

Research Article

The Influence of AB Mix Concentration and Types of Wicks on Brix Value in Cherry Tomatoes (*Solanum lycopersicum* var. *cerasiforme*) by Hydroponic Wick System

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Abstract.

Hydroponic technologies offer an alternative way to cultivate cherry tomatoes in times when a downfall is seen in productive agricultural land. This research aims to know the correlation between the Brix value of cherry tomatoes and AB mix concentration by a hydroponic wick system. The research method used was an experimental method using a factorial Randomised Block Design. The treatments consisted of K1 = 1900 ppm, K2 = 2700 ppm, K3 = 3500 ppm, S1 = felt, S2 = wool yarn, S3 = stove wick, S4 = cotton rope. Each treatment was repeated thrice. The result showed that the concentration of AB mix solution at 3500 ppm (K3) gave a better result than other concentrations, with an average percentage of Brix valued at 8.71%. At the same time, using felt (S1) as a wick showed the best result with the average percentage of Brix valued at 8.02%. The correlation analysis of AB mix concentration and Brix value resulted in a coefficient of 0.61 which showed a strong correlation between the two variables. This indicates that different levels of concentration of AB mix solution can influence the Brix value of cherry tomatoes.

Keywords: hydroponic cherry tomatoes, ab mix concentration, wick system correlation

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1. Introduction

Cherry tomato cultivation is generally conducted conventionally. Technological developments in plant cultivation have an impact on changing cherry tomato cultivation from conventional to hydroponic cultivation. Several techniques in hydroponic cultivation can be applied to cherry tomatoes, one of which is the hydroponic wick system. The wick system is a system that utilizes the capillary action of wicks to distribute the nutrients needed by plants. Several types of materials can be used as wicks including felt, wool yarn, stove wick, and cotton rope.



Capillarity is the process of the ascension and descension of a liquid which are influenced by the adhesion and cohesion forces on the liquid and the vessel walls. Capillarity is the ability of liquids to absorb into the fine pores of fabric that have been wetted and transferred to the surface that has not been exposed to wetness [1]. The capillarity of the fabric is greatly influenced by the properties of the fibre. Therefore, the type of material and its composition are determined by the properties of the fibre.

Hydroponic cultivation of plants is strongly influenced by sources of nutrients made from dissolved chemicals or organic matter, a healthy environment for roots to grow and develop, as well as the pH of water and dissolved oxygen [2]. In general, the nutrients used are in the form of a solution called AB mix. Hydroponic cultivation of tomato plants requires nutrients with a concentration of 1,400-3,500 ppm of AB mix solution with sufficient macro and micronutrients [3].

The level of concentration on each wick affects the value of Brix obtained by the fruit. The Brix value serves to show the sugar content in the fruit which resulted in the sweet taste. There is a correlation between the Brix value and the concentration of the AB mix solution. Increasing the concentration of nutrient solution in an appropriate amount would greatly affect the growth and production of these plants [4]. Which in this case could indicate that different concentration levels can also affect the Brix values obtained by the fruit of these plants. The study conducted by Hohjo et al. [5] suggests that to produce fruits with high Brix values (sugar content), high nutrient concentrations are needed. Therefore, to increase the production of tomato fruits with high sugar content, it is recommended to maintain nutrient concentration at a certain concentration level [5].

Based on the description above, a study was conducted on the correlation of AB mix application and wick type with hydroponic wick system on Brix value of cherry tomato plants (*Solanum lycopersicum* var. *cerasiforme*) to determine the relationship between AB mix concentration and Brix value in cherry tomatoes.

2. Materials and Method

2.1. Location, time, and materials

The research was conducted at Badan Penerapan Standardisasi Instrumen Pertanian Banten, Kabupaten Serang, Banten. The research was carried out from January – May 2023. The tools used in this study included a TDS meter, 20cm×30cm bucket, 10

cm diameter net pot, thread, ruler/meter, hand refractometer, hand spray, seedling tray, scales, measuring cups, stationery, labels, and cameras. The materials used in this study included tomato seeds of the Chung variety, rock wool, husk charcoal, felt, cotton cloth, stove wick, cotton rope, AB mix nutrition, and water.

2.2. Research and design

This study used a factorial randomized block design consisting of 12 treatment combinations: K1S1, K1S2, K1S3, K1S4, K2S1, K2S2, K2S3, K2S4, K3S1, K3S2, K3S3, K3S4. Where: K1 = 1,900ppm; K2 = 2,700ppm; K3 = 3,500ppm; S1 = felt; S2 = wool yarn; S3 = stove wick; S4 = cotton rop. Each treatment was repeated 3 times, in total there were 36 sample units.

