# Effect of Foliar Spray with Some Growth Stimulants on Growth and Productivity of Some Varieties of Tomato Grown In the Late Summer Seasons

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**Abstract**

Two field experiments were carried out during the two successive late summer seasons of 2017and 2018 in private sector farm at Digwa Village, Benha, El-Qalubia Governorate, to investigate the effect of foliar spray of naphthalene acetic acid (NAA), ascorbic acid(AS), calcium boron and seaweed extract(SWE) as well as their interaction on growth,

Chemical composition, fruit yield and its quality of tomato plants *(Solanum lycopersicum* Mill ) cv. Hybrid Thoeria 084 and Super strain B**.** This experiment included 18 treatments resulted from the combination between two hybrids (Hybrid Thoeria 084 and Super strain B) and nine spray treatments as follows**,** Naphthalene acetic acid (NAA) at 100 and 200ppm/l, Ascorbic acid at 500 and 1000ppm/l, Calcium Boron at 250 and 500ppm/l and Seaweed extract at 2 and 4g/l in addition to the control treatment (spray with tap water). Obtained results showed that the highest values in all measured vegetative growth, Chemical composition, fruit yield and its quality were recorded as a result of foliar spraying tomato plants of hybrid. Thoeria 0.84 NAA at 200ppm, three times during the growing season starting after 15 days from transplanting data and every (10) days by intervals.

**Key words: -** Tomato – foliar spray- growth stimulants- heat stress

## Introduction

Tomato (*Lycopersicon esculentum* Mill.) is important crop in many countries. According to FAO, tomato has a main role in human nutrition because of its rich source of lycopene, minerals and vitamins such as ascorbic acid and b-carotene which are anti-oxidants and promote good health **Catignani and Lazarus (2003).** In Egypt, the late summer market tomato crop is yielded from transplants raised from open field during May up to July. During this period, temperature can exceed 35°C under field condition resulting in either non-uniform growth and poor fruit yield or even completely failure of tomato cropping in a great part of the cultivated area **Sato *et al*, (2006)** reported that under high temperatures, fruit set in tomato plants failed due to disruption of sugar metabolism and transport during the narrow window of male reproductive development.

Climatic changes associated with the increase of air temperature and drought is among the most important factors that limit productivity and quality in horticultural crops **(Fahad *et al*. 2017)**. In tomato high temperature stress leads to flower abortion, limited fruit set and weight **(Xu *et al*. 2017).**

Higher temperature stress accelerate the formation of toxic ROS (Reactive oxygen species) such as hydroxyl radical (OH), superoxide anions radical ($O_2$), and hydrogen peroxide ($H_2O$) are gen- erated by the reduction of oxygen during both photosynthetic and respiratory electron transport **(Suzuki and Mittler 2006).**

Excessive accumulation of ROS causes oxidative damage to cell components including lipid membranes, nucleic acids, enzymes, and proteins **(Mahajan and Tuteja 2005).** The her- bicide fluroxypyr can trigger ox ative damage by produc- uperoxide and $H_2O_2$in rice **(Wu *et al*. 2010).** Rising temperature can cause a change in growth periods and crops, leading to a high risk of survival of specific species **(Mendelsohn *et al*., 2016).**

High temperatures may benefit some crops but harm others owing to the increased evapotranspiration and thermal damage. In general, plants can develop different adaptation mechanisms to avoid heat stress **(Bita and Gerats, 2013).** To satisfy the demand for food, it is necessary to develop crops with high resistance to heat stress.

Extreme temperature is one of the most severe and damaging environmental factors that affect the integrity of plant cells. The increase in temperature adversely affects the quantity and quality of all plant species, including tomatoes **(Rodriguez-Ortega *et al*., 2016).** The exposure of plants to long- or short-term high temperatures has a negative impact on the fruits by altering specific physiological processes in male reproductive development **(Sato *et al*., 2006)** and reducing crop production **(Mohammed and Tarpley, 2011).**

Recently, new rooted physiological understanding and information were reliable, accordingly new effective techniques might be investigated to induce plant tolerability. Also, it was demonstrated that an internally inducible, oxidative stress, the internal generation of reactive oxygen species (ROS, toxic oxygen free radicals), this know as the main factor beyond heat and other stresses related disturbances. Also, it was stated that oxidative stress tolerance considered as an important factor for all stresses tolerability **Howarth (2005)**

Some of the plant growth regulators included NAA are very effective to increase the fruit set, fruit size, growth as well as yield and quality under low and high temperature environment **(Chauhan *et al*.,2017).**

**Khan *et al*.( 2009)** The growth promoting effect of liquid extract of seaweeds on germination vegetative growth and biochemical characteristics are being carried out in some economic vegetables a nd

fruits. **Sarg (2005)** observed that spraying potato plants with ascorbic acid at concentrations of 100, 200 and 300 ppm had non-significant effect on both ofP and K percentages in the tubers, but the nitrogen percentage was increased as a result of the application of ascorbic acid over the control.

**El-Banna *et al*. (2006)** illustrated that foliar spraying of potato plants with ascorbic acid significantly increased N, P and K contents in leaves.

Calcium (Ca) and boron (B) are important nutrients for growth and development of plants and participate in several physiological processes in plants. Calcium is an essential part of the plant cell wall and necessary for new cell formation. It enhances resistance to bacterial and viral diseases **USTEN *et al*. (2006)** and activates several enzyme systems that regulate leaf and root growth **(MENGEL and KIRKBY, 2001)**. Boron contributes to cell wall strength and development, as well as being critical to cell division, fruit and seed development, sugar synthesis and transport, and development **CAMACHO-CRISTÓBAL et al. (2008).** Calcium and boron combined are essential to pollen grain germination and pollen tube elongation **KRICHEVSKY *et al*. (2007)**, which helps provide successful fertilization or pollination, preventing the abortion of flowers. However, the benefits of Ca and B application depend on a balance between Ca and B levels in the plant. According to **(Tariq and Mote , 2007),** low Ca and high B could be detrimental to plant growth and yield.

Therefore this study was carried out to investigate the effect of using some environmental friendly growth stimulating compounds such as naphthalene acetic acids (NAA), seaweed extract (SWE) ,ascorbic acids, calcium boron, to actively enhance the vegetative growth, chemical composition, yield and its components as well as fruit quality of tomato plants hybrid Thoria 084 and Super starin –B grown under high temperature.

