components of tomato plants in the second season 2014.

Treatments			Fruits No./ plant	Yield/plant (kg)	Total yield (ton/fed)	Fruit weight (gm)	Fruit length (cm)	Fruit diameter (cm)	Fruit shape index	Fruit set %
Location	EL-Behaira		8.68	1.18	14.83	125.99	5.84	5.64	1.04	73.62
	EL-Fayoum		9.09	1.24	15.59	128.20	6.52	6.34	1.03	75.53
L.S.D			0.48**	0.04	0.54	6.50**	0.31	0.31	0.01*	6.6**
Cultivar	Super_strain B		9.12	1.27	15.97	129.86	6.57	6.35	1.04	77.97
	Castle Rock		8.66	1.15	14.46	124.33	5.79	5.63	1.03	71.19
L.S.D			0.48**	0.04	0.54	5.32**	0.31	0.31	0.01*	6.33
Fertilizer	80 % R D		8.05	1.02	12.81	115.78	5.94	5.75	1.03	70.07
	100% RD		10.29	1.49	18.76	138.71	6.35	6.19	1.03	77.36
	120% RD		8.33	1.12	14.07	126.80	6.26	6.03	1.04	76.31
L.S.D			0.58	0.05	0.66	6.51	0.38	0.38	0.02*	7.75**
EL-Behaira		Super_strain B	8.92	1.23	15.45	128.52	6.32	6.09	1.04	75.11
		Castle Rock	8.44	1.13	14.22	123.46	5.37	5.20	1.03	71.19
EL-Fayoum		Super_strain B	9.31	1.31	16.49	131.20	6.82	6.61	1.03	79.88
		Castle Rock	8.88	1.17	14.69	125.20	6.22	6.07	1.03	71.19
L.S.D			0.67**	0.06	0.76	7.53**	0.44	0.44	0.02*	8.96**
EL-Behaira		80%	7.92	1.00	12.59	114.72	5.52	5.33	1.03	69.82
		100%	10.03	1.44	18.12	138.05	6.10	5.93	1.03	75.30
		120%	8.10	1.10	13.80	125.20	5.92	5.67	1.05	74.33

EL-Fayoum		**80%**	**8.18**	**1.03**	**13.04**	**116.83**	**6.37**	**6.17**	**1.03**	**70.32**
		100%	**10.55**	**1.54**	**19.40**	**139.37**	**6.60**	**6.45**	**1.02**	**79.42**
		120%	**8.55**	**1.14**	**14.34**	**128.40**	**6.60**	**6.40**	**1.03**	**76.87**
L.S.D			**0.82**	**0.08**	**0.93**	**9.22****	**0.54**	**0.54**	**0.02***	**10.97****
Super_strain B		**80%**	**8.25**	**1.06**	**13.38**	**118.55**	**6.50**	**6.28**	**1.04**	**72.50**
		100%	**10.48**	**1.56**	**19.72**	**142.68**	**6.62**	**6.45**	**1.03**	**83.12**
		120%	**8.62**	**1.18**	**14.82**	**128.35**	**6.60**	**6.32**	**1.05**	**76.87**
Castle Rock		**80%**	**7.85**	**0.97**	**12.24**	**113.00**	**5.38**	**5.22**	**1.03**	**67.63**
		100%	**10.10**	**1.41**	**17.81**	**134.73**	**6.08**	**5.93**	**1.03**	**71.60**
		120%	**8.03**	**1.06**	**13.32**	**125.25**	**5.92**	**5.75**	**1.03**	**74.33**
L.S.D			**0.82****	**0.08**	**0.93**	**9.22****	**0.54**	**0.54**	**0.02***	**10.97****
EL-Behaira	**Super_strain B**	**80%**	**8.13**	**1.04**	**13.10**	**117.13**	**6.23**	**6.03**	**1.03**	**70.27**
		100%	**10.23**	**1.51**	**18.97**	**141.57**	**6.40**	**6.20**	**1.03**	**81.23**
		120%	**8.40**	**1.13**	**14.28**	**126.87**	**6.33**	**6.03**	**1.05**	**76.67**
	Castle Rock	**80%**	**7.70**	**0.96**	**12.07**	**112.30**	**4.80**	**4.63**	**1.04**	**69.37**
		100%	**9.83**	**1.37**	**17.27**	**134.53**	**5.80**	**5.67**	**1.02**	**69.37**
		120%	**7.80**	**1.06**	**13.31**	**123.53**	**5.50**	**5.30**	**1.04**	**74.83**
EL-Fayoum	**Super_strain B**	**80%**	**8.37**	**1.08**	**13.67**	**119.97**	**6.77**	**6.53**	**1.04**	**74.73**
		100%	**10.73**	**1.62**	**20.46**	**143.80**	**6.83**	**6.70**	**1.02**	**85.00**
		120%	**8.83**	**1.22**	**15.35**	**129.83**	**6.87**	**6.60**	**1.04**	**79.90**
	Castle Rock	**80%**	**8.00**	**0.99**	**12.41**	**113.70**	**5.97**	**5.80**	**1.03**	**65.90**
		100%	**10.37**	**1.46**	**18.34**	**134.93**	**6.37**	**6.20**	**1.03**	**73.83**
		120%	**8.27**	**1.06**	**13.32**	**126.97**	**6.33**	**6.20**	**1.02**	**73.83**
L.S.D			**1.17****	**0.11**	**1.32**	**13.03****	**0.76**	**0.77**	**0.03***	**15.51****

