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by Muhammad Idris

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Water Conservation with the Application of Partial Root Zone Drying Technique in Increasing the Growth and Production of Tomato

M. Idris[1,*], Imam Hartono Bangun[2], Armansyah[3], Dermawan Hutagaol[4]

[1]Faculty of Science and Technology, State Islamic University of North Sumatera Medan, Jl. Lap. Golf, Kp. Tengah, Kec. Pancur Batu, Deli Serdang Regency, North Sumatera 20353, Indonesia
[2]Department of Agrotechnology, Faculty of Agriculture, Universitas Muhammadiyah Sumatera Utara, Jl. Muchtar Basri No.3 Medan, Sumatera Utara, 20238, Indonesia
[3]Faculty of Technique, UISU Medan, Jl. Sisingamangaraja No. kelurahan, Teladan Bar., Kec. Medan City, North Sumatera 20217, Indonesia
[4]Faculty of Agriculture, Al Azhar University Medan, Jl. Pintu Air IV No.214, Kwala Bekala, Kec. Medan Johor, Medan City, North Sumatera 20143, Indonesia

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Abstract Water conservation as an effort to efficiently use water is the main goal in overcoming drought/water scarcity for agriculture. One solution to overcome this condition is to use the Partial Rootzone Drying (PRD) technique, namely water application to some of the root zones. This study aimed to obtain the effective frequency of watering, the best tomato variety, and the combination of watering and the best variety for growth and production due to the application of partial root-zone drying. The research uses factorial RBD, which consists of factor I, namely the PRD technique, and factor II, namely variation. There were 12 treatment combinations, the number of replications was 3, the number of plants/plots = 9, and the total number of plants was 324. The results showed that: The PRD method was similar to applying water to the entire root zone comparison. Varieties affect crop production but do not affect vegetative growth and nutrient uptake of tomato plants as well as combinations of several varieties and watering techniques, either by giving water to the entire root area or by the PRD method.

Keywords Drought, *Solanum Lycopersicumm* Mill, Water Stress

1. Introduction

Drought is a major global issue in the twenty-first century. Between 1970 and 2000, the fraction of the world experiencing drought more than doubled. Population expansion, pollution, and climate change are all hastening the precipitous reduction in water supply over the next few decades [1]. In March 2000, the World Water Forum II (World Water Forum) in The Hague forecasted that Indonesia would be one of the countries facing a water crisis by 2025. This crisis happened due to management mistakes, including inefficient water use and excessive water contamination [2].

Increasing water use efficiency is a key goal for researchers in the face of water scarcity and continued high water demand for agriculture [3]. These sustainable practices help achieve short-term success in managing

water resources effectively and ensure long-term sustainability [4].

Partial root-zone drying (PRD) is a potential water-saving irrigation strategy, where at each water application, only one part of the root zone is irrigated [5]. PRD can save up to 50 % water and maintain yields, as seen in several grape varieties [6]. PRD is a variation of the deficit irrigation (DI) technique, where DI is a strategy of applying less water to the root zone than full irrigation (FI), which causes mild water stress and has little effect on crop yields [7]. Plant irrigation water must be met for plant growth to be optimal from the vegetative to the generative phases [8].

PRD can increase water efficiency and even fruit quality. Depending on the crops planted, soil and environmental conditions, and irrigation methods, PRD can be employed in various ways [9].

Tomatoes are currently a horticultural commodity with high economic value but still require careful management, especially in terms of increasing yields and fruit quality [10]. Tomatoes are vegetables with high market demand. Indonesia's tomato production has approached one million tons since 2012 [11]. Tomatoes are one of the most popular fruit vegetables because they taste good, fresh, and a little sour. In addition, tomatoes that are old and red in colour are a source of vitamin A, vitamin C, and some B vitamins [12].

The application of PRD techniques has been widely developed, but research on the response of tomato growth to drought conditions still needs to be completed. Therefore, it is necessary to test the application of PRD on tomato plants' growth, yield, and quality. The hypotheses of this study were (1) the application PRD technique had no effect on the growth and yield of tomato plants, (2) variety affected the growth and yield of tomato plants, (3) the combination of various treatment and PRD techniques affected the growth and yield of tomato plants.

2. Materials and Methods

Site and Study Time

The research was conducted at the experimental garden of the UINSU Faculty of Science and Technology, State Islamic University of North Sumatera Medan, and was carried out in May - September 2021.

Materials and Equipment

The materials used in this study were Tomato seeds of the Niki F1 variety, Mira variety and Mentari variety, Straw Compost and Urea fertilizer, SP-36 and KCL, and pesticides for pest and disease control.

The tools used in this study were water pipes, meters, bells, buckets, scales, chlorophyll meters, hands prayer, hoes, machetes, saws, title boards, plot boards, and treatment boards.

Research Methods

A factorial randomized block design (RBD) with three replications and two factors was employed in this investigation is Factor I, namely the PRD technique, which consisted of four levels, namely P1 = Field Capacity with daily watering, P2 = Field capacity with interval watering once a day, P3 = Half Field Capacity with watering every day (PRD 0), P4 = Half Field Capacity with watering once a day interval (PRD 1). Factor II. namely variety (V) consists of three varieties: V1 = Mira variety, V2 = Mentari variety, and V3 = Niki F1 variety. There were 12 treatment combinations, the number of replications was 3, the number of plants/plots = 9, and the number of plants was 324.

Research Procedures Research

Implementation included land preparation, nursery, planting of seeds, fertilizing, and plant maintenance (insertion, watering, weeding, pest and disease control), harvesting.

Observation Variable

Data collection was carried out by measuring several parameters on tomato plants (*Solanum lycopersicum*), which are:

1. Plant height (cm)

Plant height is measured from the stem's surface to the plant's tip. Plant height was measured at 1, 2, 4, 6, and 8 week after plant (WAP).

2. The Number of Leaves (Sheet)

The number of leaves of tomato plants was observed and counted at the age of 1, 2, 4, 6, and 8 WAP.