## Materials and Methods

Two field experiments were carried out during the two successive late summer seasons of 2017and 2018 in private sector farm at Digwa Village, Benha, El-Qalubia Governorate, to investigate the effect of foliar spray of naphthalene acetic acid (NAA), ascorbic acid(AS), calcium boron and seaweed extract(SWE) as well as their interaction on growth,
chemical composition, fruit yield and its quality of tomato plants
(*Solanum lycopersicum* Mill ) cv. Hybrid Thoeria 084 and Super strain B**.**

**Table A.** Monthly air temperature and relative humidity in El- Qalubia Governorate during two seasons of the experimental

| | 2017 | | | 2018 | | |
|---|---|---|---|---|---|---|
| | Temperature °C | | R.H% | Temperature °C | | R.H% |
| Month | Max | Min | Average | Max | Min | Average |
| **May** | 31.05 | 18.77 | 62.03 | 34.88 | 19.66 | 51.25 |
| **June** | 30.26 | 19.74 | 66.78 | 36.50 | 22.31 | 55.63 |
| **July** | 35.10 | 23.60 | 60.60 | 37.30 | 23.40 | 52.15 |
| **August** | 37.80 | 25.90 | 56.03 | 36.40 | 23.30 | 59.75 |
| **September** | 34.50 | 22.60 | 56.06 | 31.10 | 16.50 | 51.94 |
| **October** | 30.80 | 20.30 | 63.83 | 21.70 | 7.70 | 64.22 |

The area of the experimental plot was 12 $m^2$ included one bed each 8 meters in long and 1.5 meter in width. Transplanting was done on one side of ridge at 30 cm apart between transplants. Transplanting was done on 10$^{nd}$ May in both seasons of 2017 and 2018, respectively. All agriculture practices were done as recommended by Ministry of Agriculture for a good production of tomato.

This experiment included 18 treatments resulted from the combination between two hybrids and nine spray treatments as follows.

### 3.1. Foliar spray treatments.

1- Naphthalene acetic acid (NAA) at 100ppm./l
2- Naphthalene acetic acid (NAA) 200ppm./l
3- Ascorbic acid at 500ppm./l
4- Ascorbic acid at 1000ppm./l
5- Calcium Boron at 250ppm./l
6- Calcium Boron at 500ppm./l
7- Seaweed extract at 2g/l.
8- Seaweed extract at 4g/l.
9-The control treatment (spray with distilled water).

- **Naphthalene acetic acid: -** is commercial product from Future Modern Company contain naphthalene acetic acid 99%.
- **Ascorbic acid: -** is commercial product from Future Modern Company containing ascorbic acid 99%.
- **Micronate: -** is commercial product from H.K.J: Al QAWAFEL IND .AGR .CO. contains 18% calcium - 6%boron.
- **Super fifty: -** is commercial product from Mac Egypt Company contain seaweed extract 65%**.**

The spray treatments were started after 15 days from transplanting and every 10 days by intervals for three times through the growing season.

A split plot design with three replicates was used in this experiment, the agricultural practices

concerning cultivation, fertilization, irrigation, insect and disease control were conducted as commonly followed according to the recommendation of the ministry of Agriculture for the commercial production of tomato.

Data on vegetative growth, yield and its components, and physical and chemical fruits characteristics were recorded as follows:

**3.2. Sampling and collecting data:**

**1. Vegetative growth characteristics.**

Three plants were taken from each experimental plot as a representative sample after 60 days from transplanting and the following data were recorded:- plant length(cm), number of branches/plant, number of leaves/plant , fresh and dry weight per plant .

**2. Chemical composition of plant foliage:**

Total Nitrogen, Phosphorus, Potassium and carbohydrates content were determined according to **Pregl (1945), John (1970), Brown and Lilleland (1964) and Herbert *et al.* (1971), respectively.**

**3. Fruit yield and its components:** At harvest mature fruits were picked along the harvesting season and the following data were recorded

**1.** Fruit yield per plant**:** It was calculated from fruit yield/plot and number of plants/plot.

**2.** Total fruit yield per fed**:** It was calculated using plot yield and plot area.

**3.** Marketable fruit yield per fed**:** it was calculated as weight of harvested fruits after discarding the injured and misshaped fruits.

**4.** Unmarketable yield per fed**:** it was calculated as weight of discarded the all injured and misshaped fruits.

**4. Fruit quality**

**1. Physical quality:** A random sample of 10 fruits at full ripe stage from each experimental plot was taken to determine the following properties.

Fruit parameters**:** length and diameter were measured for fruit sample (5 fruits) using vernier caliber. Average fruit weight and fruit firmness**: (**g/cm$^2$) it was determined by using Digitalis Penetrometer (PCE-PTR.MITPC, USA) with a needle 8 mm in diameter.

**2. Chemical quality:**

Total soluble solids (TSS): by using the hand refractometer.

**3.2.4.2.2.** Total titratable acidity (T.T.A), Ascorbic acid "V.C according to the method described in **A. O. A.C. (1990).**

**3.3. Statistical analysis:** All collected data were subjected to statistical analysis according to **Snedecor and Cochran (1991)** where the least significant difference was considered when even possible.

**Results and Discussion**

**4-1- Vegetative growth characteristics:**

Such data in Table (1) indicated that there were significant differences between the used hybrids Thoeria 084 and super strain B in all studied vegetative growth characteristics of tomato plants during the two seasons of growth. In this connection, hybrid Thoeria 0.84 exhibited the highest values of all studied morphological characteristics of tomato plants. On the other hand, hybrid super strain B recorded the lowest values in all vegetative growth parameters during the two seasons of study. These differences among the studied hybrids may be due to the differences in genetic potentiality of such hybrids. Obtained results are similar to those reported by ……

Data in Table (1) clear that foliar spraying tomato plants with some safety compounds act as growth stimulants significantly enhanced all studied morphological traits of plants compared with the control treatment during the two seasons of study. In this connection, the highest values for all recorded morphological characters of plant were obtained as a result of foliar spraying with naphthaline acetic acid (NAA) at 200ppm, three times during the growing season starting after (15) days from transplanting date and every (10) days as intervals between them, followed by NAA at 100ppm, As at 500ppm and 100ppm as well as CaB at 500ppm in descending order. Obtained results are true during both seasons of study. Such increments in vegetative growth traits of tomato plants due to the used of growth stimulants which are necessary and play main role in enhancement plant metabolism and consequently increase plant growth. In this respect……

The effect of the interaction treatments between all tested hybirds and foliar spraying with some growth stimulants compounds on vegetative growth traits expressed as plant height, number of branches and leaves per plant as well as plant fresh and dry weight in Table (1) show that the highest values in all measured growth characters were recorded as a result of foliar spraying tomato plants of hybrid. Thoeria 0.84 NAA at 200ppm, three times during the growing season starting after (15) days from transplanting data and every (10) days as intervals between the followed by the same hybrid with NAA at 100ppm or as at 500ppm or 1000rpm or CaB at 500ppm, in descending order. Obtained results were true during the two seasons of study.