**** mean : non significant .**

Results and Discussion

4. Effect of different locations, Cultivars, fertilizer levels treatments and their interactions on fruit yield components of tomato plants:

Data recorded in Tables 4 and 5 illustrate the effect of different locations, cultivars of tomato and fertilizers level as well as their interaction on fruit yield and its components of tomato plants expressed as: number of fruits/plant, yield /plant, total fruit yield/fed, average weight, length and diameter of fruit as well as fruit shape index and fruit set percentage during both seasons of study 2013 and 2014.

1. Effect of different locations.

Data in Tables 4 and 5 indicate that there were significant differences in number of fruits/plant, fruit yield /plant, total fruit yield/fed, average weight, length and diameter of fruit among the different tested location (El Behaira and El Fauom) during the first season of study. On the contrary, there were no significant differences for fruit weight, fruit shape index and percent of fruit set among the different tested location (El Behaira and El Fauom) during the same period of study.

While in the second season there were significant differences in yield /plant, total fruit yield/fed. and average fruit length and diameter, meanwhile there were no significant differences for number of fruits/plant, fruit weight, fruit shape and fruit set%, among both tested location (El Behaira and El Fauom) during the second season of study.

During both seasons of study cultivation both cultivars at El Fayuom gave the highest values of yield /plant, total yield/fed, fruit length and diameter. While El Behaira location gave the lowest values for the above mentioned traits, with significant differences among them during the two experimental seasons.

The favorable effect of El- Fayuom location concerning all studied fruit yield characteristics as compared with El Behaira location during both seasons of this study might be due to the favorable micro climate condition such as:- higher of both maximum as well as minimum air temperature, lower percentages of air relative humidity and or lower average radiation as lux meter throughout the growing period of tomato plants grown under the open field condition.

Obtained results are in accordance with those of **Elzbieta *et al.* (2016)** who studied the effect of temperature and precipitation conditions on the growth and development dynamics of five cultivars of processing tomato. They stated that temperature and precipitation conditions, affect yield, quality growth and development dynamics of processing tomato. The number of flowers and fruits formed per inflorescence was negatively correlated with temperature. Excessive precipitation during the entire growing period led to formation of smaller fruits. The length and width of the fruit were negatively correlated with the frequency of precipitation in all stages, and with total precipitation during the period from planting to setting of the first fruits. A beneficial effect of temperature on the length and width of the fruit was noted during the entire growing period. The tomato fruit formed a thicker pericarp when precipitation was more frequent.

2. Effect of cultivars:

Concerning the effect of cultivars Super Strain B and Castle Rock on fruit yield parameters of tomato plants during both seasons of study 2013, 2014 data in Tables 4 and 5 indicate that there were significant differences in number of fruits as well as yield /plant and total fruit yield/feddan, fruit length and diameter among the tested cultivars during the first season of study. On contrary, there were no significant differences for fruit weight, shape and fruit set% among the tested cultivars during the same period of study.

While in the second season 2014, there were significant differences in fruit yield /plant, total fruit yield/fed, length, diameter and % of fruit set. Adversely there were no significant differences for number of fruits/plant, fruit weight and shape, among the tested cultivars (cv. Super Strain B and cv. Castle Rock) during the second season of study.

