International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(2): 212-217

Received: 21-01-2020
Accepted: 25-02-2020

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Effect of boron and zinc on vegetative growth, flowering and fruiting of pomegranate (*Punica granatum* L.), cv. Bhagwa

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DOI: https://doi.org/10.22271/chemi.2020.v8.i2c.8770

Abstract
A field experiment was conducted during Rabi season of 2015-16. Geographically Lucknow is situated at $26^0$50' N latitude, $80^0$52' E longitude and altitude of 111 miter above mean sea level (MSL) at Horticulture Research Farm-1, Babasaheb Bheemrao Ambedkar University Vidya Vihar, Rae Bareli Road, Lucknow, (U.P.) 226025, Studies on the "Effect of boron and zinc on vegetative growth growth, yield and quality of pomegranate (*Punica granatum* L.), cv. Bhagwa", revealed that Vegetative growth characters *viz*. Plant height (267 cm), Number of secondary branches (85.00), Spreading of canopy (east-west) (180.67 cm), Spreading of canopy (north-south) (170.00 cm) and flowering characters, Number of flowers/plant (16.33), Number of dropping flowers/plant(2.33), Total number of fruits set/Plant (1.67) and Total number of fruits set/Plant (1.33) were maximized. When we use with recommended dose of micronutrients (Boron 0.2%) + (Zinc 0.5%).

Keywords: pomegranate, vegetative growth, flowering, fruiting, boron and zinc

Introduction

Pomegranate (*Punica granatum* L.) is one of important fruit crop of India which belongs to family Punicaceae and 2n=2x=18. Pomegranate is characterized by having two types of flowers on the same tree: hermaphroditic bisexual flowers and functionally male flowers. This condition, defined as functional andromonoecy, can result in decreased yields resulting from the inability of male flowers to set fruit. It is mainly grown in subtropical and tropical regions of the world (Naik and Chand, 2011). It is native of Iran and cultivated in extensively in Mediterranean and Central Asian countries of the world. It is suitable for growing under arid and semi arid regions due to its versatile adaptability is, hardy nature, low cast maintenance and high returns.

India is the largest producer of pomegranate in the world around 82300 MT from 13800 ha Area (Anonymous, 2014) [2]. Pomegranate can be grown throughout India due to its better adaptability to arid climate, commercial cultivation is being done in Maharashtra, Karnataka and Rajasthan. Other state, where it is grown to lesser extent is Uttar Pradesh, Himachal Pradesh, Punjab, Haryana, Tamil Nadu and Andhra Pradesh.

Pomegranate plant can withstand frost (temperature up to -10 ^{0}C) and can grow up to an altitude of 1600 meters above mean sea level (Rana and Dwivedi, 1997) [6]. It thrives best under hot and dry summers with cool winters provided irrigation facilities are available. It is a hardy plant and can withstand considerable amount of drought, but does better when water is made available. Trees with best quality fruits are produced in areas with cold winters and hot dry summers. Thus, mid-hills of Himachal Pradesh have congenial climate.

The chemical composition of pomegranate fruits and recorded that the edible parts represented 52% of the total fruit weight comprising 78%, juice and 22% seeds. The fresh juice contained 85.4% moisture, 10.6% total sugar, 1.4% pectin, 0.1g/100 ml total acidity (as citric acid), 19.6 mg/100 ml free amino nitrogen and 0.05 g/100 mlash. The seed were a rich source of total lipids, protein, crude fiber and as representing 27.2, 13.2, 35.3 and 2.0% respectively and also contains 6. Pectin, 4.7% total sugar. EI-Shaaraway and Nahapetain (1983) reported that pomegranate seed contains about 15% oil with a high refractive index iodine value and very low melting point. The oil has a potential for industrial use. The seeds (100g) also contain

1.09 mg oestrone and 0.036 mg coumestrol (anon steroid oestrogenl) Melgarejo *et al*. Pomegranate one is of the most important commercial fruit being eaten fresh and also processed for jams, jellies, syrups, pomegranate juice products and is used for medical purposes. The fruit peel, tree stem, root bark and leaves are good source of secondary metabolites such as tannins, dyes and alkaloids. (Eiada and Mustafa, 2013) [14].