**4-2- Chemical constituents of plant foliage:**

Concerning the effect of hybrids on macro-nutrients (NPK) and total carbohydrates concentration in plant foliage, the same data in Table (2) show clearly that all estimated macro-nutrients and total carbohydrates studied hybrids during both seasons of study. In this connection, hybrid Thoeria 084 recorded the highest values of total nitrogen, phosphorus and potassium percentage during both seasons of study. On the other hand, hybrid super strain B reflected the

highest values of total carbohydrates percentage during the two seasons of growth. Such differences in macro- nutrients and total carbohydrates percentage may be due to the differences in genetic carbohydrates percentage may be due to the differences in genetic structure of tested hybrids which affect on mineral absorption by plant roots and carbohydrates assimilation in photosynthetic process and accumulation in plant foliage.

Referring to the effect of foliar spraying with some growth stimulants compounds on the concentration of N, P, K and total carbohydrates in tomato plant foliage, the same data in Table (2) show clearly that the content of such attributes (N, P, K and total carbohydrates) were significantly increased as a result of foliar spraying with all used growth stimulants, three times during the growing season starting after (15) days from transplanting date and every (10) days as interval between them, compared with the control treatment. In addition, NAA at 200ppm exhibited the highest values in all assayed macro-elements and total carbohydrates during the two seasons of study, followed by NAA at 100ppm, As at 500 ppm and 1000ppm as well as CaB at 500ppm. In this respect, the superiority of some used growth stimulants in increasing the percentage of determined N, P and K as well as total carbohydrates percentage may be due to its effects on root absorption to macro-elements and carbohydrates assimilation during photosynthesis phase and accumulation in plant foliage……

**4-2-3- Effect of the interaction:**

As for the effect of the interaction treatments between studied tomato hybrids (Thoeria 084 and super strain B) and foliar spray with some safety compounds, data in the same table revel that planting Thoeria 084 hybrid and spraying the plants with NAA at 200ppm reflected the highest percentage of macro-elements and carbohydrates in plant foliage, followed by the interaction treatment between the same hybrid and foliar spray with NAA at 100ppm for nitrogen and phosphorus percentage or hybrid super strain B with NAA at 200ppm for potassium and total carbohydrates without any significant differences between them. These results were true during the two seasons of study.

**4-3- Fruit yield and its compounds:**

Data showed in Table (3) clear there were significant differences among the tested hybrids in total fruit yield and its compounds expressed as total fruit yield per plant and per feddan as well as marketable and unmarketable fruit yield per feddan during 2017 and 2018 seasons of study. In this respect of hybrid Thoeria 084 gave the highest values of all fruit yield and its components traits during the two seasons of study. Moreover, plants of hybrid super strain B exhibited the lowest values in this respect. Such differences in fruit yield and its components among the tested hybrids may be due to the differences in vegetative growth (Table, 1) which may be attributed to the differences in genetical structure between such hybrids.

Regarding the effect of some growth stimulants on total fruit yield and its components, the same data in Table (3) reveal that foliar spraying tomato plants with some tested growth stimulants, three times during the growing season starting after (15) days from transplanting data and every (10) days by intervals between them, significantly increased all the formentioned fruit yield parameters compared with the control treatment during the two growing seasons. In this respect, the highest vales of total fruit yield and its components were exhibited by foliar spraying the plants with NAA at 200ppm except unmarketable fruit yield in the second season followed by NAA at 100ppm for total fruit yield per feddan and marketable fruit yield in the two season of study. Such increments in total fruit yield and its components are connected with the increment in vegetative growth traits (Table, 1) and increasing the macro-nutrients (NPK) content of tomato plant foliage (Table,2) which judging the productivity of plants .

As for the effect of combination between the used hybrids and foliar spraying with some growth stimulants, data illustrated at Table (3) show clearly that there were significant differences in total fruit yield and its components of both hybrids Thoeria 084 and super strain B due to the application of growth stimulants at different used levels during the two seasons of growth compared with the control treatment. Moreover, fruit yield in the second season, followed by the interaction treatment between the same hybrid (Thoeria 084) and foliar spraying with NAA at 100ppm for total fruit yield and followed by spraying with CaB at 500ppm for all traits during the first season only.

**4-Physical fruit quality:**

Data illustrated in Table (4) show that the tested hybrids were significantly differences in all measured fruit physical, characters during both seasons of growth. In this regard, hybrid Theria 084 fruits exhibited the highest values of fruit length and firmness average fruit weight and diameter. Obtained results are true during both seasons of study. The differences among the tested hybrids effect of genetic factors which affected on physical fruit quality traits.

With regard to the effect of foliar spraying with some growth stimulants, three times during the growing season starting after (15) days from transplanting date and every (10) days as intervals between them, on physical fruit quality, i.e. average fruit weight, length, diameter and fermness, the same date in Table (4) show that there were significant differences between all tested foliar spray treatments during the two seasons of growth. Spraying the plants with naphthaline acetic acid at 200ppm three times during the growing season reflected the highest values in all studied physical fruit parameters compared with

the control and other tested growth stimulants, followed by foliar spraying with NAA at 100ppm, As at 500ppm and 1000ppm and CaB at 500ppm in descending order. Such results are true during the two seasons of study. Obtained results may be due to thesynrgistic effect of this growth stimulants compounds in increasing the plant vegetative growth (Table, 1) and absorption of macro-elements by plant roots (Table, 2) which in turn may affect on fruit weight and size.