3. Total Chlorophyll (mg/g)

Total Chlorophyll Amount was measured at the age of tomato plants 2, 4, 6, and 8 WAP. The leaves to be tested were taken from the leaves in the middle, and total chlorophyll content was tested using a spectrometer.

4. Plant Header Wet Weight (g)

The wetness of the tomato plant header was calculated at 2 and 4 WAP.

5. Plant Header Dry Weight (g)

The dry weight of the tomato plants header was calculated at 2 and 4 WAP.

6. Root Wet Weight (g)

The wet weight of tomato plant roots was calculated at 2 and 4 WAP.

7. Root Dry Weight (g)

The dry weight of tomato plant roots was calculated at 2 and 4 WAP.

8. Total Leaf Area (cm^2)

The total leaf area of tomato plants was calculated at 2 and 4 WAP.

9. Leaf Area Index (cm^2)

The leaf area index was measured 2 times. To find the leaf area index, use the following formula:

$$LA = L_0 \times L_1 \times C$$

Information:
LA = Leaf area
L_0 = Length of leaf
L_1 = Leaf width
C = Constant

10. Number of Flowers

The number of flowers observed and counted that have bloomed at the age of 30 Day After Plant (DAP).

11. Number of Fruits.

The number of fruits observed and counted that have bloomed at the age of 50 DAP.

12. Total Suspended Solid (TSS)

TSS measurements were analyzed at the age of 50 DAP plants.

13. Plant Nutrient Uptake N, P, K, and Mg

Measurement of nutrient uptake of tomato plants was analyzed at 30 DAP.

Data Analysis

This study used a factorial randomized design consisting of 3 replications and 2 factors: Factor I. Tomato varieties of three types and Factor II. Water Giving Interval (I), which consists of five levels. Thus, there are 15 combinations with 45 polybags of experimental units. The data were analyzed with SPSS version 25 using the univariate ANOVA (analysis of variance) test at a 5% probability level if it had a significant effect, a DMRT test.

3. Results and Discussion

Effect of Partial Root Zone Technique on the Growth and Yield of Tomato Plants

The average effect of variety and frequency of watering through the PRD technique on plant height, number of leaves, and total chlorophyll are presented in Tables 1, 2, 3, and 4. The table shows that the watering technique only has a very significant effect on plant dry weight and has no significant effect on plant height, number of leaves, total chlorophyll, crown wet weight, root wet weight, root dry weight, total leaf area, leaf area index, plant nutrient uptake, number of flowers, number of fruit, fruit weight and total sugar soluble.

In more detail, the effect of the water application technique on the amount of chlorophyll is presented in Figure 1. Figure 1 shows that the best results were in treatment P4, followed by P3 and P1, and the lowest was in treatment P2.

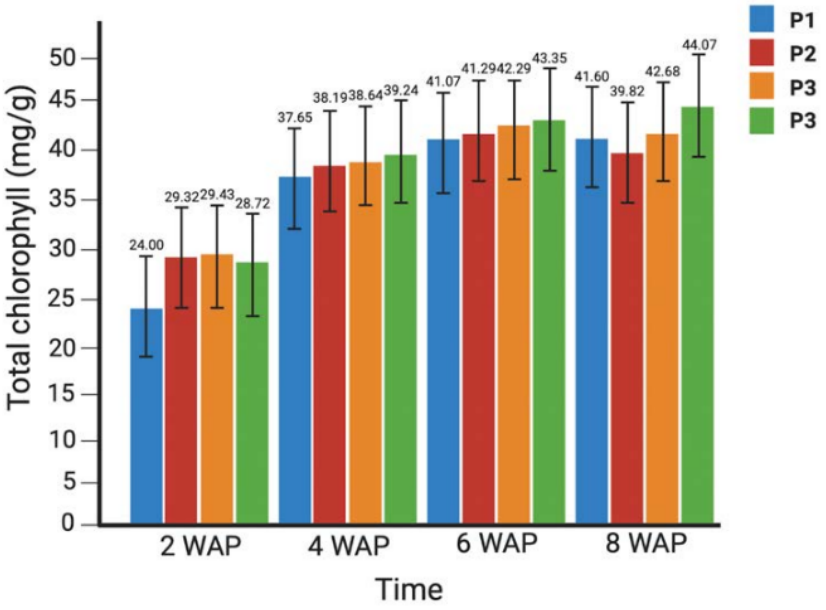

Figure 1. The effect of the PRD technique on the amount of chlorophyll in tomato leaves.

Differences in watering techniques ranging from giving full water (field capacity), which is given evenly to the soil surface, to giving half field capacity water which is given through the soil surface and pipes directly to plant roots with the PRD method did not show any effect on the vegetative phase and generative phase of the plant.

This shows that the application of PRD to tomato plants has been efficient and meets the requirements for production, even at half the field capacity. According to Zhang [13], water productivity (water productivity) is related to the efficiency of the water that is applied to plants.

Insufficient water availability in the media, high transpiration, or a combination of these conditions can cause plant water shortages. Even though the soil in the field has enough water, plants could still be stressed (water shortage). This occurs if the absorption rate is insufficient to make up for water lost by transpiration [14]. Abscisic acid will increase with stomata closure adjustments and a decrease in leaf area (ABA). This is the primary physiological reaction that the PRD method (which involves supplying water to a portion of the plant's root zone) uses to decrease plant transpiration and enhance water productivity. In a variety of plant species, the PRD approach boosts water productivity [15]. According to Akbarzadeh et al. [16], applying PRD boosts water productivity.

Based on the results of the study, it was shown that the PRD (Partial Rootzone Drying) method, namely giving water to only one part of the irrigated root zone, had no difference with giving water to the entire root zone as a comparison, both with daily watering intervals and once a day watering interval for nutrient uptake growth and production of tomato plants.

Effect of Variety on Growth and Yield of Tomato Plants

Tables 1, 2, 3, and 4 show that variety has a very significant effect on the number of leaves, the amount of chlorophyll, the dry weight of plants, the number of flowers, the number of fruits, the weight of fruits, and TSS had a significant effect on plant height, number of leaves, amount of chlorophyll, root wet weight and root dry weight and had no significant effect on shoot wet weight, total leaf area, leaf area index, and plant nutrient uptake.

