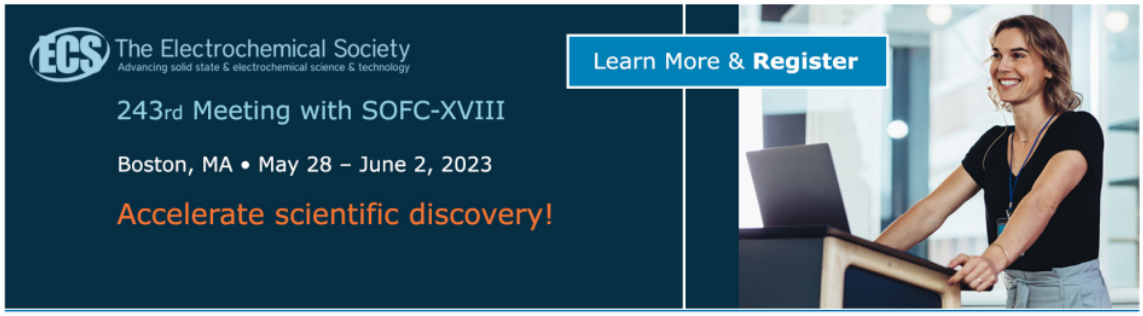
# Purwantoro_2022_IOP_Conf._Ser.__Earth_Environ._Sci._1104_012014

*by* Prodi Agroteknologi

**Submission date:** 25-May-2023 10:32AM (UTC+0700)
**Submission ID:** 2101322526
**File name:** wantoro_2022_IOP_Conf._Ser.__Earth_Environ._Sci._1104_012014.pdf (656.03K)
**Word count:** 5151
**Character count:** 25176

# Effect of Boron and Pruning on Tomato (*Lycopersicum Esculentum Mill*) Production and Quality





# Effect of Boron and Pruning on Tomato *(Lycopersicum Esculentum Mill)* Production and Quality

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**Abstract.** Tomato plant (Lycopersicum esculentum Mill) is a plant that is widely cultivated in Indonesia, has a special taste, a blend of sweet and sour, making tomatoes as one of the fruits that have many enthusiasts. Consumption of fresh and processed tomatoes increases along with the increasing population and public awareness of the importance of nutrition. Until now the productivity of tomatoes is still quite low when compared to its potential. This study aims to find out the effect of boron fertilizer and stem pruning on the production and quality of tomatoes. The research was conducted in the greenhouse of Sukodono Village Agricultural Extension Center, Sukodono Subdistrict, Sidoarjo Regency and further observations were conducted in the Agrotechnology laboratory of Muhammadiyah University of Sidoarjo. Implementation starts from October 2020 to January 2021. The study used a randomized design of factorial groups consisting of 2 factors. The first factor of boron fertilizer dose with a level of 0 kg, 1kg, 2 kg and 3 kg / ha. The second factor of pruning is without trimming armpit shoots and with trimming of armpit shoots. From both factors obtained 8 combinations of treatment and repeated as much as 3 times. The data obtained is analyzed using variety analysis, and if the results of the variety analysis are different real and very real followed by the BNJ test to find out the difference in each treatment. The results of the study showed that there was an interaction in the observation of plant height, leaf area, and sweetness, the treatment of boron doses had a noticeable effect on the amount of fruit, fruit weight, plant height, leaf area, sweetness and hardness of the fruit. Pruning treatment has a noticeable effect on plant height, leaf area, hardness, sweetness, amount of fruit, average weight of fruit. However, the treatment of boron fertilizer doses and pruning had no noticeable effect on the content of vitamin C and the amount of chlorophyll of the leaves. The results showed that the treatment of 2kg / ha boron fertilizer dose and pruning resulted in better tomato production and quality.