The data obtained were analysed using the ANOVA test at a 5% significance level, if the result showed a significant difference, it will be further tested using DMRT (Duncan Multiple Range Test). The correlation test is used to determine the relationship between 2 variables by using the Pearson Correlation Coefficient formula. The correlation formula is as follows [6]:

$$r = \frac{n(\sum XY) - (\sum X)(\sum Y)}{\sqrt{\{n.\sum X^2 - (\sum X)^2\} \{n.\sum Y^2 - (\sum Y)^2\}}} \quad (1)$$

Information:

r: Coefficient correlation value

X: Variable X

Y: Variable Y

N: Total of data

Category of Correlation:

r = 0,00 – 0,199 : very weak

r = 0,20 – 0,399 : weak

r = 0,40 – 0,599 : moderate

r = 0,60 – 0,799 : strong

r = 0,80 – 1,000 : very strong

3. Results and Discussion

3.1. Number of fruits per plant (gram)

This parameter is measured by counting the number of fruits harvested per plant. In this study, cherry tomato plants were harvested 3 times. The results of each harvest were totalled so that the production of cherry tomato plants was obtained. Data on the average number of fruits per plant in each treatment are presented in graphical form in Figure 1 and Figure 2.

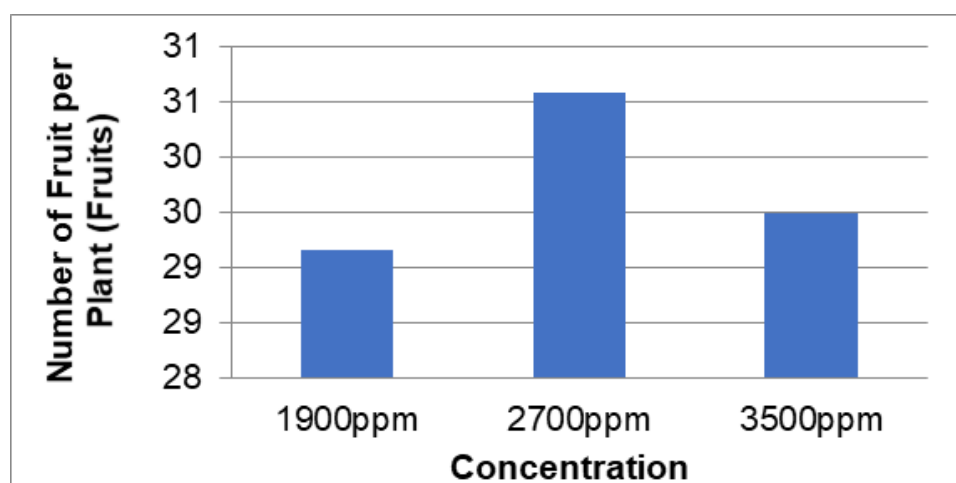


Figure 1: Average number of fruits per plant on the types of wicks.

The results presented in Figure 1 suggested that the treatment with a concentration of 2,700 ppm produces an average number of fruits that tends to show good results (31 fruits) when compared to the average number of fruits on other concentration levels. The availability of nutrients that exceed the adequacy of plant needs will cause the nutrients contained in plants to not affect crop production [7]. At the age of 8-9 WAP (Week After Planting) cherry tomato plants experience a phase of fruit formation and obtain the same dose of nutrition, in which this condition is suspected that at the age of 9 WAP cherry tomato plants begin to experience a phase of fruit ripening [8].

Figure 2 shows that cotton rope is the most effective wick in terms of producing a high number of cherry tomatoes, with an average number of 33 fruits. Cotton rope has a fairly high-water absorption capacity with a capillarity value of 0.07 cm/s. The hydroponic wick system requires wicks to absorb the available water and nutrients [9]. The capillary ability of wicks is influenced by the quality of the fibre and the size of the fibre pores. This can affect the uptake of the wick so that it can supply water and

