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UTILIZATION OF IN-Situ WASTE FROM COFFEE PLANT (Coffea sp.) AS MULCH AGAINST DROUGHT RESISTANCE OF SIGARARUTANG VARIETY ARABIC COFFEE SEEDLINGS

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Abstract

This research was carried out at the experimental field of the Faculty of Agriculture, Islamic University of North Sumatra, Jln. Karya Wisata, Medan Johor District, Medan City, North Sumatra Province. The altitude is ± 25 meters above sea level, with flat topography with soil types of the inceptisol order. This research aims to determine the in situ waste of coffee plants (coffea sp.) as mulch on the drought resistance of Arabica coffee seedlings of the Sigararutang variety. This research consisted of II research stages, namely stage I using a Factorial Split Plot Design (RPT) which consisted of 2 treatment factors, namely: various types of coffee roots (A) and watering intervals (P). The first factor A1 = Fishing roots, A2 = Needle roots and the second factor P1 = Every day watered, P2 = Once every two days watered. The parameters observed were plant height (cm), number of leaves (strands), root length (cm), Wet weight (g) and dry weight (g) and for the second phase of research using a factorial completely randomized design (RAK) consisting of 2 treatment factors, namely: P1=watered every day, P2=watered every two days, P3=three days once watered, the parameters observed were plant height (cm), number of leaves (strands), root length (cm), root volume (ml), root dry weight (g), shoot dry weight (g) and shoot root ratio (NTA).). The results of phase I research showed that providing watering intervals had a significant effect on drought resistance in coffee seedlings for all observed variables, namely fresh weight, wet weight and coffee stomata. The results of the research showed that providing various types of roots had a significant effect on drought resistance in coffee seedlings for all observed variables, namely coffee stomata. There was no interaction between providing watering intervals and various types of coffee roots. The results of phase II research showed that providing watering intervals had a significant effect on drought resistance in coffee seedlings for all observed variables, namely root dry weight 2 and 3 WST, shoot dry weight 1 and 2 WST, shoot root ratio 1 WST and coffee stomata. The results of the research showed that The provision of various types of roots has a significant effect on the drought resistance of coffee seedlings, all observation variables, namely root dry weight 1 and 2 BST and coffee stomata. There is an interaction between the provision of watering intervals and various types of coffee roots, all observation variables, namely root dry weight 2 WST.

Keywords: ***Insitu waste, coffee (coffea sp.), mulch, drought resistance of Arabica coffee seedlings, Sigararutang variety***

1. INTRODUCTION

Coffee is a plantation commodity with high economic value as a source of foreign exchange for the country. Coffee acts as the main livelihood of coffee farmers in Indonesia. This resulted in adjustments in only a few regions (Sianturi and Wachjar 2016). The Central Statistics Agency (BPS) reports that the area of coffee plantations in Indonesia will be 1.29 million ha in 2022, an increase of 0.48% compared to the previous year which was 1.28 million ha in 2021 and 1.25 million ha. in 2020. Looking at the trend, the area of national coffee plantations has tended to increase in the last few decades. The area of coffee plantations also reached its highest figure last year. Based on management, the majority of coffee plantations in Indonesia are owned by the people, namely 1.26 million ha. Meanwhile, the area of large-scale coffee plantations managed by the state and private sector is 3 million ha. Specifically for the North Sumatra region, the total area

of coffee plantations reaches 97.86 thousand ha. in 2022 consisting of 80.02 thousand ha of Arabica coffee. and Robusta 17.84 thousand ha. (BPS, 2022). The Sigararutang coffee variety was discovered among coffee plantations planted by Opung Polite Boru Siregar in the village of Batu Gajah, Warinan, Lintong Humbang Hasundutan (1400 meters above sea level) in 1988. Sigararutang coffee seeds are a coffee variety that is widely planted in North Sumatra because of its relatively more resistant adaptation to planting. without shade, resistant to leaf rust and a long economic life of up to 20 years (Kepmentan number 205/kpts/SR.120/4/2005). Coffee plant production is influenced by the application of plant cultivation techniques, namely seeding, land clearing and preparation, shade planting, preparation for planting and planting coffee, maintenance, and harvest and post-harvest handling (Tim Karya Tani Mandiri, 2010). Coffee plant maintenance activities include replanting, weed control, fertilization, pruning, and pest and disease control (Prastowo et al., 2010).

2. IMPLEMENTATION METHOD

The research consisted of three experiments. The first experiment was carried out to analyze the effectiveness of soaking coffee beans in a certain solution and time as basic information regarding the acceleration of breaking coffee bean dormancy. The second experiment was aimed at determining the shape of the roots of coffee seedlings. Through watering intervals, it was possible to identify coffee seedlings with root forms that were resistant to drought stress. The third experiment was carried out to determine the mulch from in-situ coffee plant waste and watering intervals to determine which coffee seedlings are resistant to drought stress through the use of in-situ waste from coffee plants (Coffea sp.).