**Keywords:** Boron; Quality; Pruning; Tomatoes

## 1. Introduction

Tomato plant *(Lycopersicum esculentum Mill)* one of the plants that are often cultivated in Indonesia, has a special taste, a special blend of sweet and sour taste, making tomatoes as one of the fruits that have many enthusiasts. Tomatoes can be enjoyed in fresh form or hammering industrial processes. Nutritional kandugan in tomatoes are believed to ward off various abusers, especially those related to free radicals. Consuming tomatoes regularly and continuously can reduce the risk of prostate cancer. This tomato plant counts seasonal plants that are approximately 3-4 months old. Consumption of fresh and processed tomatoes increases as the population increases and public awareness of the importance of balanced nutrition[12]. Until now the productivity of tomatoes is still quite low by 16.09 - 18.63 tons / ha in 2015 to 2019 when compared to its potential that can reach 20 - 30 tons / ha [3]. One of the efforts that can be done to improve quality and quantity is fertilization. Fertilization is

an attempt to repair or add certain materials to the soil with the aim to improve soil fertility by adding nutrients. One element that can increase productivity results in plants is boron. Boron in soil types in the tropics is generally very limited both in number and availability also for plants. The addition of boron can increase the content of chlorophyll and the amount of stomata so that it will affect photosynthesis and be able to produce optimal asymli and increase food reserves (protein, fat, carbohydrates) in seeds. Boron is a micro nutrient that has a role in carbohydrate transport, so the addition of boron can increase asymptolic transport for plant growth and development [27]. In addition to fertilization to get optimal production, pruning is needed. Pruning is done by cutting excessive shoots so that they become certain shapes that are expected to increase efficiency in the absorption of sunlight and reduce the process of respiration. Pruning is also the goal so that the leaves of the plant are not overlapping which results in bright green plant leaves that indicate chlorophyll is not formed in optimal amounts. Pruning also aims to have food from photosynthesis in plants focused on fruit development[10].

## 2. Method

### 2.1 Place and time

The study was conducted for 4 months from October 2020 to January 2021. The research was conducted at the greenhouse of Sukodono Village Agricultural Extension Center, Sukodono Subdistrict, Sidoarjo Regency with a place height of 7 mdpl, temperature 25-31ºC, rainfall of 2064 mm / year and soil acidity of 6.6. Further observations were made in the laboratory of Agrotechnology and Food Products Technology, Universitas Muhammadiyah Sidoarjo.

### 2.2 Materials and Tools

Tomato servo seeds, compost fertilizer (petroganik) 10 tons / ha , boron borate fertilizer 48 cap wasps, fertilizer SP-36, UREA, KCl and soil. Polybag size 35x35cm, cethok, bucket, gembor, wood, slicer, scissors, digital scales, meter, camera, bullpoint and label paper, water, ethanol akuades soil. Tools used polybag, cethok, bucket, gembor, wood, ruler, scissors, scales, meter, hp, bulpoint, label paper, pipette, pumpkin erlenmeyer, spectrophotometer, refractometer, measuring glass.

### 2.3 Research design

This study uses the RandomIzed Group Design (RAK) method compiled factorial, from 2 treatment factors, namely the dose of boron fertilizer and the pruning of armpit shoots. The treatments used in this study were control (0kg),B1 (1 kg/ha), B2 (2 kg/ha) and B3 (3kg/ha). Planting media uses a mixture of soil and compost fertilizer (petroganik). soil and compost in a mixture evenly inserted in a polybag size of 35cmx35cm and labeled according to the treatment. The medium is mixedwith basic fertilizer in this case SP-36 and left one week with periodic watering.

**a) Planting**

After the seeds are rejuvenated aged 3-4 weeks and the number of leaves reaches 3-4 strands of leaves, tomato seeds are ready to be transferred into a polybag. Watering and fertilizin Boron is applied every 2 times of a 14-day-old plant and 25 dap at a predetermined total dose. Sp-36 fertilization (250 Kg/Ha) is given when soil, ZA and KCl fertilizers are given at 10 dap and 35 dap (Fertilizer doses 450 Kg/Ha ZA and 100kg/hectare KCl). Watering is done every day in the morning and evening.

**b) Installation of Ajir and Weeding**

How to install anjir using a log that is plugged into the planting medium in a polybag. The salting using bamboo as high as 90 cm is done two weeks after planting. Clean the polybag regularly or once a week by removing weeds or weeds growing around the harvestingpolybag.