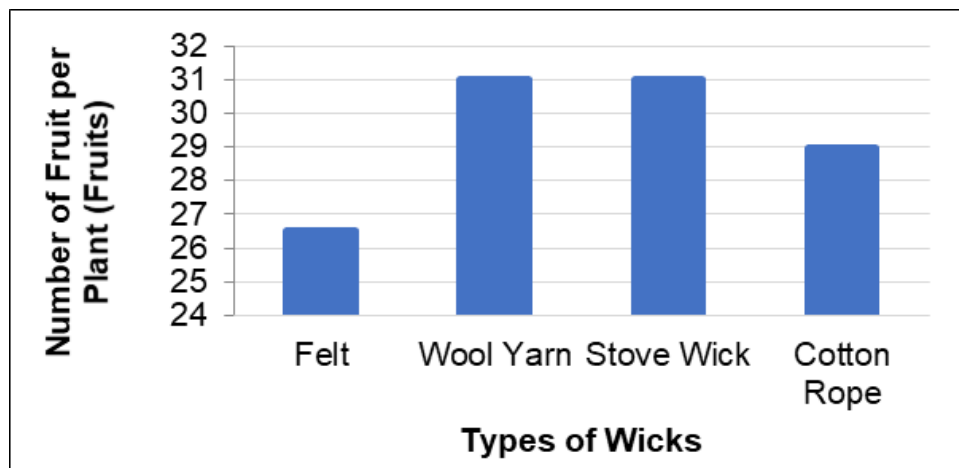


Figure 2: Average number of fruits per plant on the types of wicks.

nutrients to plants. The properties of yarn are determined by the type of yarn material and its composition [10].

3.2. Cherry tomato maturity level

The time to harvest cherry tomatoes is marked by the color of the fruit which has changed from green to red. According to the USDA (United States Standards for Grades of Fresh Tomatoes) [11], tomatoes are grouped into 6 maturity levels, namely green, breakers, turning, pink, light red, and red [12]. However, in the research conducted by Sanjaya [13], classification results consist of 5 levels namely green, turning, pink, light red, and red, where the breaker level is included within the green level because it is more dominant in dark green. This is because the breaker level only contains 10% brownish-yellow colour on its surface [14].

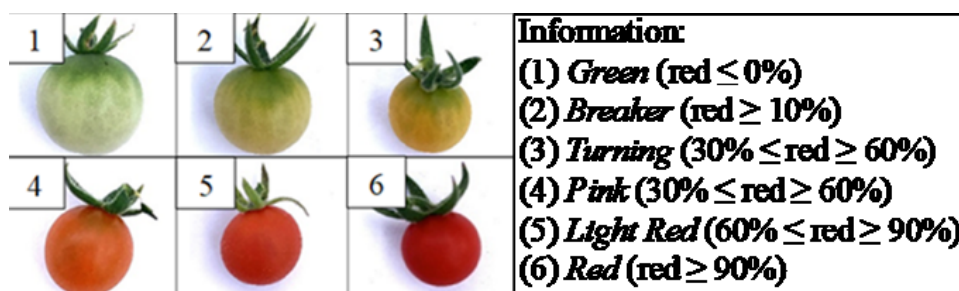


Figure 3: Colour levels of cherry tomato fruit maturity.

Based on the results, it was found that there are 6 maturity levels in cherry tomatoes as shown in Figure 3, namely green, breaker, turning, pink, light red, and red. The colour of the cherry tomatoes in Figure 3 at maturity level 1 (green) is obtained at 6 WAP (Week

After Planting), level 2 (breaker) and level 3 (turning) at 7 WAP, level 4 (pink), level 5 (light red) and level 6 (red) obtained at 8-9 WAP.

Farmers will start harvesting tomatoes at the breaker stage where at this level the fruit conditions are physiologically ripe and no longer need nutrients for fruit development. Tomatoes that have reached the breaker stage no longer need nutrients from the plants, so the fruit can be picked which can later be ripened until the fruit turns red [8]. In this research, the cherry tomatoes harvested were fruit with a red colour or at the maturity level of red (red colour $\geq 90\%$), because at this stage the cherry tomatoes are fully ripe.

3.3. Brix value (%)

In this study, the Brix value of cherry tomatoes is measured by using a hand refractometer. The cherry tomatoes that were measured in this study were harvested at the red level (red colour $\geq 90\%$). Brix value was measured after harvest. Data on the average Brix value of cherry tomatoes are presented in tabular form as follows.

TABLE 1: Average value of brix (%) of cherry tomatoes.

Concentration	Types of Wicks				Average
	Felt	Wool yarn	Stove wick	Cotton rope	
1900ppm	7,13b	6,67b	7,20b	7,07b	7,02b
2700ppm	8,67ab	9,13a	7,53b	7,67b	8,25a
3500ppm	9,07b	7,13b	9,40a	9,23a	8,71a
Average	8,29	7,64	8,04	7,99	

Table 1 shows that the combination treatment of 3,500ppm (K3) and stove wick (S3) resulted in the highest average value of Brix (9.40%). The level of sweetness in fruits is known as Brix, where the Brix value indicates the level of sucrose contained in the fruit [15]. Brix content can be expressed in percentage (%) or degrees Brix ($^{\circ}$ Brix). 1% Brix or 1° Brix is equivalent to 1 gram of sucrose sugar contained in 100 ml of water [15]. Whereas the combination treatment of 1,900ppm (K1) and wool yarn (S2) resulted in the lowest average Brix value (6.67%). Based on the results of further tests with the DMRT test at $\alpha = 0.05$, it was found that the treatment concentration of 3,500ppm (K3) showed significant differences with the concentration of 1,900ppm (K1), but did not show significant differences with the concentration treatment of 2,700ppm (K2).