Micro-elements such as Cu, Zn, B, Fe, Mn, Mo etc. are the essential elements required by plants in minute quantities. These are vital to the growth and development of plant. Micro-element deficiencies often limit the productivity in many fruit crops. Boron is an important micro-nutrient governing many physiological and biochemical plant processes and its beneficial effects on horticultural crops have been reported (Dutta *et al.*, 2003) [11]. It plays a significant role in flowering, fruiting, nitrogen metabolism, hormone movement and its action, and cell division. Its deficiency results in shoot dieback, cork spot and cracking of fruits. Boron increases fruit set of many species. Zinc is also an important nutrient element for growth, flowering and quality of fruits. It is involved in the biosynthesis of plant hormone Indole acetic acid. Zinc plays an important role in nucleic acid and protein synthesis and helps in the utilization of phosphorous and nitrogen. Favorable effects of zinc sprays on vegetative growth and health of fruit trees have been observed.

Materials and Methods

The field experiment was conducted at Horticulture Research Farm of the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, (A Central University), Vidya- vihar, Rae Bareli Road, Lucknow- 226025 (U.P.), India during Rabi season of 2015-16. Geographically Lucknow is situated at $26^0$50' N latitude, $80^0$52' E longitude and altitude of 111 miters above mean sea level (MSL). Lucknow has humid subtropical climate with an average annual rainfall of about 110 cm. The winters are severe and summer is dry and hot. The maximum temperature generally goes up to (43^0C) in summers and minimum up to 2^0C in winter. Monsoon generally sets in during the third week of June and recedes by the end of September with heavy rainfall during monsoon season. The weather parameters which prevailed during the course of investigation were recorded at the Meteorological Observatory of the Indian Institute of Sugarcane Research (IISR), Lucknow. Experiment laid out randomized block design with 9 different treatment combination and replicate thrice.

The treatments were T_0 Control (water spray), T_1 (Zinc @ 0.3%, T_2 Zinc @ 0.5%), T_3 Boron @ 0.2%, T_4 Boron @ 0.5%, T_5 Zinc @ 0.3% + Boron @ 0.2%, T_6 Zinc @ 0.3% + Boron @ 0.3%, T_7 Zinc @ 0.5% + Boron @ 0.2%, T_8 Zinc @ 0.5% + Boron @ 0.3%. Observations were recorded for Plant height, Number of secondary branches, Spreading of canopy (east-west), Spreading of canopy (north-south), Number of flowers/plant, Number of dropping flowers/plant, Total number of fruit set /plant, Total number of fruit drop /plant.