**c) Trimming**

Pruning is performed by cutting armpit shoots on plants aged 40 and 55 days.

**d) Pest and Disease Control**

Pest control of the disease is carried out if the tomato plant has indications of an attack. Control is carried out by spraying pesticides with doses as recommended on the packaging label.

**e) Harvest**

Harvesting is done at the maturity level of tomato broken color (62-65dap).

## 3. Results and Discussions

### 3.1 Plant Height

The results of the analysis of the wide variety leaves on the treatment of doses of boron fertilizer and pruning of armpit shoots there is intercation at the age of 50 dap, 60 dap and 70 dap. The table of analysis of the variety of boron fertilization and pruning treatments can be seen in appendix 4. To find out the difference from each treatment is carried out further tukey range test levels of 5%.

**Table 1.** Observations are high at ages 10, 20, 30, 40, 50, 60, 70 and 80 dap.

| Treatment | Observation Time (DAP) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 50 | 60 | | 70 | | 80 | |
| P0B0 | 8.57 | 18.53 | 34.00 | 41.83 | 63.00 | 73.47 | a | 86.77 | a | 108.10 | a |
| P0B1 | 8.63 | 18.40 | 33.70 | 41.67 | 60.33 | 76.93 | ab | 89.77 | ab | 112.00 | ab |
| P0B2 | 8.43 | 18.83 | 35.23 | 46.00 | 66.50 | 84.50 | c | 95.00 | abc | 119.10 | abc |
| P0B3 | 8.77 | 18.53 | 33.73 | 45.00 | 64.67 | 80.40 | ab | 96.43 | b | 123.80 | bc |
| P1B0 | 8.77 | 18.43 | 34.73 | 41.33 | 67.50 | 83.17 | b | 95.77 | bc | 124.07 | bc |
| P1B1 | 8.20 | 18.80 | 34.43 | 48.07 | 66.07 | 79.23 | ab | 94.50 | ab | 121.00 | bc |
| P1B2 | 8.70 | 18.70 | 35.90 | 47.83 | 70.00 | 85.67 | c | 110.10 | d | 127.03 | c |
| P1B3 | 8.73 | 18.60 | 35.60 | 47.67 | 65.57 | 81.70 | b | 100.33 | c | 123.67 | bc |
| BNJ 5% | tn | tn | tn | tn | tn | 7.40 | | 8.35 | | 12.72 | |

Description: numbers accompanied by the same letter in the same column show no real difference on the tukey range test levels of 5%
tn: Different is not real.

The tukey range test levels of 5% results showed that the combination of P1B2 treatments produced the highest planting in observations aged 60-80 dap, where in observations of age 70 the results were different from other combinations of treatments, but in observations of ages 10, 20, 30, 40 and 50 dap the results were no different compared to other treatment combinations.

### 3.2 Leaf Area

**Table 2.** Extensive observation of leaves at ages 10, 20, 30, 40, 50, 60, 70 and 80 dap

| Treatment | Age (DAP) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 50 | | 60 | | 70 | | 80 |
| P0B0 | 2.93 | 10.73 | 20.87 | 26.40 | 29.43 | a | 42.73 | ab | 46.17 | a | 47.17 |
| P0B1 | 2.93 | 11.33 | 19.90 | 25.03 | 27.87 | a | 40.83 | a | 45.17 | a | 49.40 |
| P0B2 | 2.97 | 12.33 | 21.20 | 29.33 | 30.07 | ab | 44.20 | ab | 46.23 | a | 50.27 |
| P0B3 | 2.93 | 12.10 | 20.80 | 29.07 | 30.43 | ab | 45.83 | bc | 47.83 | a | 56.83 |
| P1B0 | 3.00 | 10.47 | 21.70 | 28.27 | 28.93 | a | 43.17 | ab | 45.83 | a | 52.97 |
| P1B1 | 3.03 | 11.20 | 22.17 | 30.20 | 29.83 | ab | 43.17 | ab | 48.83 | ab | 54.17 |
| P1B2 | 3.23 | 11.67 | 22.90 | 32.30 | 33.23 | b | 48.33 | c | 55.07 | b | 55.33 |

| Treatment | Age (DAP) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | | 20 | | 30 | | 40 | | 50 | | 60 | | 70 | | 80 | |
| P1B3 | 2.93 | | 12.13 | | 22.07 | | 31.93 | | 33.27 | b | 53.40 | d | 56.87 | b | 57.00 | |
| BNJ 5% | tn | | tn | | tn | | tn | | 2.94 | | 4.85 | | 6.82 | | tn | |