As for the effect of the interaction treatments between hybrids and foliar spraying with some growth stimulants compounds on physical fruit quality, i.e. average fruit weight, length diameter and firmness, data in Table (4) clear that the highest values in average fruit weight and diameter were recorded as a result of the interaction treatment between hybrid super strain B and foliar spraying with naphthaline acetic acid at 200ppm, meanwhile the highest values in fruit length and firmness were recorded as a result of the interaction treatment between hybrid Theria 084 and foliar spray with the same concentration of NAA 200ppm during the two seasons of growth, followed by the same hybrid with foliar spray with NAA at 100ppm. These results are true during the two seasons of study.

**5- Chemical fruit quality:**

Data in the same table clear that there were significant differences in all assayed organic constituents of the produced fruits among the tested hybrids during both seasons of growth except total soluble solids which did not reach the level of significance at 5% during the two seasons of growth. These data indicate that hybrid super strain B reflected the highest constituents of vitamin C and total acidity during the two seasons of study and total soluble solids during the second season only. Meanwhile, the hybrid Thoeria 084 gave the highest values of total soluble solids in the first season only. In this connection, such differences in fruit chemical quality traits between the tested hybrids may be attributed to the genetic structure of such hybrids.

As for the effect of some growth stimulants, the same data in Table (5) indicated that spraying tomato plants with different studied growth stimulants compounds three times during the growing season starting after (15)days from transplanting date and every (10) days as interval between them positively enhanced all the assayed chemical constants of fruits compared with the control treatment. In this regard, the highest values of total soluble solids, vitamin C and total acidity were recorded in case of foliar spraying with naphthaline acetic acid at 200ppm followed by foliar spraying with NAA at 100ppm, As at 500ppm and 100ppm as well as CaB at 500ppm indisending order such results are true during the two seasons of growth.

**4-5-3- Effect of the interaction:**

As for the effect of the interaction treatments between tested hybrids and foliar spray with some growth stimulants compounds on chemical composition parameters expressed as total soluble solids, vitamin C and total acidity, data in Table (5) indicate that the highest values of total soluble solids were recorded as a result of spraying tomato plants of hybrid super storin B with naphthaline acitic acid at 200ppm in the first season, meanwhile in the second one the same concentration of NAA (200ppm) with hybrid Theria 084 gave the highest values. Moreover the highest values of vitamin C were obtained from the interaction treatment between Theria 084 hybrid with foliar spraying by NAA at 200ppm whereas, the highest values of total acidity were obtained from the interaction treatment between hybrid super strain B with NAA at 200ppm. These results were true during the two seasons of growth.

**Table 1.** Effect of some hybrids, growth stimulants and their interaction on vegetative growth characteristics of tomato plants during 2017 and 2018 beat summer seasons.

| Treatments | | Season 2017 | | | | | Season 2018 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Hybrids** | **Growth stimulants** | Plant height (cm) | No. branches/ plant | No. leaves/ plant | Plant fresh weight (g) | Plant dry weight (g) | Plant height (cm) | No. branches/ plant | No. leaves/ plant | Plant fresh weight (g) | Plant dry weight (g) |
| **Theria 084** | | 119.01 | 7.74 | 79.63 | 1273.01 | 250.28 | 118.27 | 7.26 | 81.51 | 127.88 | 251.46 |
| **Super strain B** | | 64.64 | 5.67 | 43.11 | 962.46 | 162.55 | 64.87 | 5.67 | 43.03 | 961.60 | 164.41 |
| **LSD at 5%** | | 1.49 | 0.64 | 1.37 | 9.68 | 1.25 | 1.59 | 0.52 | 1.27 | 5.76 | 2.13 |
| | **Control** | 85.56 | 5.50 | 57.89 | 1087.98 | 199.18 | 86.08 | 5.06 | 57.99 | 1094.38 | 200.78 |
| | **NAA 100ppm** | 94.26 | 7.45 | 63.35 | 1128.78 | 208.18 | 93.28 | 7.51 | 64.16 | 1128.91 | 210.59 |
| | **NAA 200ppm** | 94.51 | 7.83 | 64.30 | 1140.15 | 209.70 | 93.58 | 8.33 | 64.49 | 1132.28 | 212.06 |
| | **AS 500ppm** | 93.04 | 7.06 | 62.99 | 1122.47 | 207.76 | 92.76 | 6.94 | 62.99 | 1125.59 | 209.81 |
| | **As 1000ppm** | 92.90 | 6.83 | 62.29 | 1121.68 | 207.41 | 92.65 | 6.48 | 62.78 | 1123.89 | 209.33 |
| | **CaB 250ppm** | 92.46 | 6.33 | 61.66 | 1116.10 | 207.23 | 91.86 | 6.00 | 62.33 | 1124.41 | 207.66 |
| | **CaB 500ppm** | 92.50 | 6.65 | 62.05 | 1116.89 | 207.35 | 92.36 | 6.23 | 62.66 | 1121.55 | 207.78 |
| | **Alg 2ml** | 89.83 | 6.09 | 59.66 | 1112.38 | 204.31 | 90.3 | 5.50 | 61.42 | 1115.46 | 206.18 |
| | **Alg 4ml** | 91.13 | 6.27 | 60.83 | 1113.21 | 205.98 | 91.29 | 5.79 | 61.66 | 1115.66 | 207.21 |
| **LSD at 5%** | | 1.17 | 0.35 | 1.91 | 8.54 | 1.65 | 1.37 | 0.20 | 1.71 | 6.23 | 1.52 |
| | **Control** | 111.66 | 6.33 | 75.00 | 1235.53 | 239.16 | 111.76 | 6.13 | 75.33 | 1244.63 | 241.66 |
| | **NAA 100ppm** | 121.03 | 8.67 | 82.04 | 1286.00 | 252.90 | 120.33 | 8.36 | 83.00 | 1289.56 | 253.96 |
| | **NAA 200ppm** | 121.26 | 9.33 | 83.00 | 1305.60 | 256.03 | 120.50 | 9.33 | 83.33 | 1290.16 | 255.30 |
| | **AS 500ppm** | 120.86 | 8.00 | 81.66 | 1280.43 | 252.13 | 119.33 | 7.33 | 82.33 | 1289.23 | 253.63 |
| **Theria 084** | **As 1000ppm** | 120.73 | 7.67 | 80.59 | 1279.66 | 251.93 | 119.20 | 7.29 | 82.33 | 1286.06 | 253.13 |
| | **CaB 250ppm** | 120.40 | 7.33 | 80.33 | 1270.30 | 251.76 | 118.56 | 6.67 | 82.00 | 1278.76 | 251.70 |
| | **CaB 500ppm** | 120.40 | 7.63 | 80.47 | 1270.93 | 251.80 | 118.83 | 7.00 | 82.33 | 1282.00 | 251.73 |
| | **Alg 2ml** | 116.76 | 7.01 | 77.66 | 1264.03 | 247.00 | 117.70 | 6.33 | 81.33 | 1270.16 | 250.96 |
| | **Alg 4ml** | 117.93 | 7.25 | 79.66 | 1264.63 | 249.83 | 118.26 | 6.59 | 81.66 | 1270.36 | 251.10 |
| | **Control** | 60.06 | 4.67 | 40.79 | 940.43 | 160.06 | 60.40 | 4.00 | 40.66 | 944.13 | 159.90 |
| | **NAA 100ppm** | 67.23 | 6.32 | 44.66 | 971.56 | 163.46 | 66.23 | 6.67 | 45.33 | 968.26 | 167.23 |
| | **NAA 200ppm** | 67.76 | 6.33 | 45.61 | 974.70 | 163.83 | 66.66 | 7.33 | 45.66 | 974.40 | 168.83 |
| | **AS 500ppm** | 65.23 | 6.12 | 44.33 | 964.50 | 163.40 | 66.20 | 6.56 | 43.66 | 961.96 | 166.00 |
| **Super strain B** | **As 1000ppm** | 65.10 | 6.00 | 44.00 | 963.70 | 162.90 | 66.10 | 5.67 | 43.23 | 961.73 | 165.53 |
| | **CaB 250ppm** | 64.53 | 5.33 | 43.00 | 961.90 | 162.70 | 65.16 | 5.33 | 42.66 | 961.06 | 163.63 |
| | **CaB 500ppm** | 64.60 | 5.67 | 43.64 | 962.86 | 162.86 | 65.90 | 5.46 | 43.00 | 96.10 | 163.83 |
| | **Alg 2ml** | 62.90 | 5.18 | 41.66 | 960.73 | 161.63 | 62.90 | 4.67 | 41.51 | 960.76 | 161.40 |
| | **Alg 4ml** | 64.33 | 5.29 | 42.00 | 961.80 | 162.13 | 94.33 | 5.00 | 41.66 | 960.96 | 163.33 |
| **LSD at 5%** | | 2.48 | 0.92 | 2.12 | 9.04 | 1.75 | 2.77 | 0.55 | 1.83 | 9.30 | 1.40 |