In more detail, the effect of variety and PRD technique of P absorption, plant height, number of leaves, fresh weight of roots, dry weight of roots, number of flowers, and number of fruits at harvest is presented in Figures 2 - 6.

From Figure 2, it can be seen that V3 (Niki F1) yielded the highest in terms of plant height compared to V1 (Mira) and V2 (Mentari). From Figure 3. it can be seen that the best results on leaf number were in treatment V1 (Mira), followed by V3 (Niki F1), and the lowest number of plants was V2 (Mentari). From Figure 4. it can be seen that the best results on root wet weight were in treatment V1 (Mira), followed by V3 (Niki F1), and the lowest number of plants was V2 (Mentari). From Figure 5. it can be seen that the best results are Root Dry Weight in treatment V1 (Mira), followed by V3 (Niki F1), and the lowest number of plants was V2 (Mentari). From Figure 6. it can be seen that the best results for the number of flowers and the number of fruits were in treatment V1 (Mira), followed by V2 (Mentari), and the lowest number of plants was V3 (Niki F1).

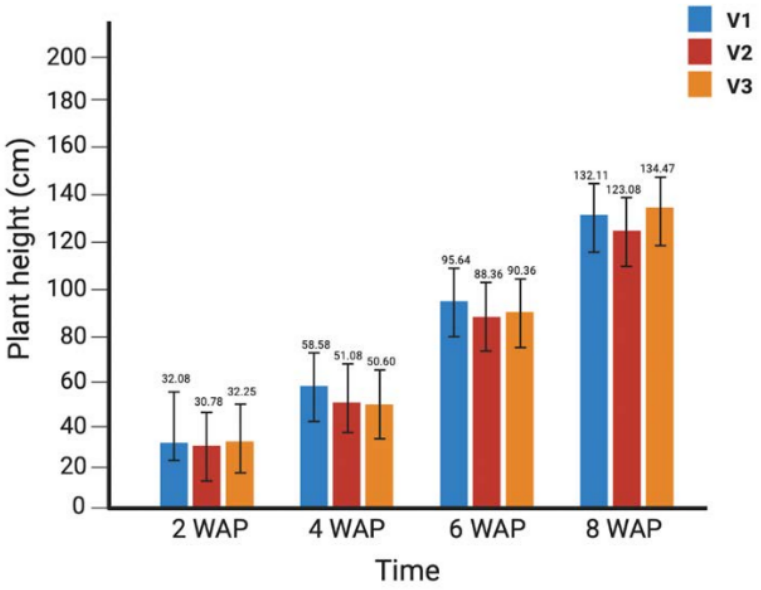

Figure 2. The Effect of varieties on plant height at 2– 8 WAP

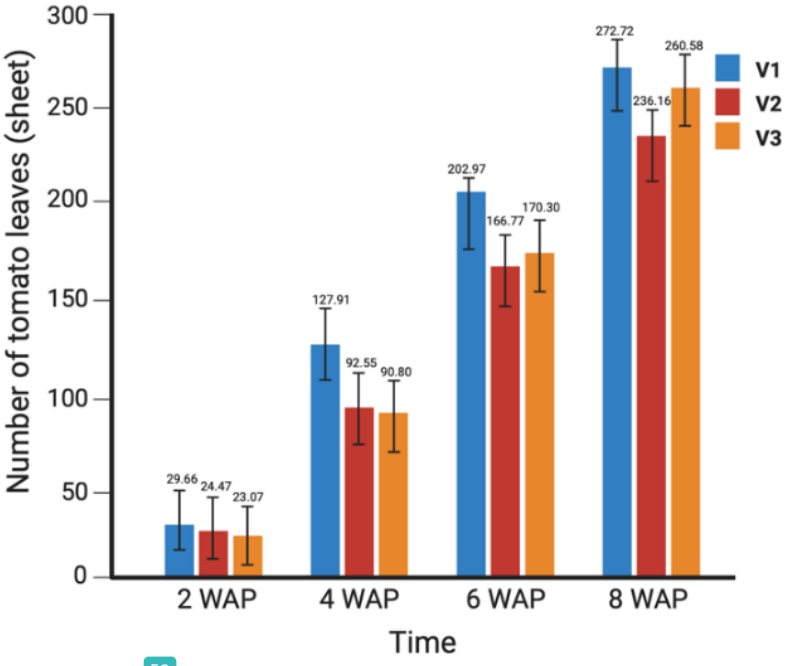

Figure 3. The Effect of Variety on the Number of Tomato Leaves at the Age of 2–8 WAP.

