# PRELIMINARY INVESTIGATION ON IMPROVING YIELD AND QUALITY OF TOMATO BY AID OF MICRONUTRIENTS FOLIAR SPRAYS

By

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## ABSTRACT

Three micronutrients i.e. B, Mn and Zn at a concentration of 100, 50 and 100 ppm respectively, separately or in combinations were used as a foliar spray on tomato plants 15, 30 and 45 days from transplanting. All micronutrients treatments enhanced plant growth characteristics expressed as stem length, number of leaves as well as fresh and dry weight per plant. In addition number of fruits per plant, early and total yield were significantly improved. Average fruit weight, total soluble sugars and vitamin C contents of fruits were also significantly increased due to all micronutrients treatments. Spraying tomato plants with a combination of 100 ppm B + 50 ppm Mn + 100 ppm Zn exerted the most pronouncing effect regarding growth, yield and quality of tomato.

## INTRODUCTION

Under some circumstances, supplying vegetable crops with micronutrients is very much essential. Verma et al.,

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(1973) reported that increasing B concentration increased plant height and number of leaves of tomato plants. Ashour (1973) found that spraying tomato plants with 100 ppm Zn $SO_4$ improved its vegetative growth. As for dry matter content it was found to be increased due to spraying tomato plants with B (Gjurov et al., 1965). Stolyarov (1971) emphasized that application of Mn and Zn showed a stimulatory effect on dry matter content.

Productivity of tomato was found to be enhanced due to micronutrients application. Gjurov et al., (1965) and Verma et al., (1973) reported that spraying tomato plants with B, Mn or Zn advanced flowering, improved earliness, reduced maturation period and consequently increased early yield. As for total yield it was found to be increased 9% over control due to B application (Adams and Winsor, 1974). However, Stancu (1964) showed that Mn application produced the highest yield compared either with B or Fe. In another study conducted by Duffek (1972), it was found that spraying tomato plants with Mn $SO_4$ at 0.2% significantly increased fruit number per plant by 9.5% compared with those unsprayed. Ashour (1973) reported that spraying tomato plants with Zn $SO_4$ at 100 ppm improved fruit setting and increased total yield.

With regard to the effect of micronutrient on tomato fruit quality, Govindan (1950) showed that increasing B

concentration resulted in larger tomato fruits. Spraying tomato plants with Mn $SO_4$ at 0.2% increased fruit weight by 12.4% compared with those unsprayed (Duffek, 1972). In addition Gencev and Gjurov (1975) reported that average fruit weight, produced from plants sprayed with Zn, was 93.1 gm while that of the control was 83.2 gm. Vitamin C and total soluble sugars contents of tomato fruits were increased due to B, Mn or Zn application (Stancu, 1964 and Aliev, 1968). On the other hand Silva and Scotti (1973) reported that Zn or Mn application decreased reducing sugars content. Acidity of tomato fruits was found to be unaffected as plants were sprayed with B, Mn or Zn (Stancu, 1964). However Verma et al. (1973) showed that acidity of tomato fruits was increased due to spraying plants either with B or Zn.

Therefore, the object of this work was to study the effect of B, Mn or Zn foliar sprays on growth characteristics and yield components of tomato.

## MATERIAL AND METHODS

Two field experiments were conducted at the Farm of the Faculty of Agricultural Science, Moshtohor, Zagazig University during the summer seasons of 1978 and 1979. Uniform seedlings of tomato (Lycopercicon esculentum Mill) cv. Pritchard were transplanted, on 19th and 11th of March

1978 and 1979 respectively, at 40 cm. apart on one side of ridegs 120 cm width. Plants were sprayed three times at 15, 30 and 45 days after transplanting with an aqueons solution of B, Mn or Zn. Sources used were boric acid, manganese sulphate and zinc sulphate respectively. Treatments were as follows:

1. Distilled water to act as control.
2. 100 ppm B.
3. 50 ppm Mn.
4. 100 ppm Zn.
5. 100 ppm B+ 50 ppm Mn.
6. 100 ppm B + 100 ppm Zn.
7. 50 ppm Mn + 100 ppm Zn.
8. 100 ppm B + 50 ppm Mn + 100 ppm Zn.

A complete randomized block design with four replicates was adopted. The plot area was about $\frac{1}{300}$ feddan. Other cultural practices were carried out as commonly followed in the district.