**Table 2.** Effect of some hybrids, growth stimulants and their interaction on chemical constituents of tomato plants during 2017 and 2018 leat summer seasons.

| Treatments | | Season 2017 | | | | Season 2018 | | | |
|---|---|---|---|---|---|---|---|---|---|
| Hybrids | Growth stimulants | N (%) | P (%) | K (%) | Carbohydrate (%) | N (%) | P (%) | K (%) | Carbohydrate (%) |
| Theria 084 | | 2.54 | 0.53 | 2.36 | 11.99 | 2.24 | 0.43 | 2.12 | 10.97 |
| Super strain B | | 2.40 | 0.51 | 2.32 | 12.00 | 2.11 | 0.41 | 2.11 | 10.98 |
| LSD at 5% | | 0.03 | 0.04 | 0.04 | 0.02 | 0.02 | 0.03 | 0.03 | 0.01 |
| | Control | 2.35 | 0.49 | 2.20 | 11.13 | 2.04 | 0.39 | 1.94 | 10.18 |
| | NAA 100ppm | 2.57 | 0.54 | 2.47 | 12.59 | 2.26 | 0.44 | 2.27 | 11.54 |
| | NAA 200ppm | 2.59 | 0.55 | 2.55 | 12.80 | 2.30 | 0.45 | 2.36 | 11.68 |
| | AS 500ppm | 2.53 | 0.53 | 2.39 | 12.23 | 2.23 | 0.43 | 2.17 | 11.26 |
| | As 1000ppm | 2.49 | 0.52 | 2.35 | 12.15 | 2.20 | 0.42 | 2.16 | 11.24 |
| | CaB 250ppm | 2.41 | 0.51 | 2.30 | 12.14 | 2.13 | 0.41 | 2.04 | 11.08 |
| | CaB 500ppm | 2.45 | 0.52 | 2.32 | 12.23 | 2.17 | 0.42 | 2.08 | 11.24 |
| | Alg 2ml | 2.37 | 0.5 | 2.22 | 11.26 | 2.12 | 0.40 | 2.01 | 10.26 |
| | Alg 4ml | 2.4 | 0.51 | 2.26 | 11.38 | 2.12 | 0.41 | 2.03 | 10.36 |
| LSD at 5% | | 0.06 | 0.09 | 0.09 | 0.05 | 0.05 | 0.08 | 0.08 | 0.03 |
| | Control | 2.37 | 0.51 | 2.20 | 11.17 | 2.05 | 0.40 | 1.96 | 10.19 |
| | NAA 100ppm | 2.70 | 0.55 | 2.51 | 12.66 | 2.36 | 0.45 | 2.29 | 11.56 |
| | NAA 200ppm | 2.71 | 0.56 | 2.58 | 12.85 | 2.43 | 0.46 | 2.37 | 11.71 |
| | AS 500ppm | 2.65 | 0.54 | 2.39 | 12.23 | 2.32 | 0.44 | 2.19 | 11.30 |
| Theria 084 | As 1000ppm | 2.59 | 0.54 | 2.38 | 12.07 | 2.28 | 0.43 | 2.18 | 11.27 |
| | CaB 250ppm | 2.46 | 0.53 | 2.32 | 12.22 | 2.17 | 0.42 | 2.06 | 11.10 |
| | CaB 500ppm | 2.51 | 0.53 | 2.35 | 12.24 | 2.24 | 0.43 | 2.10 | 11.27 |
| | Alg 2ml | 2.40 | 0.52 | 2.24 | 11.28 | 2.16 | 0.41 | 2.02 | 10.28 |
| | Alg 4ml | 2.44 | 0.53 | 2.30 | 11.35 | 2.16 | 0.42 | 2.05 | 10.39 |
| | Control | 2.34 | 0.48 | 2.20 | 11.10 | 2.04 | 0.38 | 1.92 | 10.17 |
| | NAA 100ppm | 2.44 | 0.53 | 2.44 | 12.53 | 2.16 | 0.43 | 2.26 | 11.53 |
| | NAA 200ppm | 2.47 | 0.54 | 2.53 | 12.76 | 2.17 | 0.44 | 2.35 | 11.66 |
| | AS 500ppm | 2.41 | 0.52 | 2.39 | 12.24 | 2.15 | 0.42 | 2.16 | 11.23 |
| Super strain B | As 1000ppm | 2.40 | 0.51 | 2.33 | 12.23 | 2.13 | 0.42 | 2.15 | 11.22 |
| | CaB 250ppm | 2.37 | 0.50 | 2.28 | 12.07 | 2.09 | 0.41 | 2.02 | 11.06 |
| | CaB 500ppm | 2.39 | 0.51 | 2.29 | 12.22 | 2.11 | 0.41 | 2.06 | 11.21 |
| | Alg 2ml | 2.35 | 0.49 | 2.21 | 11.24 | 2.08 | 0.39 | 1.99 | 10.24 |
| | Alg 4ml | 2.37 | 0.50 | 2.22 | 11.41 | 2.09 | 0.40 | 2.02 | 10.34 |
| LSD at 5% | | 0.09 | 0.12 | 0.01 | 0.07 | 0.07 | 0.11 | 0.12 | 0.05 |