Result and Discussion

The results obtained during the investigation in respect to Boron and Zinc on growth parameters *viz*., plant height, number of the secondary branches/ plant. The maximum plant height at 0, 30, 60, 90 and 120 days after foliar spray. The maximum (237.00cm, 260.67cm, 265.67 cm, 266.4 cm, and 267.00 cm, respectively observed in the treatment T_7 (Zinc @ 0.5% + Boron @ 0.2%) and the minimum plant height recorded at 0, 30, 60, 90 and 120 DAP, (260.67 cm, 21.33cm, 126.33cm, 127.33cm and165.23cm, cm) in the respectively under T_0 (Control). The study revealed that number of secondary branches per plant were significantly more in 30, 60, 90,and 120 days of treatment T_7 (79.00, 81.67, 83.33 and 85.00) respectively observed (Zinc @ 0.5% + Boron @ 0.2%). Number of flowers per plant was maximum (11.33) under treatment T_5 followed by treatment T_8 at the time of spray of borax and minimum was recorded under treatment T_0 at the time of (starting) after 30, 60, 90, and 120 days maximum number of flower per plant were recorded under the treatment $T_{8,}$ $T_{7,}$ $T_{2,}$ T_4 followed by treatment $T_{2,}$ T_3, T_5 and T_7. The minimum (5.06) number of flower per plant was recorded under treatment T_4 revealed that number of dropping flower per plant was maximum (11.33) under treatment T_6 followed by treatment T_5 at the time 30 days of treatment start and minimum was recorded under treatment T_7 and after 60 days data was recorded maximum (65.33) dropping flower per plant under treatment T_8 followed by treatment T_4. The minimum (20.33) number of dropping flowers per plant was recorded under treatment T_7. Data recorded after 90 days found that maximum (10.67) dropping flowers per plant under treatment T_8 followed by treatment T_5 and minimum was recorded under treatment T_4. 120 days after treatment I was found that maximum (3.60) number of dropping flower per plant under treatment T_5 followed by $T_{4,}$ and minimum was recorded under treatment $T_{8.}$ The result of present study on fruit set as revealed in represented that number of fruit set per plant and was not found any fruit in any treatment at the time of treatment start however at 30, 60, 90 and 120 days after treatment the data was recorded maximum (9.33, 11.00, 11.33 and 1.67) fruit set per plant under treatment $T_{7,}$ $T_{6,}$ T_7 and T_7 followed by treatment T_3, $T_{6,}$ T_7 and T_8. The minimum (0.33, 0.67. 0.67 and 0.00) were recorded under treatment T_5 and The result of present study on fruit drop as revealed in represented that number of fruit set per plant and was not found any fruit in any treatment at the time of treatment start however at 30, 60, 90 and 120 days after treatment the data was recorded maximum (1.33, 1.00, 1.00 and 0.33) fruit set per plant under treatment $T_{8,}$ $T_{4,}$ T_2 and T_1 followed by treatment T_4, $T_{2,}$ T_1 and T_0. The minimum (0.00, 0.00. 0.00 and 0.00) were recorded under treatment T_0 (control). These results are in agreement with the findings of Singh *et al*. (1993). These results are in collaboration with the findings of Singh, *et al*. (1990) on guava variety 'Allahabad Safeda'., Sharma (2001) in apple., Singh, *et al*. (2003) in pomegranate cv. Jalore Seedless., Babu *et al*. (2002) [3] on litchi trees., Ruby *et al*. (2001) fruit cracking in litchi., Pathak *et al*. (2011) in banana.

Table 1: Effect of Boron and Zinc on vegetative growth characters.

Treatments Details	Plant height (cm)	Number of secondary branches / Plant	Canopy of plant east-west (cm)	Canopy of plant North-south (cm)	Number of flowers/plant	Number of flowers drop /plant	Total number of fruit set /plant	Total number of fruit drop /plant
	120 DAT	120 DAT	120 DAT	120 DAT	120 DAT	120 DAT	120 DAT	120 DAT
T_0 (Control)	165.23	34.00	113.00	112.00	13.67	1.00	0.33	0.00
T_1 (Zinc @ 0.3%)	183.00	39.00	153.00	156.33	8.00	0.00	0.67	0.33
T_2 (Zinc @0.5%)	207.00	39.67	114.33	118.00	16.33	1.33	1.00	1.00
T_3 (Boron @ 0.2%)	219.00	75.67	163.00	159.33	0.33	0.00	0.00	0.00
T_4 (Boron @ 0.5%)	138.33	71.00	124.00	129.67	5.00	2.33	0.33	1.00
T_5 (Zinc @ 0.3% + Boron @ 0.2%)	169.33	74.67	159.67	125.33	14.00	0.00	0.00	0.00
T_6 (Zinc @ 0.3% + Boron @ 0.3%)	133.33	51.33	124.00	126.00	5.33	0.00	0.67	0.00
T_7 (Zinc @ 0.5% + Boron @ 0.2%)	267.00	85.00	180.67	170.00	5.00	2.00	1.67	1.00
T_8 (Zinc @ 0.5% + Boron @ 0.3%)	163.33	68.67	128.00	126.67	0.00	0.00	1.33	1.33
CD at 5% (P = 0.05)	10.995	3.343	2.575	3.118	1.102	1.102	1.049	1.056
SE (m) ±	3.636	1.106	0.852	1.031	0.364	0.364	0.347	0.428