During both seasons of study, cv. Super Strain B gave the highest values of yield /plant, total yield, length and diameter of fruit. While the cv. Castle Rock gave the lowest values for the above mentioned traits, with a significant difference among them during the two experimental seasons. Obtained results are in agreement with those reported by **seleguini (2007), Naroli *et al.*(2012), Mahopatra *et al.*(2013), Reddy *et al.*(2013) and Tiwari *et al.*(2013).**

3. Effect of fertilizers level:

With regard to the effect of fertilizers level (80, 100 and 120 %) from the recommended doses on fruit yield of parameters tomato plants, data in Tables 4 and 5 indicate that there were significant differences in fruit yield/plant, total fruit yield/fed and fruit weight among the tested cultivars during the first and second seasons (2013, 2014) of the study.

On the contrary, there were no significant differences for number of fruits/plant, fruit length and diameter, between the use of 80 or 120 %) from the recommended doses, during the first season. But both of fruit shape index and fruit set% had no significant effects for all used levels of fertilizers.

At all treatments, during both seasons of study 100 % from the recommended doses gave the highest values of determined fruit yield parameters, with a significant difference among them during the two experimental seasons.

Obtained results are in agreement with those reported by **Dorais *et al.*, (2001) Dorais *et al.* (2008); Al-Ghawas and Al-Mazidi (2004); Chapagain and Wiesman (2004); Direkvandi *et al.*(2008); Tesfaye**

Balemi (2008); Moniruzzaman *et al*.(2009); Haque *et al*.(2011); El-Nemr *et al.* (2012) and Manoj Kumar *et al*. (2013).

Furthermore increasing nitrogen, phosphors and potassium fertilizers led to an increase in the fruit yield of tomato (**Filiz and Sahriye (2010); Majid *et al*. (2010).** On the other hand, **Yagmur *et al.* (2004)**; **Abdrabbo *et al.* (2005)**; **Aujla *et al.* (2007); Ibia *et al.* (2008); Masome Hozhbryan (2013); Biswas *et al*. (2015); Zia-ul-Hassan *et al*. (2016).**

4. Effect of the interaction between different locations and different cultivars:

Regarding to the interaction between different locations and different cultivars, data in Tables 4 and 5 indicate that the highest values of different fruit yield characteristics were mostly recorded by the cv. Super Strain B tomato plants cultivated under El Fayuom conditions. While the lowest values were recorded in case of El Behaira location and cv. Castel Rock.

No significant differences were noticed for fruit weight as well as fruit shape index for both cultivars (Cv. Super Strain B and Castle Rock) cultivated under El Fayuom and El Behaira locations during both seasons of the experiment.

Therefore, this experiment suggests that Ca_2+ can effectively mitigate the deleterious effect of Na+ stress in tomato cultivation (Table 1).

5. Effect of the interaction between different locations and different fertilizers level.

Concerning to the interaction between different locations and different fertilizer levels, data in Tables 4 and 5 illustrate that the highest values of different fruit yield characteristics of tomato plant were produced by plants grown in El Fayuom location and supplemented with 100% level from the recommended doses of N.P.K. While the lowest values were recorded by El Behaira using 80% level from recommended doses of N.P.K. for both seasons of 2013, 2014.

There were significant differences in fruit yield / plant, total fruit yield/feddan as well as fruit length and diameter. No significant differences were noticed for number of fruits/plant, fruit shape index and fruit set%, for both locations (El Fayuom and El Behaira**)** using different levels of used fertilizers during the first season (2013). To some extent similar results were recorded with the same trend obtained by the second season 2014 of this study. Generally, at all treatments during both seasons of study adding 100 % from the recommended NPK doses to tomato plants grown under El Fayuom location gave the highest values of fruit yield parameters, as compared with the used NPK levels.

The obtained results are in agreement with **Mahmoud *et al.* (2012) and Jayasinghe *et al.* (2016)** who observed that increasing NPK levels resulted in higher growth performance in all three used tomato varieties. Elevated NPK level did not reflect significant yield increase, implying that such additions are not necessary as they increase the cost of the production in terms of high cost incurred for fertilizer and pollution.

6. Effect of the interactions between cultivars and different used fertilizers levels.

According to the interaction between different varieties and different fertilizers levels, data in Tables 4 and 5 illustrate that the highest values of different fruit yield characteristics of tomato were gained by Super Strain B cv. plants received 100% level from the recommended N.P.K dose. While the lowest values of yield components were recorded by Castel Rock cv. Plants supplemented with 80% from the recommended N.P.K dose. Also, no significant differences were noticed among: fruit weight, fruit shape index and fruit set % for both the first and the second seasons.

Compared the use of 80% or 120 % from the recommended N.P.K dose, no obvious significant differences were mostly remarcabls.