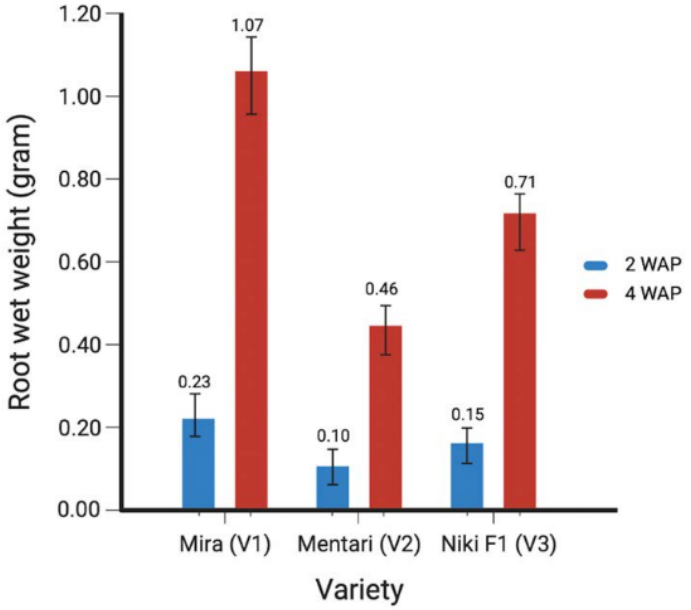

Figure 4. Influence Varieties to Root et Weight Age 2 and 4 WAP

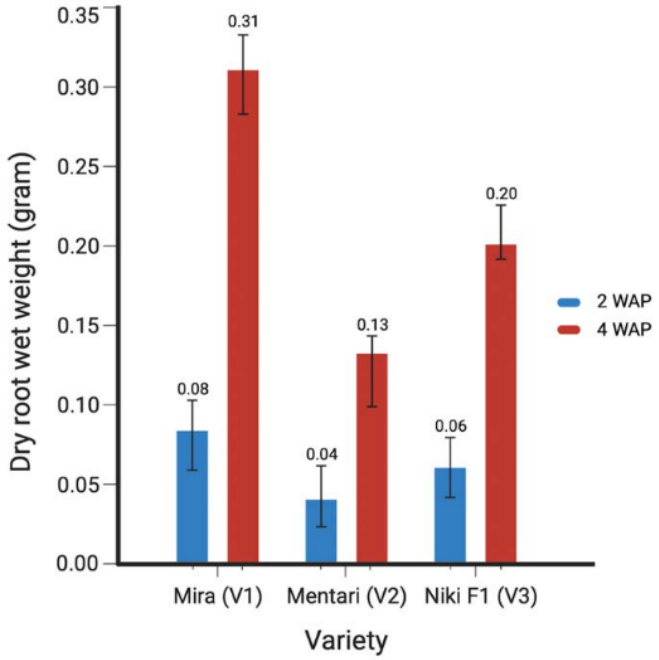

Figure 5. Influence. Varieties to Dry Weight of Roots Age 2 and 4 WAP

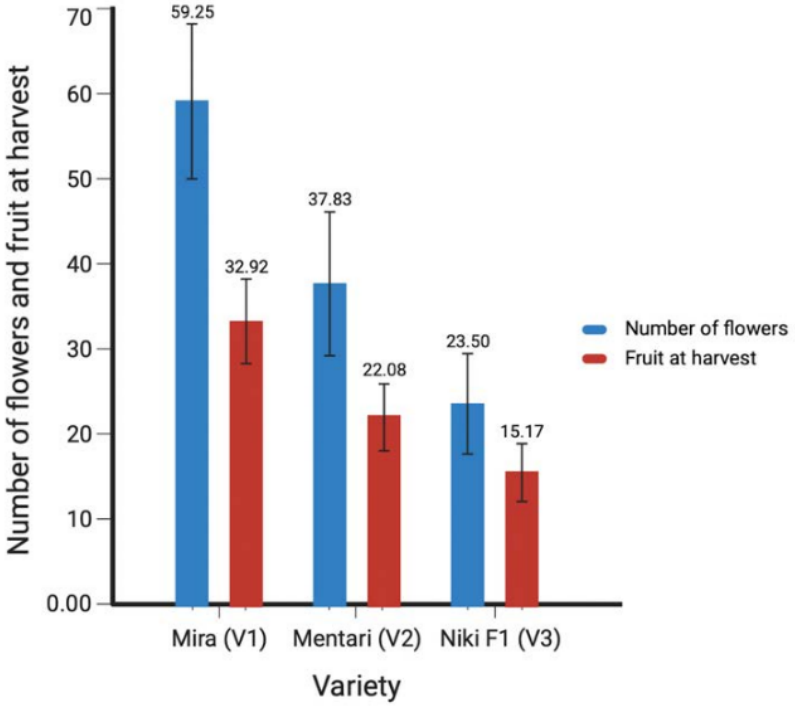

Figure 6. Influence. Varieties to the number of flowers and fruit at harvest

The treatment of different varieties due to the PRD method applied, namely when there was insufficient water, affected tomato plants' vegetative and generative phases. Plant production, which refers to growing and cultivating plants for various purposes, can also be influenced by external and internal factors. External factors are influenced by the environment, while internal factors are influenced by genetics [17]. Furthermore, Solichatun et al. [18] stated that if there is insufficient water supply during the vegetative growth stage, it can negatively impact cell growth and development, leading to smaller leaves and limited production of photosynthate that can be transported to the fruit, ultimately resulting in smaller fruit size. Suppose a water deficit occurs after leaf expansion, especially after fruit or seed filling. In that case, there will be competition between leaves and seeds in utilizing photosynthates so that relatively few fruits are formed and cause small fruit sizes, automatically affecting the weight and quality of the fruit produced. Cultivar improvements must be continuously carried out to obtain varieties resistant to stress from environmental factors such as wilt resistance, hot weather and rain, and resistance to changes in the growing environment that are unfavourable or environmental stress [19].

The Effect of a Combination of Several Varieties and Partial Root Zone Techniques on the Growth and Yield of Tomato Plants

Tables 1, 2, 3, and 4 show that the combination of several varieties and PRD techniques have a very significant effect on the number of leaves, the amount of chlorophyll, dry weight, the number of flowers, the number of fruit, fruit weight, and TSS, had a significant effect on plant height, root wet weight, root dry weight, and plant P uptake and had no significant effect on wet weight, total leaf area, leaf area index, and N, K, Ca and Mg absorption plant.

The occurrence of interactions between varieties with the PRD method was since the V1 variety (Mira) could adapt to water shortages, so just giving some roots showed a positive effect. So as not to affect the growth and yield.

In more detail, the effect of a combination of several varieties and partial root zone dying techniques on plant P uptake, the number of flowers, the number of fruits, and TSS are presented in Figures 7, 8, 9, and 10.