**Table 3.** Effect of some hybrids, growth stimulants and their interaction on fruit yield and its components of tomato plants during 2017 and 2018 leat summer seasons.

| Treatments | | Season 2017 | | | | Season 2018 | | | |
|---|---|---|---|---|---|---|---|---|---|
| Hybrids | Growth stimulants | Total yield (kg/plant) | Total yield (t/fed.) | Marketable yield (t/fed.) | Unmarketable yield (t/fed.) | Total yield (kg/plant) | Total yield (t/fed.) | Marketable yield (t/fed.) | Unmarketable yield (t/fed.) |
| Theria 084 | | 6.33 | 43.46 | 40.69 | 2.52 | 6.35 | 43.41 | 41.03 | 2.44 |
| Super strain B | | 4.53 | 23.34 | 20.99 | 2.47 | 4.51 | 23.39 | 21.09 | 2.29 |
| LSD at 5% | | 0.16 | 3.25 | 3.06 | 0.92 | 0.17 | 4.82 | 4.54 | 1.97 |
| | Control | 5.20 | 30.13 | 27.52 | 2.61 | 5.20 | 30.51 | 28.51 | 2.00 |
| | NAA 100ppm | 5.38 | 35.22 | 32.58 | 2.63 | 5.43 | 34.98 | 32.45 | 2.51 |
| | NAA 200ppm | 5.79 | 36.27 | 33.63 | 2.67 | 5.83 | 37.15 | 34.54 | 2.62 |
| | AS 500ppm | 5.53 | 33.56 | 31.29 | 2.27 | 5.48 | 32.99 | 30.69 | 2.48 |
| | As 1000ppm | 5.36 | 33.94 | 31.49 | 2.45 | 5.30 | 33.27 | 31.19 | 2.08 |
| | CaB 250ppm | 5.33 | 33.42 | 31.06 | 2.35 | 5.49 | 33.21 | 30.94 | 2.26 |
| | CaB 500ppm | 5.39 | 34.52 | 32.01 | 2.53 | 5.32 | 33.24 | 30.76 | 2.48 |
| | Alg 2ml | 5.37 | 31.28 | 29.50 | 2.37 | 5.37 | 32.44 | 30.10 | 2.34 |
| | Alg 4ml | 5.49 | 32.25 | 29.68 | 2.55 | 5.51 | 32.79 | 30.40 | 2.39 |
| LSD at 5% | | 0.14 | 2.89 | 2.49 | 0.34 | 0.15 | 2.22 | 1.64 | 0.18 |
| | Control | 6.06 | 39.40 | 36.80 | 2.60 | 6.13 | 40.31 | 38.10 | 2.20 |
| | NAA 100ppm | 6.24 | 46.26 | 43.57 | 2.69 | 6.35 | 45.72 | 43.15 | 2.56 |
| | NAA 200ppm | 6.61 | 46.65 | 43.79 | 2.85 | 6.74 | 48.12 | 45.53 | 2.59 |
| | AS 500ppm | 6.30 | 43.31 | 40.95 | 2.36 | 6.19 | 41.99 | 39.92 | 2.67 |
| Theria 084 | As 1000ppm | 6.31 | 44.28 | 41.91 | 2.37 | 6.28 | 43.57 | 41.23 | 2.33 |
| | CaB 250ppm | 6.17 | 44.15 | 41.72 | 2.43 | 6.27 | 42.97 | 40.30 | 2.66 |
| | CaB 500ppm | 6.36 | 45.66 | 43.05 | 2.63 | 6.23 | 43.10 | 40.95 | 2.16 |
| | Alg 2ml | 6.29 | 40.39 | 38.31 | 2.25 | 6.29 | 42.34 | 39.94 | 2.39 |
| | Alg 4ml | 6.60 | 41.05 | 38.56 | 2.47 | 6.63 | 42.57 | 40.17 | 2.39 |
| | Control | 4.33 | 20.86 | 18.24 | 2.62 | 4.27 | 20.71 | 18.91 | 1.79 |
| | NAA 100ppm | 4.52 | 24.18 | 21.61 | 2.57 | 4.50 | 24.24 | 21.76 | 2.45 |
| | NAA 200ppm | 4.97 | 25.88 | 23.46 | 2.48 | 4.91 | 26.18 | 23.55 | 2.63 |
| | AS 500ppm | 4.77 | 23.81 | 21.64 | 2.17 | 4.76 | 24.00 | 21.45 | 2.54 |
| Super strain B | As 1000ppm | 4.41 | 23.61 | 21.08 | 2.53 | 4.33 | 22.98 | 21.15 | 1.83 |
| | CaB 250ppm | 4.50 | 22.70 | 20.40 | 2.29 | 4.71 | 23.45 | 21.59 | 1.86 |
| | CaB 500ppm | 4.43 | 23.39 | 20.96 | 2.42 | 4.41 | 23.38 | 20.58 | 2.80 |
| | Alg 2ml | 4.46 | 22.18 | 20.69 | 2.49 | 4.45 | 22.54 | 20.26 | 2.28 |
| | Alg 4ml | 4.38 | 23.44 | 20.80 | 2.63 | 4.39 | 23.02 | 20.63 | 2.38 |
| LSD at 5% | | 0.28 | 3.74 | 3.17 | 0.75 | 0.19 | 3.46 | 1.80 | 0.41 |