1. Research Method I

The research method used was a Split Plot Design with two factors. The first factor is root shape and the second factor is watering. The level of each factor is as follows:

The first factor is the shape of the coffee roots (A) which consists of 2 levels, namely:

A1 = Fishing Root

A2 = Needle Root

The second factor is watering (P) which consists of 2 levels, namely:

P1 = Every Day Watered

P2 = Watered once every 2 days

There were 4 treatment combinations and each treatment was repeated 4 times so that there were 16 experimental units observed. The statistical model used for the two-factor RPT design is:

$$Yijk = \mu + \alpha i + \delta ik + \beta j + (\alpha\beta)ij + \varepsilon ijk$$

Information:

Yijk : Observation value of factor A of the ith level, factor P of the jth level, in the kth repetition

μ : General average of responses.

αi : The main influence of factor A

ßj : Main influence of factor P

(αß)ik : Effect of interaction between treatments A and P

Δik : Random components of the main plot that are normally distributed

εijk : Random effect of normally distributed subplots.

The data obtained was analyzed using analysis of variance (ANOVA) at the 5% level, and if it had a real effect, it was continued with the Duncan Multiple Range Test (DMRT).

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2. Research Method II

The research method used was a completely randomized design with two factors. The first factor is watering and the second factor is mulch. The level of each factor is as follows:

The first factor is watering (P) which consists of 3 levels, namely:

P1 = Every Day Watered
P2 = Watered once every 2 days
P3 = Once watered every 3 days

The second factor is mulch (M) which consists of 2 levels, namely:

M1 = Dried Coffee Leaves
M2 = Dry Coffee Fruit Skin

There were 6 treatment combinations and each treatment was repeated 3 times so that there were 18 experimental units observed. The statistical model used for the two-factor RAK design is:

$Yijk = \mu + \alpha i + \rho k(i) + ßj + (\alpha ß)ij + \varepsilon ijk$

Information:

Yijk : Observation value in the i-th watering, j-th mulch, and k-th group.
μ : General average.
αi : Effect of the i-th watering treatment (P = 1, 2, 3)
ρk(i) : Influence of the kth group (k = 1, 2, 3) on the ith watering
ßj : Effect of j-th mulch treatment (M = 1, 2)
(αß)ij : Effect of interaction between watering treatment i andj-th mulch.
εijk : Random effect on i-th watering, j-th mulch, and k-th group

The data obtained was analyzed using analysis of variance (ANOVA) at the 5% level, and if it had a real effect, it was continued with the Duncan Multiple Range Test (DMRT).

3. Data analysis.

Statistical analysis was carried out to determine the effect of treatment. This analysis was carried out according to the design used and continued with the F test with an accuracy of 95%. If the F test shows that there are significant differences between each treatment, proceed with the Duncan Multiple Range Test at an accuracy level of 95% (Gomez et al., 1995).

3. RESULTS AND DISCUSSION

A. Growth in the Vegetative and Generative Phases of Coffee Plant Varieties Sigararhutang (Coffea sp)

1. Plant Height (cm)

Table 1. Coffee plant height with interval treatment watering and type of coffee roots.

Sprinkling	Root		
	A1	A2	Average P
P1	10.07	50.98	30.52
P2	9.99	48.88	29.43
Average A	10.03	49.93	

Note: Numbers followed by letters that are not the same in the same column and row are significantly different according to the 5% DMRT Test. Based on Table 1, the results of the DMRT test at the 5% level show that the watering interval treatment and various types of roots have no significant effect on plant height. Coffee plants that were treated with watering (P2) with watering intervals every other day produced the lowest average, namely 29.43, and with treatment (P1) watering once every day, namely 30.52.

Coffee plants that were treated with various types of roots (A1), hook roots, produced the lowest average, namely 10.03, and with treatment (A2), needle roots, namely 30.52, both treatments had no effect on integration. Plant growth is influenced by nutrition and soil conditions (Fitriyantini, Z. 2019). Coffee plant height is often one of the factors that coffee farmers observe closely because it has the potential to be an indicator of plant health and productivity. However, in some cases, the results of observations of coffee plant height may not provide a definite picture of the overall condition of the plant. This can be caused by various factors, such as genetic variations in plants, environmental conditions, and agricultural practices.

2. Number of Leaves (Number)

Table 2. Number of coffee leaves by interval treatment watering and type of coffee roots.