This finding agreed with those reported by **Akanbi *et al.* (2003), De Pascale *et al.* (2006)**, **Parisi *et al.* (2006), Segura *et al*. (2006)**, **Balemi (2008), Direkvandi *et al.* (2008), El-Nemr *et al.* (2012), Manoj Kumar *et al*. (2013)** on tomato who found that applying nitrogen, phosphorus and potassium to tomato plants led to increase fruit yield. Moreover, **Gough and Hobson (1990), Snapp and Shennan (1990), Ohta *et al.* (1992)** revealed that reductions in yield were also observed at the highest N and K levels but this was probably due to salinity of the root zone.

7. Effect of the interaction between all different treatments:

As the effect of the interaction treatments between locations, cultivars and fertilizers levels treatments, data in Tables 4 and 5 indicate clearly that cultivation the tomato plants cv. Super Strain B in El Fayoum location combined with using 100% level from the recommended N.P.K doses exhibited the highest values of all fruit yield characteristics compared with the other interaction treatments during the two seasons. On the other hand, using cv. Castel Rock and 80% from the recommended dose treatments in El Behaira location gave the lowest values.

On the other hand, no significant effects of these interactions on: fruit weight, fruit shape index and fruit set % at both seasons (2013 and 2014) in addition to number of fruits / plant in the second season (2014).

The obtained results are confirmed by **De Pascale *et al.* (2006) Parisi *et al.* (2006)**, **Segura *et al.* (2006), Balemi (2008), Direkvandi *et al.* (2008) and Manoj Kumar *et al*. (2013)** who mentioned that the tomato crop showed positive responses to the increase of the NPK nutrient solution concentration,

which raised the NPK extraction, yield and number of fruits per truss. An increase of the nutrient concentration from 100 to 200% produced a slight increase of yield (less than 10%), but lowered the nutrient uptake efficiency (27% for N, 44% for P and 34% for K).

Adil *et al.* (2003) reported a shortage of tomatoes is common in summer due to high temperatures as monthly average temperatures are between 31 to 35°C. They studied the heat stress on vegetative and productive development of heat sensitive and tolerant tomato genotypes, in order to compare the growth and development of different genotypes under defined heat stress conditions (intensity and duration).

They found that reproductive processes in tomato were more sensitive to high temperatures than the vegetative ones. The number of pollen grains produced by the heat tolerant genotype were higher than the numbers produced by the heat sensitive genotypes. However, other field condition factors such as: Low relative humidity, insect and virus diseases as well as soil physical properties have also to be considered. Optimization of microclimate could be very important to ensure a good performance of new tolerant varieties cultivated in summer periods.

They also stated that the high temperature condition strongly affected the vegetative and reproductive organs and tissues of tomato plants for all cultivars.

This confirms earlier findings of **Abdalla and Verkerk (1968), Abdul-Baki (1991) and Peet *et al.* (1997)** who revealed the adverse effects of HS (heat stress) on the vegetative and reproductive development in tomato plants.

Effect of different locations, Cultivars, fertilizers level and their interactions on chemical fruit quality of tomato.

Data tabulated in Tables 6 and 7 illustrate the effect of different locations (El Behaira and El Fayoum), cultivars(cv. Super Strain B and Castel Rock) and fertilizer levels (80% , 100% and 120 %) from the recommended NPK fertilizers, as well as their interactions on chemical fruit quality of tomato plant (Nitrogen%, Phosphorus%, Potassium%, total carbohydrates , T.S.S and total acidity) in the two seasons of 2013 and 2014.

1. Effect of different locations:

Data in Tables 6 and 7 show that there were clear significant differences in: Nitrogen**%**, Phosphorus**%**, Potassium**%**, total carbohydrates, TSS and total acidity among the tested different locations (El Behaira and El Fayom) during both seasons of study (2013 and 2014), with the exception of P% during the second season (2014).

During both seasons of study, El Behaira gave the highest values for all studied chemical fruit parameters. While El Fauom location gave the lowest values for the above mentioned measures, with significant differences among them during the two experimental seasons.

Such clear significant differences between the two locations and their effect on the chemical fruit quality, may be attributed to a combined macro-climatic conditions either collectively or separately, especially, relative humidity, air temperature, wind speed and soil nature and structure.

2. Effect of different cultivars:

Data in Tables 6 and 7 recorded that there were clear significant differences in: Nitrogen%, Phosphorus%, Potassium%, total carbohydrates, T.S.S. and total acidity among the tested cultivars : Super Strain B and cv. Castle Rock during the tested two seasons of study (2013 and 2014).