**Table 4.** Effect of some hybrids, growth stimulants and their interaction on physical fruit quality of tomato plants during 2017 and 2018 leat summer seasons.

| Treatments | | Season 2017 | | | | Season 2018 | | | |
|---|---|---|---|---|---|---|---|---|---|
| Hybrids | Growth stimulants | Average fruit | Fruit length | Fruit diameter | Fruit firmness | Average fruit | Fruit length | Fruit | Fruit |
| Theria 084 | | 113.85 | 4.7 | 3.9 | 7.50 | 113.35 | 5.0 | 3.9 | 7.51 |
| Super strain B | | 163.94 | 4.5 | 4.4 | 4.93 | 161.18 | 4.8 | 4.4 | 5.03 |
| LSD at 5% | | 2.26 | 0.15 | 0.17 | 0.16 | 1.52 | 0.15 | 0.18 | 0.16 |
| | Control | 126.66 | 4.20 | 3.60 | 5.20 | 126.19 | 4.50 | 3.60 | 5.40 |
| | NAA 100ppm | 145.28 | 4.80 | 4.30 | 6.70 | 141.00 | 5.10 | 4.30 | 6.70 |
| | NAA 200ppm | 146.81 | 5.00 | 4.60 | 6.90 | 144.00 | 5.30 | 4.50 | 6.80 |
| | AS 500ppm | 141.59 | 4.60 | 4.20 | 6.40 | 139.80 | 5.00 | 4.20 | 6.40 |
| | As 1000ppm | 140.08 | 4.60 | 4.20 | 6.40 | 137.89 | 5.00 | 4.30 | 6.30 |
| | CaB 250ppm | 137.34 | 4.50 | 4.10 | 5.90 | 136.45 | 4.80 | 4.20 | 6.10 |
| | CaB 500ppm | 139.75 | 4.60 | 4.20 | 6.20 | 137.53 | 4.90 | 4.20 | 6.30 |
| | Alg 2ml | 135.73 | 4.40 | 3.95 | 5.80 | 135.70 | 4.70 | 4.05 | 6.03 |
| | Alg 4ml | 136.81 | 4.50 | 4.00 | 6.05 | 136.15 | 4.70 | 4.10 | 6.07 |
| LSD at 5% | | 2.80 | 0.11 | 0.16 | 0.14 | 1.23 | 0.13 | 0.19 | 0.15 |
| | Control | 104.70 | 4.30 | 3.40 | 6.37 | 102.62 | 4.70 | 3.40 | 6.53 |
| | NAA 100ppm | 121.46 | 4.90 | 4.00 | 7.93 | 119.86 | 5.20 | 4.00 | 8.03 |
| | NAA 200ppm | 122.73 | 5.10 | 4.30 | 8.07 | 121.50 | 5.30 | 4.40 | 8.17 |
| | AS 500ppm | 115.66 | 4.80 | 3.90 | 7.80 | 116.40 | 5.10 | 3.90 | 7.80 |
| Theria 084 | As 1000ppm | 114.70 | 4.80 | 3.90 | 7.77 | 113.93 | 5.10 | 3.90 | 7.67 |
| | CaB 250ppm | 111.03 | 4.70 | 3.80 | 7.50 | 111.30 | 4.90 | 3.90 | 7.30 |
| | CaB 500ppm | 114.50 | 4.70 | 3.90 | 7.50 | 113.36 | 5.00 | 3.90 | 7.57 |
| | Alg 2ml | 109.20 | 4.60 | 3.70 | 7.27 | 110.33 | 4.90 | 3.80 | 7.23 |
| | Alg 4ml | 110.66 | 4.70 | 3.70 | 7.27 | 110.90 | 4.90 | 3.80 | 7.27 |
| | Control | 148.63 | 4.20 | 3.80 | 4.10 | 149.76 | 4.40 | 3.80 | 4.27 |
| | NAA 100ppm | 169.10 | 4.70 | 4.60 | 5.47 | 163.50 | 5.10 | 4.60 | 5.53 |
| | NAA 200ppm | 170.90 | 4.90 | 4.90 | 5.50 | 166.50 | 5.30 | 4.60 | 5.53 |
| | AS 500ppm | 167.53 | 4.50 | 4.50 | 5.03 | 163.20 | 4.90 | 4.60 | 5.10 |
| Super strain B | As 1000ppm | 165.46 | 4.40 | 4.50 | 5.03 | 161.86 | 4.90 | 4.60 | 5.10 |
| | CaB 250ppm | 163.66 | 4.40 | 4.40 | 4.93 | 161.60 | 4.80 | 4.50 | 4.93 |
| | CaB 500ppm | 165.00 | 4.40 | 4.50 | 4.97 | 161.70 | 4.80 | 4.50 | 5.10 |
| | Alg 2ml | 162.26 | 4.30 | 4.20 | 4.50 | 161.16 | 4.60 | 4.30 | 4.83 |
| | Alg 4ml | 162.96 | 4.40 | 4.30 | 4.83 | 161.40 | 4.60 | 4.50 | 4.87 |
| LSD at 5% | | 3.79 | 0.15 | 0.20 | 0.19 | 3.57 | 0.16 | 0.15 | 0.16 |

**Table 5.** Effect of some hybrids, growth stimulants and their interaction on chemical fruit quality of tomato plants during 2017 and 2018 leat summer seasons.