At full blooming stage, four plants from each experimental plot were chosen randomly for measuring the following characters:

1- Stem length (cm).

2- Number of leaves per plant.

3- Fresh weight of the above ground vegetative organs (gm).

4- Dry weight (gm).

All harvested fruits from each experimental plot were used for determining: number of fruits per plant, early yield (calculated from the first three pickings as Ton/fed) and total yield (Ton/fed). Early yield percentage was then calculated.

At each picking time a representative sample of 10 -15 fruits from each experimental plot was taken for determining the following characters:

a. Fruit length (cm).

b. Fruit diameter (cm).

c. Average fruit weight (gm).

d. Total soluble sugars evaluated colorimeterically according to Forsee (1938) and Morell (1941).

e. Vitamin C content assayed using the 2.6 dichlorophenolendophenol dye (A.O.A.C., 1970).

f. Total acidity determined as described in A.O.A.C. (1970).

All obtained data were subjected to statistical analysis according to Snedecor (1962).

## RESULTS AND DISCUSSION

### Plant growth characteristics:

Data presented in Table (1) clearly show that application of micronutrients i.e. B, Mn and Zn separately or in their combinations significantly enhanced stem length, number of leaves as well as fresh and dry weight per plant compared with the control during both seasons. In this respect using 100 ppm B showed the best response compared either with 50 ppm Mn or 100 ppm Zn. The favorable effect of B on vegetative growth could be attributed to its stimulatory effect on cell number and cell volume (Whittington, 1959). Moreover, Coke and Whittington(1968) suggested that B may affect plant metabolism through controlling the hormonal level within plant tissues. It is worthy to note that a combination of 100 ppm B, 50 ppm Mn and 100 ppm Zn (Table 1) exerted the greatest promoting effect on the various growth characteristics compared with the other used treatments. The promoting effect of micronutrients application on growth characteristics is in accordance with those of Gjurov *et al*. (1965) and verma *et al*. (1973) on boron, Ashour (1973) on zinc and Stolyarov (1971) on manganese and zinc.

Table (1): Effect of B, Mn and Zn foliar sprays on vegetative growth of tomato plants.

| Treatments | 1978 season | | | | 1979 season | | | |
|---|---|---|---|---|---|---|---|---|
| | Length of main stem (cm) | No. of leaves per plant | Fresh weight/ plant (gm) | Dry weight /plant (gm) | Length of main stem (cm) | No. of leaves /plant | Fresh weight /plant (gm) | Dry weight /plant (gm) |
| Control | 48.5 | 68.0 | 399.5 | 63.9 | 46.0 | 69.2 | 367.9 | 58.2 |
| B 100 ppm | 71.2 | 89.8 | 540.1 | 88.7 | 66.3 | 84.5 | 507.3 | 87.4 |
| Mn 50 ppm | 65.7 | 79.5 | 499.8 | 82.0 | 58.4 | 77.7 | 475.2 | 79.5 |
| Zn 100 ppm | 57.4 | 80.3 | 472.9 | 81.9 | 54.0 | 81.3 | 447.0 | 80.1 |
| B 100 + Mn 50 ppm | 66.8 | 76.3 | 498.1 | 83.9 | 62.1 | 90.5 | 516.6 | 89.4 |
| B 100 + Zn 100 ppm | 68.1 | 82.5 | 525.6 | 87.5 | 58.2 | 84.2 | 512.9 | 85.7 |
| Mn 50 + Zn 100 ppm | 70.3 | 77.0 | 534.9 | 89.5 | 65.0 | 89.2 | 521.3 | 86.1 |
| B 100 + Mn 50 + Zn 100 ppm | 79.0 | 101.0 | 632.6 | 103.6 | 70.7 | 103.5 | 612.6 | 104.5 |
| L.S.D. 5% | 1.6 | 9.5 | 102.4 | 5.3 | 1.6 | 10.7 | 104.2 | 9.2 |

Yield and yield components:

It is evident from Table (2) that application of B, Mn or Zn separately or their various combinations significantly enhanced number of fruits per plant as well as early and total yield during both seasons. A synergestic effect was noticed in case of a combination of any two used nutrients. In this respect, the most pronouncing effect was observed when the three micronutrients were combined together. Increasing early yield of tomato due to B, Mn or Zn was reported by Gjurov et al. (1965) and Verma et al. (1973). The obtained results on total yield coincide with those of Adams and Winsor (1974) on boron, Stancu (1964) and Duffek (1972) on Mn and Ashour (1973) on Zn.