During both seasons of study, cv. Castle Rock gave the lowest significant values for: Nitrogen%, Phosphorus%, Potassium%, total carbohydrates, T.S.S and total acidity. While the cv. Super Strain B gave the highest values for the above mentioned measures, with a significant difference among them during the two experimental seasons.

3. Effect of fertilizers level.

With regard to the effect of fertilizers level (80, 100 and 120 %) from the recommended doses of NPK fertilizers on Nitrogen**%**, Phosphorus**%**, Potassium**%**, total carbohydrates, T.S.S and total acidity of tomato fruits during the tested two seasons of study (2013 and 2014), data in Tables 6 and 7 show that there were significant differences for mentioned studied fertilizer levels during both seasons of the study for all studied chemical fruit parameters except total acidity in the second season only where no significant differences for total acidity were noticed among the three used recommended levels of fertilizers. In this connection, adding 120 % from the recommended doses of N.P.K gave the highest values for all studied chemical fruit parameters during two experimental seasons (2013 and 2014). Where 80% from recommended doses of N.P.K gave the lowest significant values in this regard at both seasons.

Obtained results are in agreement with those reported by **Adams (1992), Bergmann (1992), Marschner (1995), Kreij (1996) and (1999), Petersen *et al.* (1998), Auerswald *et al.* (1999), Dorais *et al.* (2001) and (2008), Oded and Uzi (2003), Chapagain and Wiesman (2004), Lin *et al.* (2004**), El-Nemr *et al.* (2012)**.

4. Effect of the interaction between different locations and cultivars:

Regarding to the interaction between different locations and cultivars data in Tables 6 and 7, indicate that there were significant effects of both locations (El Behaira and El Fayuom) and different cultivars (Super Strain B and Castle Rock) on all chemical parameters of tomato fruits in both seasons (2013 and 2014), except N and P% in the second season as differences did not reach the 5% level of significance.

Table 6. Effect of different locations, Cultivars, fertilizers level treatments and their interactions on chemical fruit quality of tomato plant in the first season 2013**.**

Treatments				N %	P %	K %	Total carbohydrate%	T S S%	Total acidity mg/liter
Location	EL-Behaira			1.31	0.94	2.14	11.81	4.93	24.78
	EL-Fayoum			1.12	0.85	1.65	10.16	4.71	22.16
L.S.D				0.06	0.01	0.12	0.51	0.10	0.41
Cultivar	Super_strain B			1.40	0.99	2.13	12.16	5.01	24.90
	Castle Rock			1.02	0.80	1.65	9.81	4.63	22.04
L.S.D				0.06	0.01	0.12	0.51	0.10	0.41
Fertilizer	80 % Recommended Doses			0.86	0.86	1.48	10.24	4.52	22.49
	100% Recommended Doses			1.23	0.90	1.84	10.79	4.88	23.44
	120% Recommended Doses			1.55	0.94	2.36	11.92	5.07	24.46
L.S.D				0.08	0.01	0.14	0.63	0.12	0.50
EL-Behaira		Super_strain B		1.49	1.03	2.42	13.30	5.10	26.12
		Castle Rock		1.13	0.85	1.86	10.32	4.76	23.45
EL-Fayoum		Super_strain B		1.32	0.95	1.85	11.03	4.92	23.69
		Castle Rock		0.92	0.75	1.45	9.30	4.50	20.63
L.S.D				0.09	0.02	0.16	0.72	0.14	0.58
EL-Behaira		80%		1.00	0.89	1.56	10.86	4.60	24.10
		100%		1.33	0.93	2.03	11.90	4.98	24.80
		120%		1.60	1.00	2.83	12.66	5.20	25.44
EL-Fayoum		80%		0.73	0.82	1.41	9.63	4.43	20.88
		100%		1.13	0.86	1.64	9.68	4.77	22.10
		120%		1.50	0.88	1.89	11.18	4.93	23.50
L.S.D				0.11	0.02	0.20	0.89	0.17	0.71
Super_strain B		80%		1.03	0.96	1.60	11.51	4.68	24.19
		100%		1.34	0.99	2.12	12.22	5.05	25.08
		120%		1.85	1.03	2.67	12.75	5.30	25.43
Castle Rock		80%		0.70	0.76	1.37	8.97	4.35	20.79
		100%		1.12	0.80	1.55	9.36	4.70	21.82
		120%		1.25	0.85	2.04	11.08	4.83	23.51
L.S.D				0.11	0.02	0.20	0.89	0.17	0.71
EL-Behaira	Super_strain B		80%	1.13	0.99	0.99	12.44	4.77	25.54
			100%	1.45	1.02	1.02	13.31	5.10	26.32
			120%	1.87	1.08	1.08	14.14	5.43	26.49
	Castle Rock		80%	0.87	0.80	0.80	9.28	4.43	22.66
			100%	1.20	0.85	0.85	10.49	4.87	23.28
			120%	1.32	0.92	0.92	11.18	4.97	24.39
EL-Fayoum	Super_strain B		80%	0.92	0.92	0.92	10.59	4.60	22.85
			100%	1.22	0.96	0.96	11.12	5.00	23.85
			120%	1.83	0.98	0.98	11.37	5.17	24.37
	Castle Rock		80%	0.53	0.72	0.72	8.67	4.27	18.91
			100%	1.04	0.75	0.75	8.23	4.53	20.35
			120%	1.18	0.78	0.78	10.99	4.70	22.63
L.S.D				0.15	0.03	0.29	1.25	0.25	1.01