Description: the number accompanied by the same letter shows no real difference on the tukey range test levels of 5%.

tn (tidak nyata) : Different is not real.

The results of the analysis of the wide variety of leaves on the treatment of doses of boron fertilizer and pruning of armpit shoots there is intercation at the age of 50 dap, 60 dap and 70 dap. In doses of boron fertilizer differently is very real at the age of 40 and 80 dap. The table of analysis of the variety of boron fertilization and pruning treatments can be seen in appendix 4. To find out the difference from each treatment is carried out further test BNJ 5%. Tukey range test levels of 5% result showed that the combination of P1B3 treatments produced the highest tanmaan in observations of age 40-80 dap, where in observations of age 60 the results were different from other combinations of treatments, but in other age observations the results were no different compared to other treatment combinations.

### 3.3 Save Power

**Table 3.** Observation of the effect of boron fertilizer on the shelf life of the fruit

| Treatment | Shelf life of fruit (day) | |
|---|---|---|
| B0 | 34.50 | a |
| B1 | 34.67 | a |
| B2 | 40.83 | b |
| B3 | 38.83 | b |
| bnj 5% | 2.76 | |
| PO | 37.83 | |
| P1 | 36.58 | |
| BNJ 5% | TN | |

Description: Numbers accompanied by the same lowercase letter show different unreal. tn: not real

The results of the 5% BNJ test of boron fertilizer doses and trimming of armpit shoots on variable observation of fruit shelf life showed that the B2 treatment produced the longest fruit shelf life (40.83) although it was not real different from B3, while B0 treatment produced the lowest fruit hardness although not real difference from B1. The P0 treatment produces a longer shelf life (37.83) but is no different from the P1 treatment.

### 3.4 Sweetness

**Table 4.** Observation of the effect of boron fertilizer on sweetness

| D | N | | | | | | | | BNJ 5% |
|---|---|---|---|---|---|---|---|---|---|
| | B0 | | B1 | | B2 | | B3 | | |
| P0 | 4.67 A | A | 4.70 a | A | 5.43 a | B | 4.77 a | A | 0.65 |
| P1 | 5.00 A | A | 5.40 b | A | 5.57 a | B | 5.83 b | B | |
| BNJ 5% | 0.48 | | | | | | | | |

Description: Numbers accompanied by the same lowercase letter on the column and the same uppercase letter on the same row indicate a different unreal.

BNJ test results 5% against tomato sweetness variables. In P0 treatment the B3 treatment produces the highest plants although not different from B0 and B2, the B1 treatment produces the lowest plants although not different from the B0 and B2 treatments. In P1 treatment the B3 treatment produces the highest plant but is not different from the B2 treatment. In B0 treatment the P0 treatment produces the same plant height as P1. But in B1, B2 and B3 P1 treatment produces plants that are higher and different than P0 treatment. Pruning is the activity of reducing branch stems or fruit with the aim of increasing the efficiency of the use of photosynthetic results. The weight of the fruit per grain can increase when a reduction in the number of fruits is made. This can happen because the less fruit per plant, the more asymilat received per fruit will be. If the carbohydrates received per fruit are many then the starch substances converted into sugar will be higher so as to give sweet fruit flavor to the fruit The application of boric acid increases the parameters of tomato growth significantly due to increased photosynthetic activity and metabolic activity under the application of B. Tomato quality parameters such as lycopene, ascorbic acid, coarse protein and total soluble sugar also increase significantly, and fruit yields increased compared to controls due to the application of boron [28].