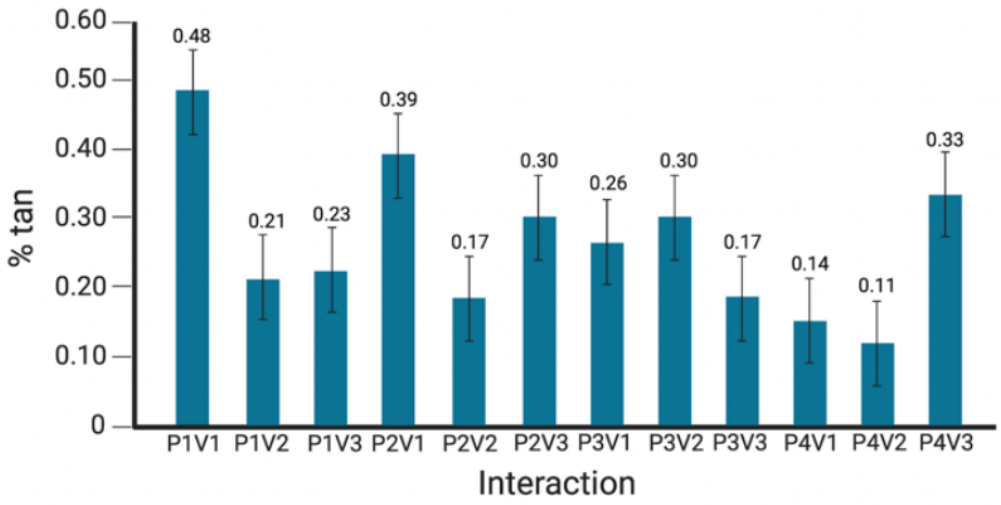

Figure 7. P absorption of tomato plants

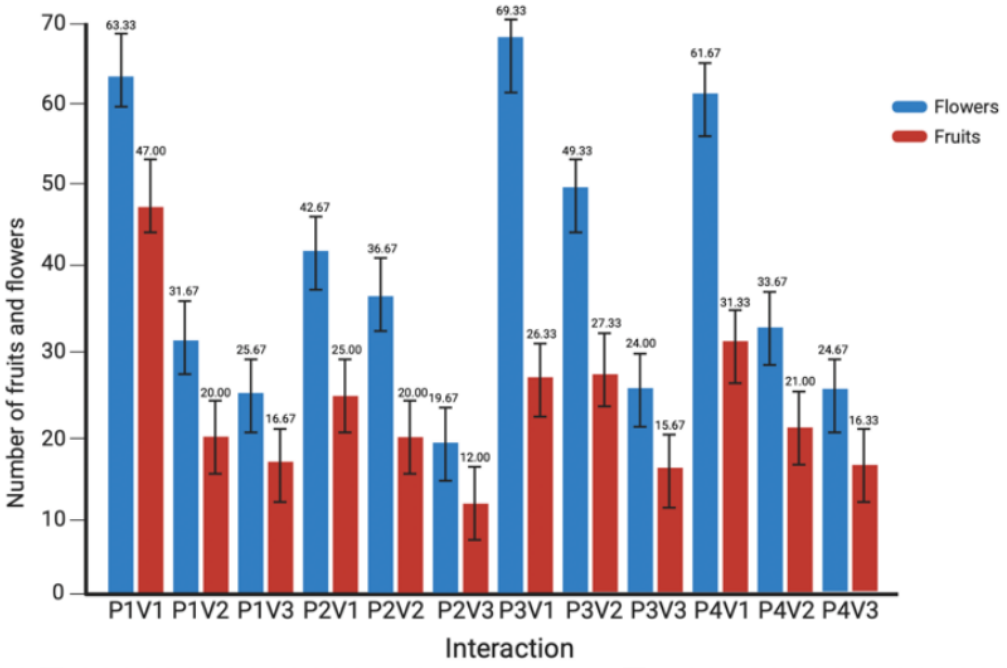

Figure 8. The effect of a combination of varieties and watering techniques on the number of flowers and the number of fruits

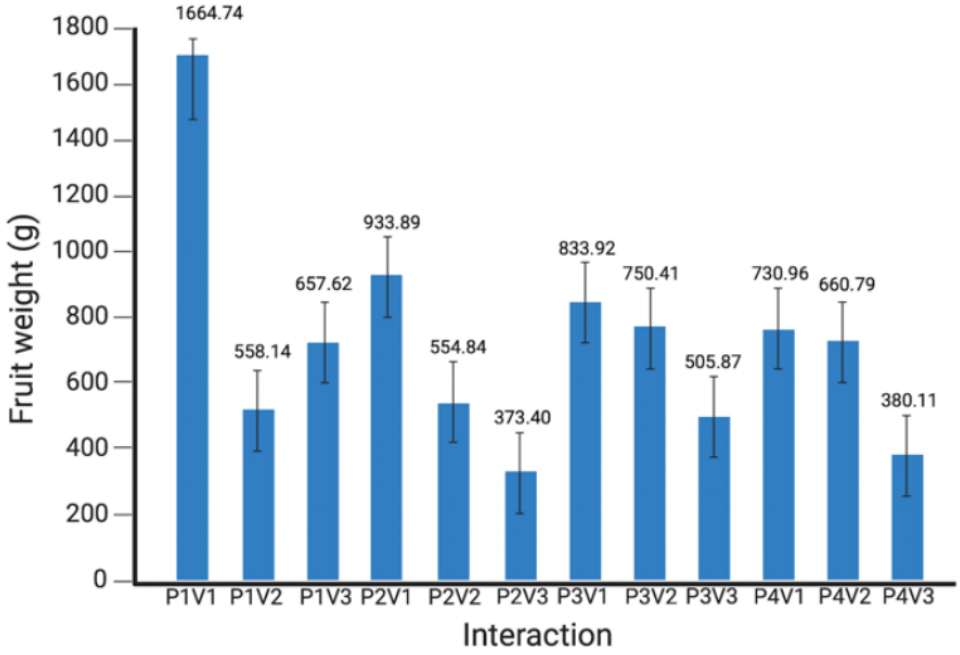

Figure 9. The effect of a combination of varieties and watering techniques on fruit weight.