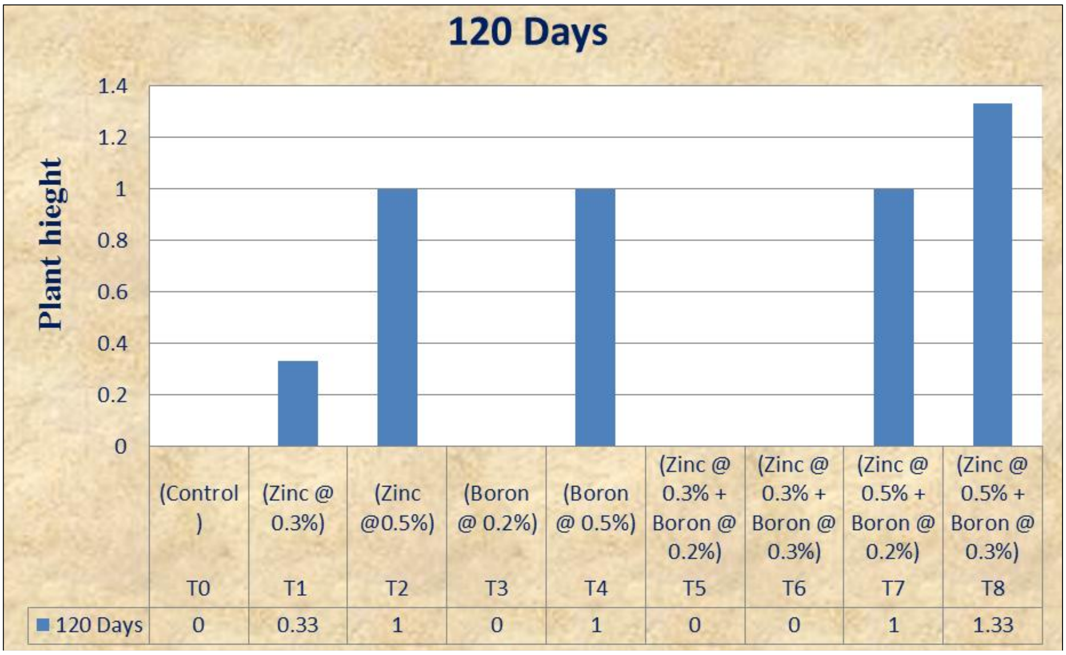

Fig 1: Plant height (cm) after 120 Days

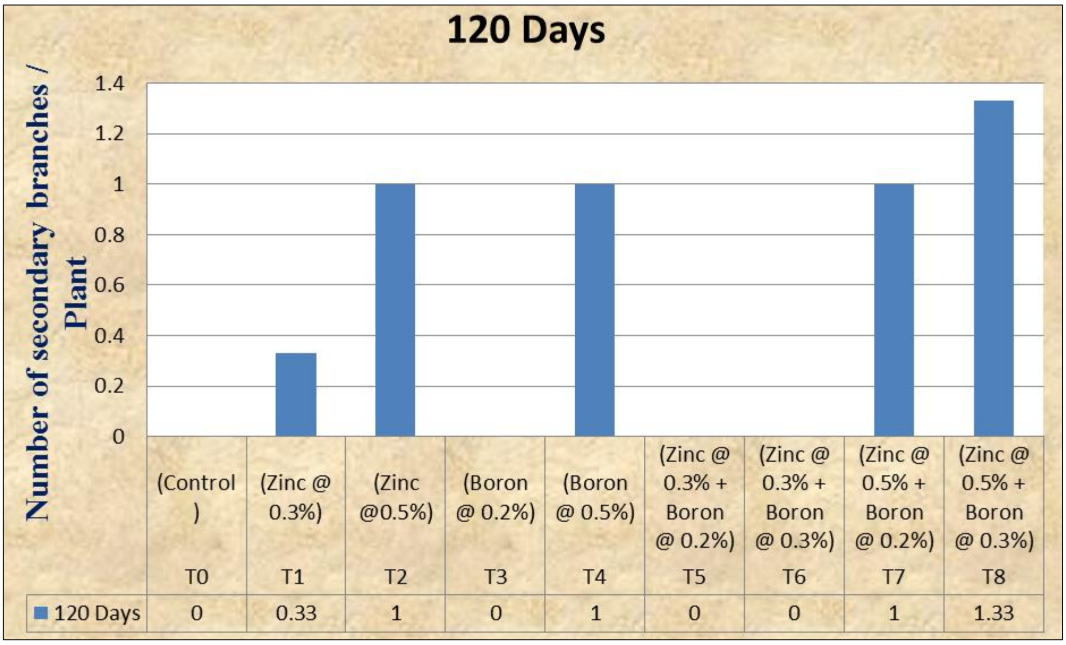

Fig 2: Number of secondary branches / Plant