**** mean :non-significant .**

Table 7. Effect of different locations, Cultivars, fertilizers level treatments and their interactions on chemical fruit quality of tomato plant in the second season 2014**.**

Treatments				N %	P %	K %	Total carbohydrate%	T S S%	Total acidity mg/liter
Location	EL-Behaira			1.14	0.73	1.50	10.72	4.70	20.91
	EL-Fayoum			0.95	0.72	1.19	10.07	4.43	17.93
L.S.D				0.07	**0.02	0.11	0.49	0.11	1.03
Cultivar	Super_strain B			1.18	0.81	1.65	11.12	4.80	21.41
	Castle Rock			0.91	0.65	1.04	9.66	4.33	17.44
L.S.D				0.07	0.02	0.11	0.49	0.11	1.03
Fertilizer	80 % Recommended Doses			0.86	0.68	1.15	9.55	4.24	18.27
	100% Recommended Doses			1.04	0.75	1.31	10.39	4.63	19.49
	120% Recommended Doses			1.23	0.76	1.58	11.24	4.83	20.50
L.S.D				0.09	0.02	0.13	0.59	0.14	**1.26
EL-Behaira	Super_strain B			1.36	0.81	2.02	11.58	4.93	22.03
	Castle Rock			0.92	0.66	0.98	9.85	4.47	19.80
EL-Fayoum	Super_strain B			0.99	0.81	1.27	10.67	4.67	20.78
	Castle Rock			0.90	0.64	1.10	9.47	4.20	15.08
L.S.D				*0.10	**0.03	0.15	0.69	0.16	1.46
EL-Behaira	80%			0.90	0.68	1.27	9.82	4.37	20.11
	100%			1.16	0.76	1.40	10.94	4.73	20.78
	120%			1.37	0.76	1.84	11.39	5.00	21.84
EL-Fayoum	80%			0.83	0.67	1.04	9.28	4.12	16.44
	100%			0.93	0.75	1.21	9.84	4.53	18.19
	120%			1.08	0.75	1.31	11.09	4.65	19.17
L.S.D				0.13	0.03	0.19	0.84	0.20	**1.79
Super_strain B	80%			0.95	0.73	1.40	10.60	4.47	19.79
	100%			1.14	0.86	1.54	10.91	4.85	21.76
	120%			1.44	0.84	2.00	11.86	5.08	22.67
Castle Rock	80%			0.78	0.63	0.91	8.50	4.02	16.76
	100%			0.94	0.64	1.07	9.87	4.42	17.22
	120%			1.01	0.67	1.15	10.62	4.57	18.33
L.S.D				0.13	0.03	0.19	0.84	0.20	**1.79
EL-Behaira	Super_strain B	80%		1.05	0.72	1.61	10.92	4.63	20.75
		100%		1.31	0.86	1.83	11.34	4.93	22.27
		120%		1.72	0.84	2.62	12.47	5.23	23.06
	Castle Rock	80%		0.75	0.64	0.93	8.73	4.10	19.47
		100%		1.00	0.65	0.96	10.53	4.53	19.29
		120%		1.02	0.68	1.06	10.30	4.77	20.62
EL-Fayoum	Super_strain B	80%		0.84	0.74	1.20	10.28	4.30	18.82
		100%		0.98	0.86	1.24	10.47	4.77	21.24
		120%		1.16	0.83	1.38	11.25	4.93	22.29
	Castle Rock	80%		0.81	0.61	0.88	8.27	3.93	14.05
		100%		0.88	0.63	1.18	9.21	4.30	15.14
		120%		1.01	0.67	1.25	10.93	4.37	16.04
L.S.D				0.18	0.05	0.26	1.19	0.28	2.53

** mean :non significant.

The highest values for Nitrogen%, Phosphorus%, Potassium%, total carbohydrates, T.S.S and total acidity were obtained by planting cv. Super Strain B in El Behaira. While the lowest values were recorded by El Fayuom using Castle Rock cultivar.