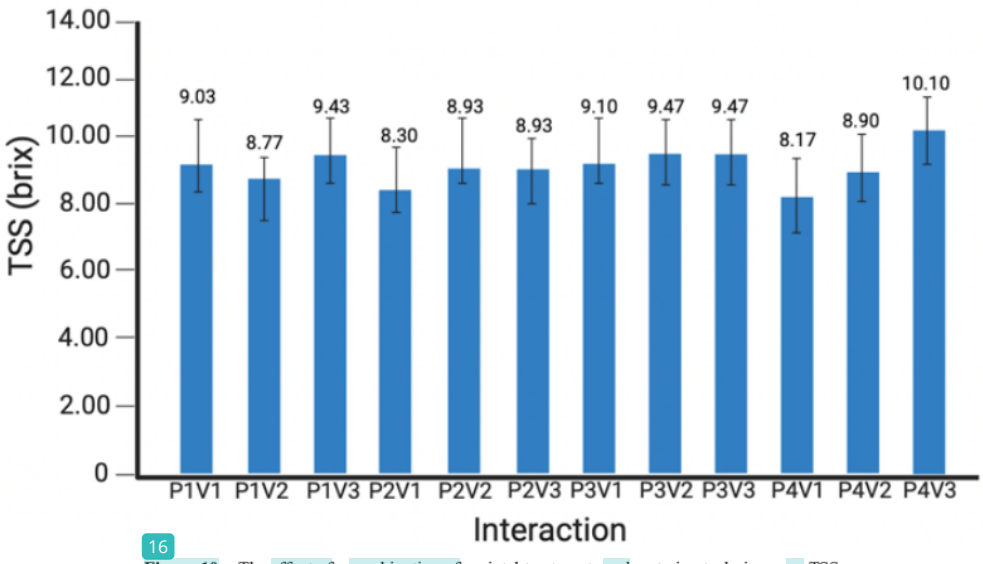

Figure 10. The effect of a combination of varietal treatments and watering techniques on TSS

Figure 7 shows that the best combination of varietal treatments and watering techniques for plant P absorption variables was obtained in treatment P1V1 (Mira and FC watering every day), and the lowest was in treatment P4 V2 (Mentari and Partial rootzone drying technique with ½ FC watering once a day interval).

Figure 8 shows the best combination for the number of flowers in the P3V1 treatment (Mira and Partial rootzone drying technique with ½ FC with daily watering) and the lowest in the P2V3 treatment (Niki F1 and FC with daily watering). Meanwhile, the best combination for the number of fruit was in treatment P1V1 (Mira and FC with daily watering). The lowest was in treatment P2V3 (Varieties Niki F1 and FC with daily watering).

Figure 9 shows that the best combination of fruit weight was in treatment P1V1 (Mira and ½ FC with daily watering), and the lowest was in treatment P4V3 (Niki F1 and FC with watering once-a-day intervals).

Figure 10 shows that the best combination of varietal and watering techniques for the TSS variable was obtained in the P4V3 treatment (Niki F1 and PRD ½ FC technique with watering intervals once a day). While the lowest TSS was obtained in the P4V1 treatment combination (Mira and PRD ½ FC with 1-day intervals of watering). watering every day) and the lowest was in the P4 V2 treatment (Mentari and Partial rootzone drying technique with ½ FC watering once a day interval)

Based on the analysis (Table 4), results showed that the combination of treatments of the varieties and watering techniques that were tried gave a positive response both to the vegetative phase and generative phase. However, there are differences in the technique of giving water, starting from giving full water (field capacity), which is given evenly to the soil surface, to giving half field capacity water given to the soil surface and through pipes directly to plant roots with the PRD method.

There was an interaction between varieties and the P2V1 partial root zone technique on fruit weight with an average value of 933.89 grams, and there was an interaction with P4V1 TSS levels with an average value of 8.17 mg/l. Varieties and watering techniques had no significant effect on plant height, number of leaves, chlorophyll, crown wet weight, shoot dry weight, root wet weight, root dry weight, total leaf area, leaf area index, number of flowers, number of fruits, and absorption of nutrients.

This shows that water application to tomato plants has been efficient and meets the requirements for production, even at half the field capacity. According to Zhang [13], water productivity (water productivity) is related to the efficiency of water applied to plants. Thus during plant growth, there is no water deficit, so the process of growth and development in the vegetative growth phase is not hampered. Many photosynthetic products can be translocated to fruit in the leaves to form many fruits. Fruit size is large, automatically affecting fruit weight and quality.

Hypothesis test

Based on statistical tests on the PRD method, there is no effect on the growth and yield of tomato plants, so the hypothesis is accepted. This shows that the PRD method is efficient in drought conditions because all treatments show no difference.

Based on statistical tests on varieties, there is an effect on the growth and yield of tomato plants, so the hypothesis is accepted.

Based on statistical tests on the interaction of varieties and the PRD method, there is an effect on the growth and yield of tomato plants, so the hypothesis is accepted.

Table 1. The average effect of varieties and watering techniques on plant height, number of leaves, and chlorophyll of tomato plants at the age of 2 – 8 WAP