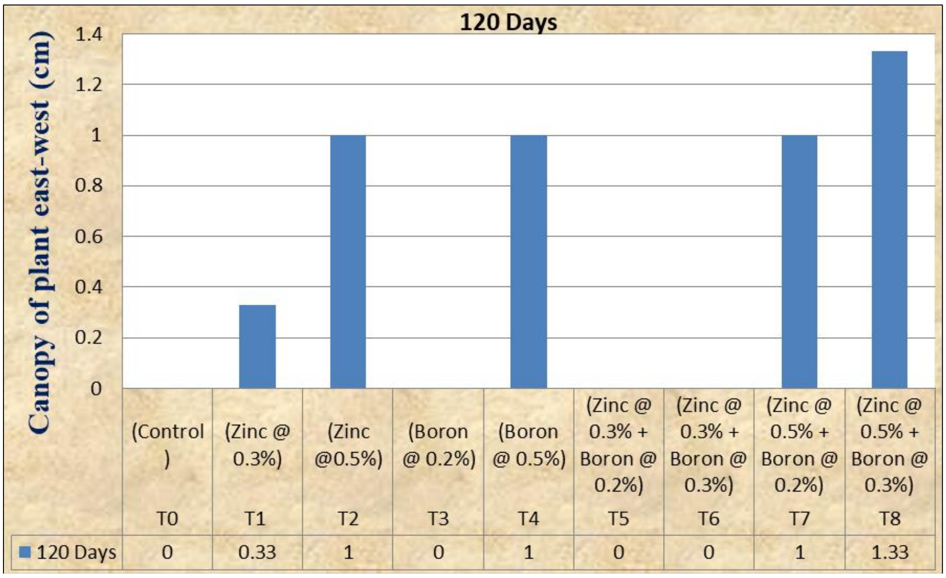

Fig 3: Canopy of plant east-west (cm)

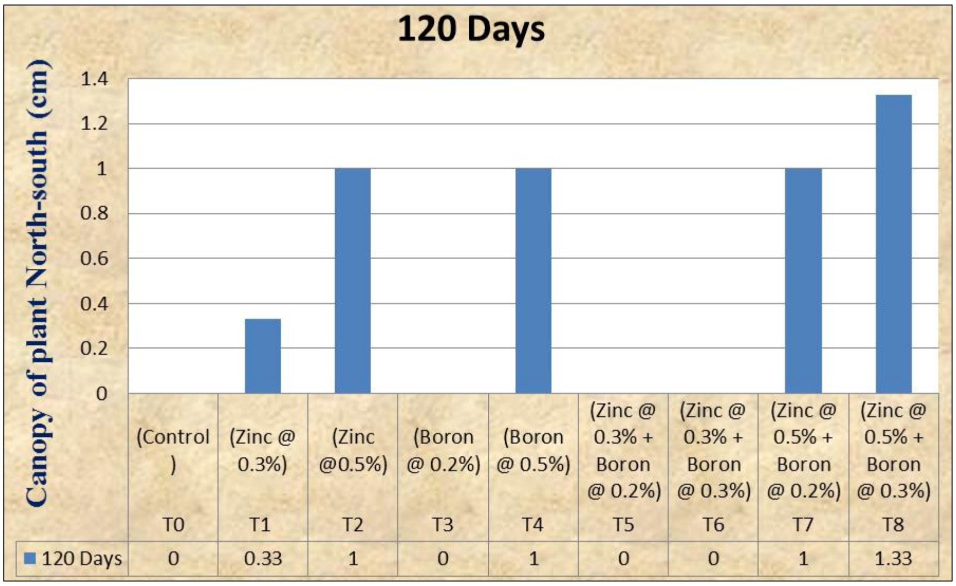

Fig 4: Canopy of plant North-south (cm)