### 3.5 Fruit Violence

**Table 5.** Observation of the effect of boron fertilizer on fruit hardness

| Treatment | Fruit violence | |
|---|---|---|
| B0 | 6.47 | a |
| B1 | 6.78 | ab |
| B2 | 6.92 | b |
| B3 | 7.09 | b |
| bnj 5% | 0.43 | |
| PO | 6.80 | |
| P1 | 6.83 | |
| BNJ 5% | TN | |

Description: Numbers accompanied by lowercase letters that show different are not real. tn: not real

The results of the 5% BNJ test of boron fertilizer doses and cutting of armpit shoots on the total observation variable of the number of fruits per tree showed that the B3 treatment produced the hardest fruit (7.09) although it was not real different from B1 and B2, while the B0 treatment produced the lowest fruit hardness although not real difference from B1. The P1 treatment produces harsher fruit (6.83) but is no different from the P0 treatment. According to Marschner boron can affect cell walls and cell wall interfaces of plasma membranes, metabolism, reproductive growth and development, and root lengthening and budding growth of growing plant structures. Boron plays an important role as a constituent of the cell wall because it binds to polysaccharide compounds (sugars) forming the cell wall pectin. According to Rab and Haq's research[26] it was found that the application of boron leaves significantly increased the number of flowers per cluster, fruit per plant and fruit per plant, fruit weight, fruit hardness and total dissolved solid content in fruit.

### 3.6 Number of Fruits

**Table 6.** Observation ofboron fertilizers against the amount of fruit

| Treatment | Number of fruits | |
|---|---|---|
| B0 | 32.83 | a |
| B1 | 35.17 | ab |
| B2 | 37.50 | b |
| B3 | 36.33 | b |
| BNJ 5% | 3.34 | |
| PO | 38.83 | b |
| P1 | 32.08 | a |

| Treatment | Number of fruits |
|---|---|
| BNJ 5% | 1.742851 |

Description: Numbers accompanied by different lowercase letters are not real on the 5% BNJ test.

The results of the BNJ test of 5% of boron fertilizer doses and pruning of armpit shoots on the total observation variable of the number of fruits per tree showed that the B2 treatment produced the most amount of fruit (37.50) although it did not differ markedly from B3 and B1, while the B0 treatment produced the least total number of fruits per tree although not real difference from B1. The P0 treatment produces a total of more fruit (38.83) and differs very markedly from P1. Tomatoes come from the success of the flower organ in the process of falling pollen above the pistil head so that it forms a tomato flower is the source of fruit, if the deciduous flower will affect the many or a bit of fruit formed so that at the time of harvest does not get optimal results. This is in accordance with the opinion of Praveena et al..[23] which states that the addition of boron is able to increase the formation of flowers, vertility of pollen, and seeds. The results of the 5% BNJ test of boron fertilizer doses and pruning of armpit shoots on the variable observation of the total number of fruits per tree showed that the B2 treatment produced the most total fruit weight (1315.83) although it did not differ markedly from B3, while the B0 treatment produced the least total number of fruits per tree although not real difference from B1. The P1 treatment produces a total of more fruit (1235.50) and differs very markedly from P0.

### 3.7 Weight of the Solid Fruit

**Table 7.** Observation of the effect of boron fertilizer on the total weight of the land

| Treatment | Number of fruits | |
|---|---|---|
| B0 | 1108.83 | a |
| B1 | 1158.33 | abc |
| B2 | 1315.83 | c |
| B3 | 1275.50 | bc |
| bnj 5% | 157.00 | |
| PO | 1193.75 | |
| P1 | 1235.50 | |
| BNJ 5% | tn | |

Description: Numbers accompanied by different letters are not real. tn: no different real

Boron fertilization with certain concentrations is also believed to play a role in aiding better absorption and transport of photosynthetics[17]. According to Aref[2], boron has an effect on the formation and proliferation of cambium cells and impaired differentiation of xylem. Xylem is responsible for increased absorption of nutrients and contributes to nutritional mobility so that food needs in the tissues formed are fulfilled. B fertilization significantly improves home tomato yield [5].