Fruit quality:

Results on tomato fruit quality as affected by the various used micronutrients are presented in Tables (3 and 4). It is obvious that no significant differences were detected between the various used treatments regarding fruit length and fruit diameter. Average fruit weight was significantly increased due to application of B, Mn or Zn individually or in their combinations. These data are in agreement with those of Govindan (1950) on B, Duffek (1972) on Mn and Gencev and Gjurov (1975) on Zn.

Table (2): Effect of B, Mn and Zn foliar sprays on yield components of tomato plants.

| Treatments | 1978 season | | | | 1979 season | | | |
|---|---|---|---|---|---|---|---|---|
| | No. fruits /plant | Total yield ton/ fed. | Early yield ton/ fed. | Early yield % | No. fruits /plant | Total yield ton/ fed. | Early yield ton/ fed. | Early yield % |
| Control | 17.7 | 11.585 | 2.032 | 17.5 | 14.6 | 10.430 | 1.885 | 18.1 |
| B 100 ppm | 20.4 | 14.593 | 3.168 | 21.7 | 17.8 | 14.226 | 3.194 | 22.5 |
| Mn 50 ppm | 17.7 | 14.548 | 2.972 | 20.4 | 18.1 | 14.770 | 3.215 | 21.8 |
| Zn 100 ppm | 19.1 | 13.528 | 2.732 | 20.2 | 17.1 | 13.725 | 2.866 | 20.9 |
| B 100 + Mn 50 ppm | 22.2 | 16.648 | 4.017 | 24.1 | 20.1 | 16.615 | 4.349 | 21.2 |
| B 100 + Zn 100 ppm | 22.5 | 17.183 | 3.970 | 23.1 | 20.5 | 16.140 | 4.047 | 25.1 |
| Mn 50 + Zn 100 ppm | 21.5 | 16.721 | 3.930 | 23.5 | 20.4 | 15.475 | 4.005 | 25.9 |
| B 100 + Mn 50 + Zn 100 ppm | 27.4 | 19.332 | 4.913 | 25.4 | 23.3 | 17.498 | 5.351 | 30.6 |
| L.S.D. 5% | 1.1 | 0.818 | 0.384 | 7.5 | 1.2 | 0.797 | 0.186 | 9.4 |

With regard to the effect of the used treatments on the chemical fruit characters, data in Tables (3 and 4) clearly indicate that total soluble sugars content were significantly increased due to micronutrients application. Spraying tomato plants with 100 ppm boron combined with 100 ppm zinc led to the maximum total soluble sugars content during both seasons. These data are in accordance with those of Stancu (1964) and Aliev (1968). However, Silva and Scotti (1973) emphasized that Zn or Mn application decreased reducing sugars of tomato fruits. Vitamin C content was significantly increased due to all used micronutrients treatments (Table 3 and 4). In this respect, the highest value was observed in case of spraying plants with a combination of B, Mn and Zn at 100, 50 and 100 ppm respectively. These results confirm those of Stancu (1964) and Aliev (1968). Fruit acidity was increased by all micronutrients treatments, although no significant differences were detected. Plants sprayed with the combination of the three micronutrients produced fruits contained higher acidity compared with the other treatments. These data are in accordance with those of Verma et al. (1973). However, Stancu (1964) showed no effect on fruit acidity due to spraying plants with B, Mn or Zn.

Generally, it could be concluded that micronutrients application enhanced vegetative growth, improved fruit Quality and increased early as well as total yield of tomato. Spraying

Table (3) Effect of B, Mn and Zn foliar sprays on physical and chemical characters of tomato fruits, 1978 season.