| Treatments | | Season 2017 | | | Season 2018 | | |
|---|---|---|---|---|---|---|---|
| Hybrids | Growth stimulants | T.S.S (%) | V.C (mg/100g) | Acidity (%) | T.S.S (%) | V.C (mg/100g) | Acidity (%) |
| Theria 084 | | 3.9 | 32.74 | 1.31 | 3.9 | 32.81 | 1.27 |
| Super strain B | | 3.8 | 33.56 | 2.28 | 4.1 | 33.78 | 2.31 |
| LSD at 5% | | NS | 0.87 | 0.09 | NS | 0.94 | 0.10 |
| | Control | 3.15 | 28.50 | 1.61 | 3.15 | 27.50 | 1.60 |
| | NAA 100ppm | 4.50 | 37.33 | 1.88 | 4.40 | 38.33 | 1.96 |
| | NAA 200ppm | 4.55 | 40.50 | 2.01 | 4.75 | 41.00 | 2.01 |
| | AS 500ppm | 4.15 | 35.00 | 1.86 | 4.25 | 34.50 | 1.89 |
| | As 1000ppm | 4.00 | 34.62 | 1.85 | 4.15 | 34.00 | 1.81 |
| | CaB 250ppm | 3.65 | 32.17 | 1.75 | 3.85 | 32.00 | 1.74 |
| | CaB 500ppm | 3.85 | 33.66 | 1.79 | 4.10 | 32.66 | 1.76 |
| | Alg 2ml | 3.30 | 30.00 | 1.67 | 3.50 | 29.50 | 1.66 |
| | Alg 4ml | 3.60 | 32.00 | 1.71 | 3.75 | 30.16 | 1.70 |
| LSD at 5% | | 0.18 | 0.27 | 0.20 | 0.29 | 0.17 | 0.11 |
| | Control | 3.20 | 28.33 | 1.13 | 3.10 | 25.67 | 1.03 |
| | NAA 100ppm | 4.30 | 36.67 | 1.40 | 4.30 | 38.00 | 1.53 |
| | NAA 200ppm | 4.40 | 42.00 | 1.53 | 4.80 | 42.67 | 1.55 |
| | AS 500ppm | 4.30 | 34.67 | 1.40 | 4.20 | 33.33 | 1.41 |
| Theria 084 | As 1000ppm | 4.00 | 34.58 | 1.37 | 4.00 | 33.00 | 1.30 |
| | CaB 250ppm | 3.70 | 32.67 | 1.27 | 3.70 | 32.00 | 1.23 |
| | CaB 500ppm | 4.00 | 34.33 | 1.31 | 4.00 | 33.00 | 1.23 |
| | Alg 2ml | 3.30 | 29.00 | 1.17 | 3.30 | 28.33 | 1.10 |
| | Alg 4ml | 3.70 | 32.33 | 1.20 | 3.50 | 29.33 | 1.17 |
| | Control | 3.10 | 28.67 | 2.10 | 3.20 | 29.33 | 2.17 |
| | NAA 100ppm | 4.70 | 38.00 | 2.37 | 4.50 | 38.67 | 2.40 |
| | NAA 200ppm | 4.70 | 39.00 | 2.50 | 4.70 | 39.33 | 2.47 |
| | AS 500ppm | 4.00 | 35.33 | 2.33 | 4.30 | 35.67 | 2.37 |
| Super strain B | As 1000ppm | 4.00 | 34.67 | 2.33 | 4.30 | 35.00 | 2.33 |
| | CaB 250ppm | 3.60 | 31.67 | 2.23 | 4.00 | 32.00 | 2.26 |
| | CaB 500ppm | 3.70 | 33.00 | 2.28 | 4.20 | 32.33 | 2.30 |
| | Alg 2ml | 3.30 | 31.00 | 2.17 | 3.70 | 30.67 | 2.23 |
| | Alg 4ml | 3.50 | 31.67 | 2.23 | 4.00 | 31.00 | 2.23 |
| LSD at 5% | | 0.64 | 0.28 | 0.18 | 0.79 | 0.17 | 0.10 |

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# تاثير الرش الورقى ببعض منشطات النمو على نمو وانتاجية بعض اصنافف الطماطم المنزرعة فى العروة الصيفية المتاخرة

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أجريت تجربتين حقليتين خلال موسمي اواخر صيفي عامي 2017–2018 في مزرعة خاصة بقرية دجوي , مركز بنها بمحافظة القليوبية لدراسة تاثير الرش الورقي لكل من حمض النفثالين وحمض الاسكوربيك والكالسيوم بورون ومستخلص الطحالب البحرية وكذلك معاملات التفاعل بينهما على النمو الخضرى والتركيب الكيميائي والمحصول الثمرى وصفات الجودة لثمار نباتات الطماطم هجين ثريا 084 وصنف سوبر سترين بي اشتملت التجربة علي 18 معاملة ناتجه من التفاعل بين الصنفين ثريا 084 وصنف سوبر سترين بي و9 معاملات رش علي النحو التالي , حمض النفثالين تركيز 100 ,200 جزء في المليون /لتر , حمض الأسكوربيك تركيز 500 ,1000 جزء في المليون /لتر , كالسيوم بورون تركيز 250 ,500 جزء في المليون / لتر ,مستخلص الطحالب البحرية تركيز 2 ,4 جم / لتر بالاضافه الي معاملة الكنترول( بدون أي إضافات ). **اوضحت النتائج المتحصل عليها ما يلي** ان هجين ثريا 084 والرش بحمض النفثالين تركيز 200 جزء في المليون / لتر ادي للحصول علي اعلي القيم في صفات النمو الخضري( طول النبات عدد الاوراق عدد الافرع الوزن الطازج والجاف للنبات) وكذلك التركيب الكيميائي للمجموع الخضري(نسبة النيتروجين والفسفور و البوتاسيوم و الكربوهيدرات ) المحصول ومكوناته (المحصول الكلي للنبات والمحصول الكلي للفدان وكذلك المحصول القابل للتسويق والغير قابل للتسويق ) وصفات الجوده الطبيعيه للثمار (متوسط وزن وطول وقطر وصلابة الثمار) وصفات الجودة الكيميائية (نسبة المواد الصلبة الذائبة وفيتامين سي والحموضة الكلية )