### 3.8 Average Weight of the Fruit

The results of the 5% BNJ test of boron fertilizer doses and trimming of armpit shoots on the average weight observation variable of the fruit showed that the B3 treatment produced the heaviest average fruit (35.73) although it was not real different from B0, B1 and B2. The P1 treatment produces a total of more fruit (38.54) and differs very markedly from P0. Pruning is one of the factors that help in increasing the number of flowers, fruit and weight of the fruit. In general, pruning serves to rejuvenate the plant, form plants, arrange for sunlight to enter the header evenly so that the leaves are more productive in producing food, increase the plant to produce fruit, encourage the plant to form new leaves and remove unwanted parts. So it is suspected that there is a pruning effect on the weight of fruit per plant carried out on tomato plants. In baihaqi et al research,[4] stated that pruning aims to increase productivity so that it can spur production, to achieve efficiency of sunlight utilization so that plants are able to achieve high productivity that will affect the number and quality of fruit.

**Table 8.** Observation of the effect of boron fertilizer on the average weight of the fruit

| Treatment | Flat weight | |
|---|---|---|
| B0 | 34.23 | |
| B1 | 33.44 | |
| B2 | 35.25 | |
| B3 | 35.73 | |
| BNJ 5% | tn | |
| PO | 30.79 | a |
| P1 | 38.54 | b |
| BNJ 5% | 2.54 | |

Description: The number accompanied by the same lowercase letter shows an unreal difference in the 5% BNJ test. tn (tidak nyata) : not real.

### 3.9 Vitamin C

**Table 9.** Dose of boron fertilizer and pruning of vitamin C content.

| Treatment | Average weight |
|---|---|
| B0 | 16.03 |
| B1 | 22.00 |
| B2 | 23.76 |
| B3 | 20.04 |
| P0 | 19.51 |
| P1 | 21.41 |

Description: tn (no different real)

Vitamin C (ascorbic acid) is the simplest vitamin, easily changed by oxidation, but very useful for humans. According to Wijayani and Wahyu [33], said the content of vitamin C in a fruit is closely related to the genetic properties and function of elemental nitrogen for plant metabolism Vitamin C is easily damaged due to oxidation processes, especially at high temperatures. With the provision of boron fertilizer of B1 can increase the amount of vitamin C 37% compared to B0. Further increase in boron administration (B2) can still increase the content of vitamin C compared to B1. But the next increase in boron dose (B3) even lowered the content of vitamin C in tomatoes by 15%.

### 3.10 Amount of chlorophyll

The results of the analysis of the variety of boron fertilizer treatment and the pruning of armpit shoots showed no interaction and there was no real difference there were all treatments.

**Table 10.** Dose of boron fertilizer and pruning of the amount of chlorophyll

| Treatment | Flat weight |
|---|---|
| B0 | 15.26 |
| B1 | 19.74 |
| B2 | 21.49 |
| B3 | 10.69 |
| P0 | 14.69 |
| P1 | 18.90 |

Description: tn (no different real)

The results of the BNJ test of 5% of the dose of boron fertilizer and the pruning of armpit shoots observation of the amount of chlorophyll by giving boron fertilizer with a dose of 2kg / ha resulted in a better amount of chlorophyll than the control. With the provision of boron fertilizer can increase the absorption of nutrients by plants (Matas et al. 2009 in Sugianto, et al. 2014). This is because by giving

boron, nutrients contained in the soil, especially nitrogen nutrients which are chlorophyll forming elements can be absorbed optimally.

## 4. Conclusion

There was an interaction of boron fertilizer dose and pruning of water buds on observations of plant heights of 60, 70 and 80 DAP. Interactions occur in leaf area occur at the age of 50.60 and 70 dap and at the level of sweetness there is also a real interaction. The treatment of boron fertilizer doses showed a noticeable effect on variable observation of plant height, area of sweetness leaves, hardness of fruit, amount of fruit, weight of the ground fruit. While the pruning treatment showed a noticeable influence on the variable observation of plant height, the area of sweetness leaves, the number of fruits, average weight.

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