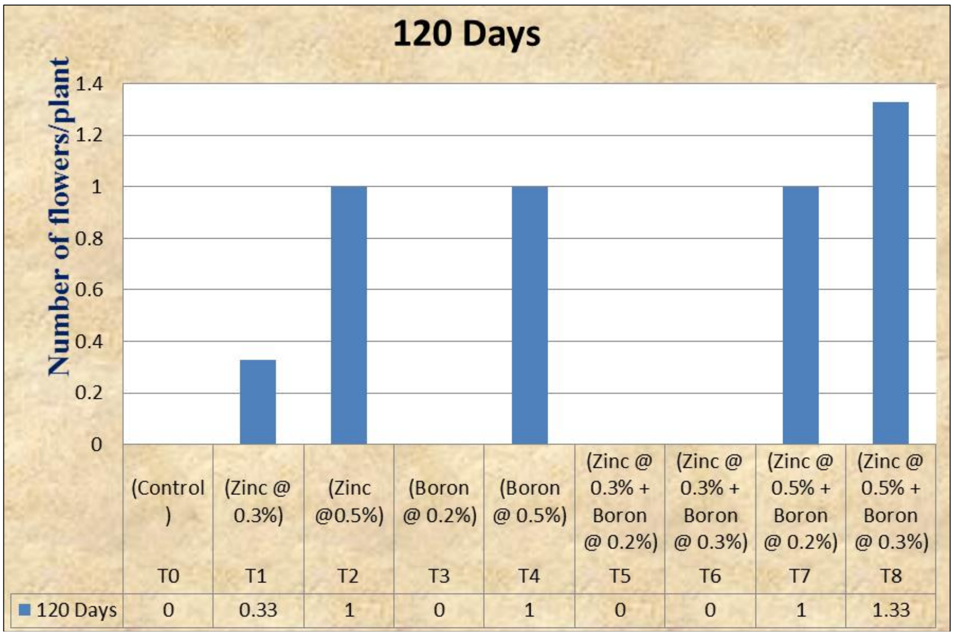

Fig 5: Number of flowers/plant

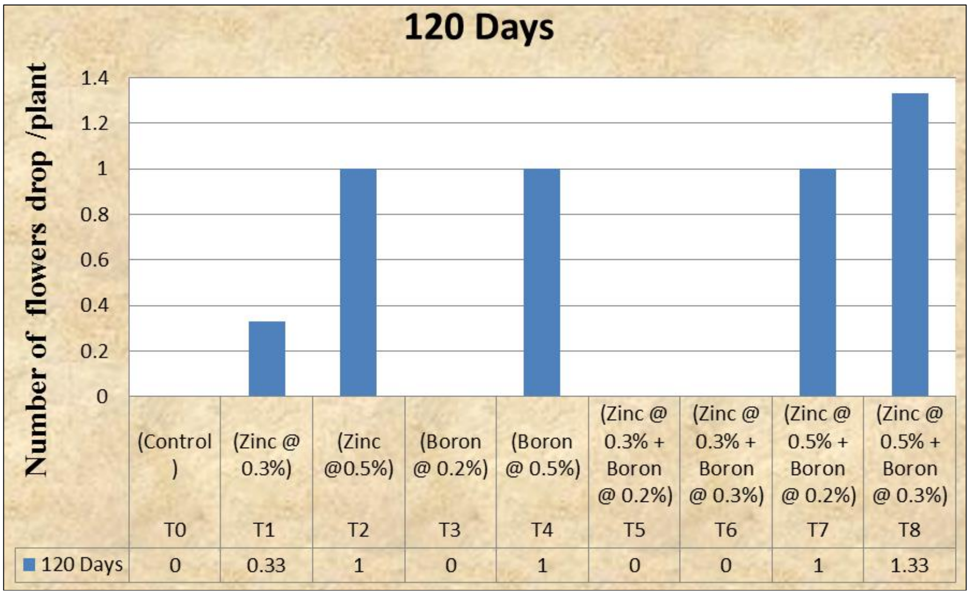

Fig 6: Number of flowers drop /plant

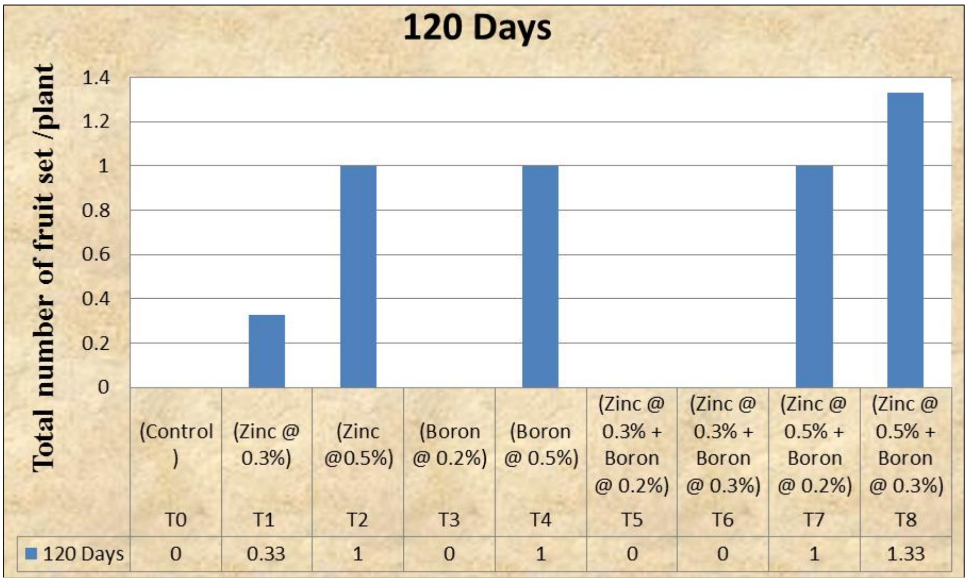