The cultivar Castle Rock planted in the two locations didn't appear any significant differences in N% as well as P% at the second season (2014)

The highest values for: Nitrogen%, Phosphorus%, Potassium%, total carbohydrates, T.S.S and total

acidity) during the tested two seasons of study (2013 and 2014) were obtained by planting cv. Super Strain B in El Behaira. While the lowest values were recorded by El Fayuom and Castel Rock. Referring the different nature of both locations of El Behaira and El Fayuom through many factors such as soil type, soil contracture, rainfall, relative humidity, sun shine hours and temperature degrees which may lead to remarkable differences in all chemical fruit parameters.

5. Effect of the interaction between different locations and fertilizers levels.

Concerning to the interaction between different locations and used fertilizer levels (80%, 100% and 120% of the recommended dose of N.P.K), data in Tables (6 and 7) illustrate that the highest values were received by El Behaira and 120 % from the recommended applied doses of N.P.K fertilizers. While the lowest values were recorded by El Fayuom location and 80% from the recommended doses of N.P.K. for both seasons 2013, 2014.

No significant differences were noticed for N% by the recommended doses (120%) for either El Fayuom or El Behaira at the first season (2013). But in the second one (2014), no significant differences were noticed for N% by using the recommended doses (80 %) for either El Fayuom or El Behaira.

Whereas no significant differences were noticed for P% by using the recommended fertilizers doses (100% or 120%) for El Fayuom location at the first season (2013) and between El Fayuom and El Behaira during the second season (2014).

Results indicate also high significant differences for K%, total carbohydrates and T.S.S by using the recommended doses of (80%, 100% and 120% N.P.K), for either El Fayuom or El Behaira at the first season (2013).

Total acidity was slightly affected in El Behaira but strongly affected in El Fayuom location by using the recommended doses of (80%, 100% and 120% N.P.K) (Table 6). Other results in Table (7) indicate non significant differences for Total acidity, which were noticed by using the recommended doses of (80%, 100% and 120% N.P.K), for either El Fayuom or El Behaira each alone at the second season (2014).

T.S.S. were strongly effected and gave significant differences by using the recommended doses of (80%, and 120% N.P.K) for either El Fayuom or El Behaira at the second season (2014). On the contrary, using the recommended doses of (100%) of N.P.K did not greatly affect T.S.S either at El Fayuom or El Behaira. There was a slightly differences between the uses of recommended doses of (100% or 120% N.P.K). So, logically, the researchers prefer to use 100% of recommended doses of N.P.K fertilizers than used 120%, to minimize the cost and the harmful effects causes' illness.

6. Effect of the interactions between cultivars and different used fertilizer levels:

According to the interaction between different cultivars and the recommended fertilizers used doses (80%, 100% and 120% of N.P.K), data in Tables 6 and 7 illustrate that the highest values for the chemical fruit properties of tomato plants (Nitrogen**%**, Phosphorus**%**, Potassium**%**, total carbohydrates, T.S.S and total acidity)**,** during the tested two seasons of study (2013 and 2014) were received by Super Strain B cultivar combined with and 120% from the recommended NPK used doses. While the lowest values were recorded by Castle Rock and 80% from the recommended dose for N.P.K treatments.

All the interactions between the cultivars Super Strain B and Castle Rock and different used fertilizers levels gave significant results as shown by tables 6 and 7.

Total carbohydrate (g) was 12.75 (the highest value) was recorded by use Super Strain B and 120% of NPK recommended dose, but there was no significant differences between this level and the used level of 100% of the recommended NPK dose. The lowest values of total carbohydrate was recorded by using Castle Rock and 80% of the NPK recommended dose.

Generally chemical fruit quality (T.S.S and total acidity) were affected by both of used cultivars (Super Strain B and Castle Rock) or the used of different recommended levels of NPK. The highest values of both T.S.S and total acidity: 5.30 and 25.43 were recorded by using Super Strain B and 120% of recommended NPK level. No significant differences were noticed when used 100% of recommended NPK dose. On the contrary the Castle Rock showed the lowest values by using 80% of the recommended NPK dose.