Treatments	Plant Height (cm)					∑ Leaves (sheet)					∑ Chlorophyll (mg/g)			
	Beginning	2	4	6	8	Beginning	2	4	6	8	2	4	6	8
Variety														
V1	23.38a	32.08a	58.58a	95.64a	132.11a	16.19a	29.66a	127.91a	202.72a	272.72a	29.35a	38.35a	41.63a	41.90a
V2	23.19a	30.78a	51.08a	88.36a	123.08a	16.97a	24.47a	92.55a	166.77a	236.16a	29.16a	38.29a	41.89a	42.00a
V3	25.33a	32.55a	50.60a	90.36a	134.47a	15.39a	23.07a	90.80a	170.30a	260.58a	28.44a	38.65a	42.40a	42.63a
PRD Technique														
P1	22.55a	29.48a	53.12a	95.11a	134.67a	16.18a	25.96a	105.03a	189.25a	268.22a	24.00a	37.65a	41.07a	41.60a
P2	25.59a	31.63a	51.88a	91.92a	131.41a	16.29a	24.99a	94.44a	174.51a	203.22a	29.32a	38.19a	41.19a	39.82a
P3	25.85a	33.40a	56.03a	91.00a	132.40a	15.55a	27.44a	116.29a	187.70a	268.37a	29.43a	38.64a	42.29a	42.68a
P4	22.41a	32.70a	52.66a	87.77a	121.03a	16.70a	24.51a	99.26a	168.54a	235.92a	28.72a	39.24a	43.35a	44.07a
PxV Interaction														
P1V1	24.66a	32.11a	60.44a	102.00a	135.66a	16.11a	29.33a	147.44a	231.22a	297.89a	28.34	37.93a	39.52a	39.35a
P1V2	20.11a	26.67a	48.55a	87.00a	128.55a	16.78a	25.22a	84.33a	161.22a	244.33a	29.12	36.53a	41.18a	42.01a
P1V3	22.89a	29.66a	50.31a	96.33a	139.89a	15.66a	23.33a	83.33a	175.33a	262.44a	29.53	38.47a	42.50a	43.45a
P2V1	22.89a	29.11a	54.66a	94.67a	134.89a	16.44a	29.44a	113.77a	193.77a	274.11a	28.47	37.37a	40.81a	39.89a
P2V2	26.99a	32.00a	52.89a	89.44a	126.33a	17.66a	23.33a	84.66a	159.77a	233.55a	29.97	39.17a	41.56a	40.99a
P2V3	22.44a	33.77a	49.11a	91.66a	133.00a	14.78a	22.22a	84.89a	170.00a	252.67a	29.53	38.02a	41.21a	38.57a
P3V1	22.44a	31.88a	58.55a	86.44a	130.78a	15.99a	27.89a	131.11a	191.33a	273.55a	31.52	38.91a	42.77a	42.81a
P3V2	22.44a	33.55a	54.88a	91.22a	119.11a	16.66a	28.44a	110.67a	183.33a	239.11a	28.97	38.51a	40.99a	42.03a
P3V3	30.66a	34.77a	54.66a	95.33a	147.33a	13.99a	26.00a	107.11a	188.44a	292.44a	27.81	38.51a	43.12a	43.19a
P4V1	25.11a	35.22a	60.66a	99.44a	127.11a	16.22a	32.00a	199.33a	195.55a	245.33a	30.68	39.17a	43.43a	43.92a
P4V2	21.33a	30.89a	49.00a	85.77a	118.33a	16.77a	20.88a	90.55a	162.78a	227.66a	25.57	38.96a	43.84a	42.97a
P4V3	20.78a	32.00a	48.33a	78.11a	117.11a	17.11a	20.66a	87.89a	147.44a	234.77a	26.90	39.60a	42.77a	45.32a

Note: Numbers followed by unequal letters in the same treatment group were significantly different at the 5% level based on the DMRT test. Those without notations showed no significant difference.

Table 2. Mean effect of variety and PRD technique on shoot wet and dry weight, wet weight and root dry weight, total leaf area, and leaf area index at 2 and 4 WAP

Treatments	Head wet weight (g)		Head dry weight (g)		Root wet weight (g)		Root dry weight (g)		Leaf area (cm^2)		ILD (cm^2)	
	2	4	2	4	2	4	2	4	I	II	I	II
Variety												
V1	3.20a	7.76a	0.23a	1.13a	0.23a	1.07a	0.08a	0.31a	22.56a	43.05a	9.73a	84.76a
V2	1.10a	5.75a	0.15a	0.84a	0.10a	0.46a	0.04a	0.13a	107.09a	31.91a	3.92a	37.39a
V3	1.41a	6.69a	0.22a	1.02a	1.05a	0.71a	0.06a	0.20a	20.44a	38.61a	6.34a	53.18a
PRD Technique												
P1	1.49a	7.48a	0.23a	1.09a	0.18a	0.83a	0.06a	0.24a	143.22a	41.50a	8.09a	70.93a
P2	1.39a	6.99a	0.20a	1.02a	0.17a	0.78a	0.06a	0.22a	20.27a	38.77a	7.31a	65.41a
P3	1.39a	6.99a	0.20a	1.02a	0.17a	0.78a	0.06a	0.22a	20.27a	38.77a	7.31a	65.41a
P4	3.20a	5.24a	0.15a	0.76a	0.12a	0.58a	0.03a	0.16a	14.61a	29.05a	3.68a	35.35a
PxV Interaction												
P1V1	1.94a	9.51a	0.30a	1.39a	0.31a	1.50a	0.10a	0.43a	28.17a	52.73a	14.79a	127.58a
P1V2	1.19a	6.26a	0.15a	0.93a	0.09a	0.42a	0.03a	0.12a	381.96a	35.21a	3.56a	40.78a
P1V3	1.34a	6.59a	0.23a	0.96a	0.13a	0.58a	0.05a	0.17a	19.54a	36.57a	5.91a	44.44a
P2V1	1.98a	9.71a	0.29a	1.41a	0.28a	1.30a	0.11a	0.37a	28.75a	53.81a	12.09a	101.63a
P2V2	0.91a	4.95a	0.15a	0.72a	0.07a	0.34a	0.04a	0.10a	12.24a	27.48a	2.91a	18.99a
P2V3	1.65a	8.12a	0.25a	1.18a	0.16a	0.76a	0.06a	0.21a	24.05a	45.01a	7.71a	65.58a
P3V1	1.48a	7.46a	0.20a	1.09a	0.23a	1.07a	0.07a	0.31a	21.53a	41.36a	9.94a	88.95a
P3V2	1.69a	8.30a	0.23a	1.21a	0.16a	0.76a	0.06a	0.22a	24.58a	46.01a	8.15a	77.37a
P3V3	1.01a	5.22a	0.17a	0.76a	0.11a	0.51a	0.05a	0.14a	14.69a	28.94a	3.83a	29.91a
P4V1	7.41a	4.38a	0.12a	0.64a	0.09a	0.43a	0.03a	0.12a	11.78a	24.27a	2.08a	20.87a
P4V2	0.59a	3.42a	0.09a	0.50a	0.07a	0.32a	0.02a	0.09a	8.58a	18.95a	1.06a	12.40a
P4V3	1.61a	7.92a	0.24a	1.15a	0.21a	0.97a	0.06a	0.28a	23.47a	43.92a	7.91a	72.79a

Description: Numbers followed by unequal letters in the same treatment group were significantly different at the 5% level based on the DMRT test and those without notations showed no significant difference

Table 3. The average effect of varieties and watering techniques on plant N, P, K, Ca, and Mg uptake.