Fig 7: Total number of fruit set /plant

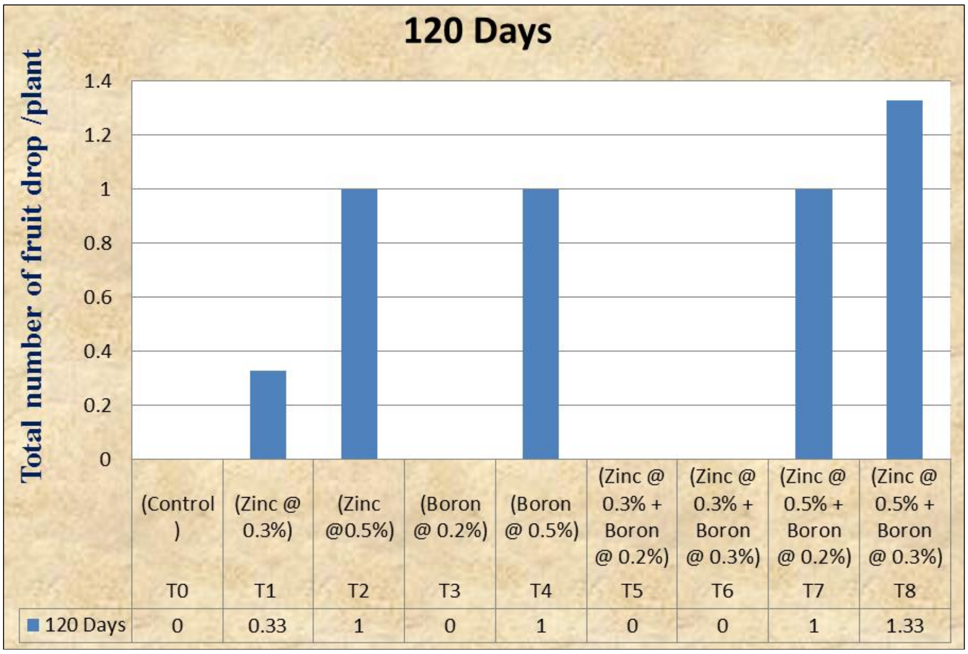

Fig 8: Total number of fruit drop /plant

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