Data show that the N% and P% on fruit chemical quality were significantly affected by using cultivars or even using recommended fertilizers level (for the year 2014). The highest figures was 1.44% N recorded by Super Strain B and 120% from the recommended NPK dose.

While the highest figures For P % was 0.67 % recorded by Castle Rock and 120% from the recommended NPK dose. While the lowest was recorded by using the Castle Rock and 80% of the recommended NPK dose, for both of N% and P%.

Regard to the K%, the highest value was 2.00 % recorded by using Super Strain B which fertilized by 120% of the NPK recommended dose. On contrary, the Castle Rock which fertilized by 80% of the recommended NPK dose gave the lowest value for K% (0.91 %).

Total carbohydrate (g) was 11.86 (the highest value) was recorded by use Super Strain B and 120% of NPK recommended dose. The lowest values of total carbohydrate (8.50g) was recorded by using Castle Rock and 80% of the NPK recommended dose.

Generally chemical fruit quality (T.S.S and total acidity) were affected by both of used cultivars (Super Strain B and Castle Rock) or the used of different recommended levels of NPK. The highest values of both T.S.S and total acidity: 5.08 and 22.67 were recorded by using Super Strain B and 120% recommended NPK level. No significant difference compared with the aforementioned were noticed when used 100% of recommended NPK dose with the Castle Rock varity. The Castle Rock give the lowest values by using 80% of the recommended NPK dose.

7. Effect of the interaction between all different treatments:

As the effects of the interactions between all used treatments on chemical fruit quality of tomato plant (Nitrogen**%**, Phosphorus**%**, Potassium**%**, total carbohydrates, T.S.S and total acidity) in the two seasons of 2013 and 2014 data in Tables 6 and 7 indicate clearly that cultivating the tomato plants in El Behaira by using cv. Super Strain B and 120 % from the recommended NPK doses exhibited the highest values of all of chemical fruit properties of tomato plants (Nitrogen%, Phosphorus%, Potassium%, total carbohydrates, T.S.S and total acidity, compared with the other interaction treatments during the two seasons. On the contrary, using Cv. Castle Rock and 80% from the recommended NPK dose treatments in El Fayoum location gave the lowest values.

The obtained results are in agreement with **Abdalla and Verkerk (1968), Abdul-Baki (1991), Peet *et al*. (1997), Adil *et al* (2003**), **De Pascale *et al.* (2006), Parisi *et al.* (2006) and Manoj Kumar *et al*. (2013)**

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الملخص العربى

تجربتين حقليتين تم القيام بهم خلال موسمين صيفيين متتاليين ٢٠١٣ و٢٠١٤في البوصيلي (محافظه البحيره) والفيوم لدراسه النمو والانتاجيه لصنفين طماطم تحت ظروف مناخيه مختلفه وكذلك بأستخدام مستويات تسميد مختلفه وقد كان تصميم التجربه قطع منشقه عشوائيه حيث تم ترتيب المواقع قطعه رئيسيه وتم ترتيب اصناف الطماطم كقطع تحت فرعيه وتم ترتيب مستويات التسميد المختلفه كقطع تحت فرعيه.وقد اوضحت النتائج بأن نباتات الطماطم صنف السوبر استرين بي في الفيوم والتي تم استخدام مستوى تسميدى ١٠٠% من المعدلات الموصى بها من NPK اظهرت اعلى محصول خلال موسمي الزراعه معبر عنها بعدد الثمار/ نبات وعدد الثمار /نبات والمحصول/ الفدان وكذلك وزن وطول وقطروشكل الثماروكذلك نسبه عقد الثمار. ومن جهه اخري فأن استخدام كاسل روك ومعدل التسميد ٨٠% من المعدلات السماديه الموصى بها في محافظه البحيره اعطى اقل قيم.كما اظهرت النتائج بوضوح ايضا ان الطماطم المنزرعه بالبحيره بأستخدام صنف سوبر استرين بي ومستوى تسميد ١٢٠% من النسبه الموصى بها من السماد NPK اظهرت اعلى قيم خصائص جوده معبر عنها بالنسبه المئويه للنيتروجين والفوسفور والبوتاسيوم وكميه الكربوهيدرات كليه ومواد صلبه ذائبه كليه وكذلك الحموضه الكليه وذلك خلال موسمي الزراعه. ومن جهه اخرى فأن صنف الكاسل روك ومستوى تسميد ٨٠ % من النسبه الموصي بها والمنزرعه في الفيوم اعطت اقل القيم.