Treatments	Nitrogen plants (%)	Phosphorus plants (%)	Potassium plants (%)	Calcium plants (%)	Magnesium plants (%)
Variety					
V1	2.99 a	0.32 a	2.20 a	0.53 a	0.36 a
V2	1.77 a	0.20 a	1.45 a	0.38 a	0.30 a
V3	2.47 a	0.26 a	1.74 a	0.45 a	0.39 a
PRD Technique					
P1	2.80 a	0.31 a	1.80 a	0.49 a	0.34 a
P2	2.65 a	0.29 a	2.08 a	0.53 a	0.45 a
P3	2.34 a	0.24 a	2.07 a	0.45 a	0.30 a
P4	1.85 a	0.20 a	1.24 a	0.34 a	0.31 a
P x V Interaction					
P1V1	4.17 a	0.48 a	2.25 a	0.62 a	0.42 a
P1V2	1.89 a	0.21 a	1.57 a	0.43 a	0.29 a
P1V3	2.34 a	0.23 a	1.58 a	0.43 a	0.30 a
P2V1	3.70 a	0.39 a	3.02 a	0.74 a	0.50 a
P2V2	1.52 a	0.17 a	1.04 a	0.30 a	0.30 a
P2V3	2.72 a	0.30 a	2.20 a	0.55 a	0.55 a
P3V1	2.66 a	0.26 a	2.48 a	0.48 a	0.32 a
P3V2	2.65 a	0.30 a	2.39 a	0.55 a	0.37 a
P3V3	1.70 a	0.17 a	1.32 a	0.32 a	0.21 a
P4V1	1.43 a	0.14 a	1.05 a	0.29 a	0.19 a
P4V2	1.01 a	0.11 a	0.80 a	0.22 a	0.22 a
P4V3	3.10 a	0.33 a	1.87 a	0.51 a	0.51 a

Description: Numbers followed by letters that are not the same in the treatment group significantly different at the 5% level based on the DMR test and those that don't have notation indicate no significant difference.

Table 4. The average effect of varieties and watering techniques on the number of flowers, number of fruits, fruit weight, and TSS at harvest

Treatment	Σ Flower	Σ Fruit	Weight (g)	TSS (brix)
Variety				
V1	59.25 a	32.92 a	1040.88 a	8.65 b
V2	37.83b	22.08 b	631.05 b	9.02 a
V3	23.50c	15.17 c	479.25 c	9.48 a
PRD Technique				
P1	40.22 a	27.89 a	960.16 a	9.08 a
P2	33.00 a	19.00 a	620.71 a	8.72 a
P3	47.56 a	23.78 a	696.73 a	9.34 a
P4	40.00 a	22.89 a	590.62 a	9.06 a
P x V Interaction				
P1V1	63.33 a	47.00 a	1664.74 a	9.03 ab
P1V2	31.67 a	20.00 a	558.14 a	8.77 b
P1V3	25.67 a	16.67 a	657.62 a	9.43 a
P2V1	42.67 a	25.00 a	933.89b	8.30 b
P2V2	36.67 a	20.00 a	554.84 a	8.93 b
P2V3	19.67 a	12.00 a	373.40 a	8.93 b
P3V1	69.33 a	28.33 a	833.92b	9.10 ab
P3V2	49.33 a	27.33 a	750.41 a	9.47 a
P3V3	24.00 a	15.67 a	505.87 a	9.47 a
P4V1	61.67 a	31.33 a	730.96 a	8.17 b
P4V2	33.67 a	21.00 a	660.79 a	8.90 b
P4V3	24.67 a	16.33 a	380.11 a	10.10 a

Note: Numbers followed by letters are not the same in the treatment group, significantly different at the 5% level based on the DMR test, and those that don't have notation indicate any significant difference.

4. Conclusions

The partial root zone technique had no significant effect on plant height, number of leaves, total chlorophyll, crown wet weight, shoot dry weight, root wet weight, root dry weight, total leaf area, leaf area index, plant nutrient uptake, number of flowers, number of fruits, fruit weight. The best results were obtained in treatment P1 (FC.0) (Capacity with daily water administration), followed by P3 (PRD.0) (Half Capacity with daily water administration), and the lowest was in P4 (PRD.1) (half FC with water interval once a day). Based on the hypothesis that applying the PRD technique does not affect the growth and yield of tomato plants is accepted.

The V1 variety (Mira) had a very significant effect on the number of flowers, number of fruits, fruit weight and TSS. The best results were obtained in treatment V1 (Mira), followed by V2 (Mentari), and the lowest was V3 (Niki F1). Varietal treatment did not significantly affect the number of leaves, total chlorophyll, crown dry weight, shoot wet weight, root wet weight, root dry weight, total leaf area, leaf area index, and nutrient absorption. It is accepted based on the hypothesis, which states that variety affects the growth and yield of tomato plants.

The combination of several varieties and PRD techniques had a very significant effect on the number of flowers, number of fruits, fruit weight and TSS. While the combination of varieties and PRD techniques did not significantly affect plant height, number of leaves, amount of chlorophyll, root wet weight, root dry weight and plant P uptake, shoot wet weight, shoot dry weight, total leaf area, leaf area index and plant nutrient absorption. The best results were obtained in the P1V1 treatment combination (Mira and FC with daily watering). In contrast, the lowest results were obtained in the P4V3 treatment combination (Niki F1 and 1/2 FC with water once-a-day intervals).

Based on the hypothesis, which states that the interaction of varieties and PRD techniques affect the growth and yield of tomato plants, it is accepted.

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