Cherry tomatoes generally have Brix values ranging from 6-8%. However, based on the description of the Chung variety, in general, the Brix content of cherry tomatoes

in the Chung variety, based on observations, was 5.27% [16]. The taste and sugar content (glucose and fructose) present in the fruit are affected by the total dissolved solids, generally, the total dissolved solids in cherry tomatoes have a higher value than ordinary tomatoes [1].

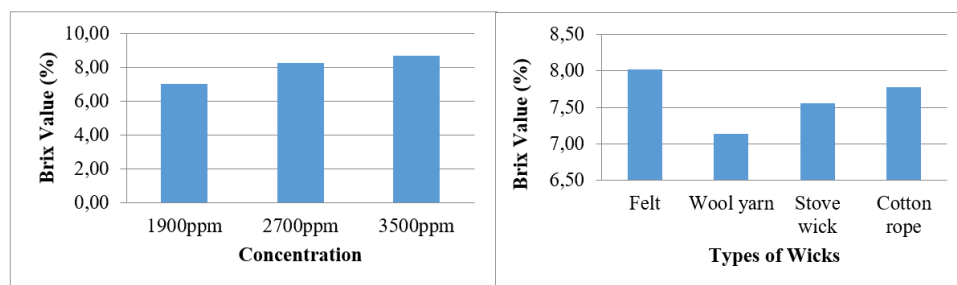


Figure 4: The average value of Brix in cherry tomatoes.

In this study, 3 level of concentrations were used and amongst the different levels of concentrations, the concentration of 3,500 ppm yielded the best results at 8.71% of Brix value compared to other concentrations. In this case, it suggests that the higher the concentration level given to cherry tomato plants, the higher the Brix value of the cherry tomatoes. The Brix value can be influenced by several factors, namely the type of plant, maturity or stage of fruit growth, water management, and plant fertility [17].

There were 4 types of wicks were used, namely felt, wool yarn, stove wick, and cotton rope. Each type of wick has a different capillarity strength. Capillary action uses a ratio of water absorption height (cm) to absorption time [12]. Based on this formula, it is found that felt has a capillary action of 0.09 cm/s; wool yarn has a capillarity of 0.08 cm/s; the wool stove wick has a capillary action of 0.07 cm/s; Cotton wool rope has a capillarity of 0.07 cm/s. Based on the graph of the average Brix value of cherry tomatoes in Figure 4, it showed that the use of felt wicks resulted in significantly better outcomes (8.02%) compared to other types of wicks. This is because felt has good capillary action (0.09 cm/s) which allows the plant roots to absorb nutrients effectively.

3.4. Correlation coefficient analysis

The relationship between the level of concentration and the Brix value of cherry tomatoes can be analyzed using correlation analysis which aims to obtain a value that indicates the relationship strength between the two variables. The results of the correlation analysis are presented in tabular form as follow Table 2.

Information:

TABLE 2: Correlation analysis of Brix content value.

	Brix Value	Wick	Concentration
Brix Value	1		
Wick	0 ⁽¹⁾	1	
Concentration	0,61 ⁽⁴⁾	0 ⁽¹⁾	1

$r = 0.00 - 0.199$: very weak (1)

$r = 0.20 - 0.399$: weak (2)

$r = 0.40 - 0.599$: moderate (3)

$r = 0.60 - 0.799$: strong (4)

$r = 0.80 - 1.000$: very strong (5)

The correlation analysis in this study showed that the correlation coefficient between the wicks with Brix value and the wicks with concentration showed a very weak correlation which indicates that there was no correlation at all between the two variables, this can be seen from the correlation coefficient obtained was valued at 0. Meanwhile, the correlation between Brix value and the concentration of the AB mix solution shows a strong correlation with a value of 0.61. The appropriate level of nutrient solution concentration will greatly affect the growth and production of plants [4]. This may indicate that different concentration levels can also affect the Brix content of the fruit.

4. Conclusion

Based on the results, it can be concluded that the concentration of AB mix solution of 3,500ppm resulted in a high value of Brix in cherry tomatoes with an average value of 8.71%. At the same time, felt as wick yields the highest Brix value with an average of 8.02%. Moreover, the correlation coefficient between Brix value and AB mix solution indicates a strong correlation (0.61) between the two variables.

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