| Treatments | Fruit length (cm) | Fruit diameter (cm) | Fruit weight (gm) | Total* soluble Sugars | Vit. C* | Total* acidity |
|---|---|---|---|---|---|---|
| Control | 5.5 | 6.0 | 93.5 | 1005 | 20.6 | 560 |
| B 100 ppm | 5.4 | 6.0 | 102.2 | 2044 | 25.6 | 710 |
| Mn 50 ppm | 5.3 | 5.9 | 105.5 | 1956 | 24.2 | 670 |
| Zn 100 ppm | 5.6 | 5.9 | 101.2 | 1852 | 21.6 | 600 |
| B 100 + Mn 50 ppm | 5.5 | 6.0 | 107.1 | 2158 | 27.7 | 770 |
| B 100 + Zn 100 ppm | 5.3 | 5.9 | 109.1 | 2210 | 25.6 | 740 |
| Mn 50 + Zn 100 ppm | 5.7 | 6.5 | 111.1 | 1873 | 24.7 | 680 |
| B 100 + Mn 50 + Zn 100ppm | 5.3 | 5.1 | 100.8 | 2031 | 29.3 | 840 |
| L.S.D. 5% | n.s | n.s | 1.5 | 548 | 1.9 | n.s |

* Mg/100 $cm^3$ juice

Table (4): Effect of B, Mn and Zn foliar sprays on physical and chemical characters of tomato fruits, 1979 season.

| Treatments | Fruit length (cm) | Fruit diameter (cm) | Fruit weight (gm) | Total* soluble sugars | Vit.C* | Total* acidity |
|---|---|---|---|---|---|---|
| Control | 4.2 | 5.4 | 102.1 | 809 | 19.5 | 550 |
| B 100 ppm | 4.8 | 5.4 | 114.2 | 1840 | 24.5 | 700 |
| Mn 50 ppm | 4.8 | 6.1 | 116.6 | 1752 | 23.1 | 660 |
| Zn 100 ppm | 5.1 | 5.6 | 114.7 | 1655 | 20.7 | 590 |
| B 100 + Mn 50 ppm | 4.8 | 5.2 | 118.1 | 1951 | 26.6 | 760 |
| B 100 + Zn 100 ppm | 4.5 | 4.8 | 112.5 | 2013 | 24.5 | 730 |
| Mn 50 + Zn 100 ppm | 4.4 | 5.0 | 108.4 | 1676 | 23.6 | 670 |
| B 100 + Mn 50 + Zn 100ppm | 4.6 | 5.2 | 107.3 | 1830 | 28.2 | 830 |
| L. S. D. 5% | n.s | n.s | 1.3 | 554 | 2.2 | n.s |

* Mg/100 $cm^3$ juice.

plants with 100 ppm B + 50 ppm Mn + 100 ppm Zn showed the best response in this respect. The increase in productivity of tomato plants could be due to the enhancing effect of these micronutrients upon vegetative growth which induce a greater opportunity to synthesize and accumulate the photosynthate over a longer period of time.

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بسم الله الرحمن الرحيم

# تحسين انتاجية و مواصفات الجودة لمحصول الطماطم باستخدام الرش ببعض العناصر النادرة ٠

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أجريت هذه التجربة خلال العروة الصيفية لموسمى ١٩٧٨ ، ١٩٧٩ على صنف الطماطم برتشارد لدراسة تأثير رش النباتات بعناصر البورون و المنجنيز و الزنك بتركيزات ١٠٠ ، ٥٠ ، ١٠٠ جزء فى المليون على التوالى اما منفردة أو فى تراكيب مختلفة على النمو الخضرى و المحصول و مواصفات الجودة ٠ و قد رشت نباتات الطماطم ثلاثة مرات بعد ١٥ ، ٣٠ ، ٤٥ يوم من الشتل وفيما يلى أهم النتائج : —

١ — أدت جميع معاملات العناصر النادرة الى تحسين مواصفات النمو الخضرى معبرا عنها بطول الساق — عدد الاوراق على النبات — الوزن الغض و الوزن الجاف للنبات مقارنة بالنباتات الغير معاملة ٠

٢ — كانت هناك زيادة معنوية فى متوسط عدد ثمار النبات — المحصول المبكر و المحصول الكلى نتيجة لجميع معاملات العناصر النادرة بالمقارنة بالكنترول ٠

٣ — ازداد متوسط وزن الثمرة و محتواها من كل من السكريات الذائبة الكلية وفيتامين ج زيادة معنوية باستخدام جميع معاملات العناصر النادرة ٠

٤ — كانت أحسن المعاملات التى أدت الى تحسين خواص النمو الخضرى و الى أعلى زيادة فى كل من المحصول المبكر و الكلى و أفضل خواص الجودة للثمار هى رش النباتات بمعدل ١٠٠ جزء فى المليون بورون + ٥٠ جزء فى المليون منجنيز + ١٠٠ جزء فى المليون زنك مجتمعة ٠