Sprinkling	Root		Average P
	A1	A2	
P1	5.60	27.00	16.30
P2	5.50	28.50	17.00
Average A	5.55	27.75	

Note: Numbers followed by letters that are not the same in the same column and row are significantly different according to the 5% DMRT Test

Based on Table 2, the results of the DMRT test at the 5% level show that the treatment of watering intervals and various types of roots did not have a significant effect on the number of leaves. Coffee plants that were given the watering treatment (P1), watering once every day, produced the lowest average, namely 16.30 and with the treatment (P1), watering every day was 17.00. Coffee plants treated with various types of roots (A1), hook roots, produced the lowest average, namely 5.55, and with treatment (A2), needle roots, namely 27.55, both treatments had no effect on integration. According to Suhendra & Armaini (2017), nutrients obtained through fertilization will have a physiological effect on the absorption of nutrients by plant roots so that plant growth is better.

3. Root Length (cm)

Table 3. Length of coffee roots by interval treatment watering and type of coffee roots.

Sprinkling	Root		Average P
	A1	A2	
P1	5.92	6.62	6.27
P2	7.36	6.52	6.94
Average A	6.64	6.57	

Note: Numbers followed by letters that are not the same in the same column and row are significantly different according to the 5% DMRT Test. Based on Table 3, the results of the DMRT test at the 5% level show that the watering interval treatment and various types of roots did not have a significant effect on the number of leaves. Coffee plants that were given the watering treatment (P1), watering once a day, produced the lowest average, namely 6.27, and with the treatment (P2), the watering interval was once every two days, namely 6.94. Coffee plants treated with various types of roots (A2), needle roots, produced the lowest average, namely 6.64, and with treatment (A1), fishing roots, namely 6.57, both treatments had no effect on integration. According to Sinaga (2018), cell division in the vegetative phase occurs in the creation of new cells, especially in the meristematic tissues at the growing points of stems and roots. These new cells require large amounts of carbohydrates, because their walls are made of cellulose and the protoplasm is mostly

made of sugar so that if other factors are available in balance then the rate of cell division depends on the supply of carbohydrates.

4. Wet Weight (g)

Table 4. Fresh weight of coffee with interval treatment watering and type of coffee roots.

Sprinkling	Root		Average P
	A1	A2	
P1	0.54	0.74	0.64b
P2	0.46	0.70	0.58a
Average A	0.50	0.72	

Note: Numbers followed by letters that are not the same in the same column and row are significantly different according to the 5% DMRT Test

Based on Table 4, the results of the DMRT test at the 5% level show that the watering interval treatment had a significant effect on wet weight, while various types of roots had no significant effect on wet weight. Coffee plants that were treated with watering (P2) with watering intervals every two days produced the lowest average, namely 0.58, and with treatment (P1), watering every day, namely 0.64.

5. Dry Weight (g)

Table 5. Dry weight of coffee with interval treatment watering and type of coffee roots

Sprinkling	Root		Average P
	A1	A2	
P1	0.18	0.18	0.18b
P2	0.20	0.00	0.10a
Average A	0.19	0.09	

Note: Numbers followed by letters that are not the same in the same column and row are significantly different according to the 5% DMRT Test

Based on Table 5, the results of the DMRT test at the 5% level show that the watering interval treatment had a significant effect on wet weight, while various types of roots had no significant effect on wet weight. Coffee plants that were treated with watering (P2) with watering intervals every two days produced the lowest average, namely 0.10, and with treatment (P1) watering every day, namely 0.18.

6. Coffee Stomata (%)

Table 6. Coffee stomata with interval treatment watering and type of coffee roots.

Sprinkling	Root		Average P
	A1	A2	
P1	54.00	40.00	47.00b
P2	52.00	34.00	43.00b
Average A	53.00c	37.00b	

Note: Numbers followed by letters that are not the same in the same column and row are significantly different according to the 5% DMRT Test

Based on Table 6, the results of the DMRT test at the 5% level show that the watering interval treatment has a significant effect on wet weight, while various types of roots also have a significant effect on stomata. Coffee plants that were treated with watering (P2) with watering intervals every two days produced the lowest average, namely 43.00, and with treatment (P1) watering every day, namely 47.00.

B. Research 2: Response of Coffee Seedling Growth to Drought Stress Using Coffee Plant Waste Mulch Application

1. Plant Height (cm)

Table 7. Plant height with interval treatment watering and mulching.

Treatment	Month After Planting (BST) 1BST	2BST	3BST
Watering (P)			
P1	12	22	27
P2	10	18	26
P3	13	17	33
Mulch (M)			
M1	16	14	36
M2	10	15	26
PXM Interaction			
P1M1	14.33	21.00	31.67
P1M2	12.67	18.00	27.33
P2M1	13.00	18.67	28.67
P2M2	14.33	19.67	29.33
P3M1	15.00	18.67	28.33
P3M2	14.33	18.00	27.67

Note: Numbers followed by different letters in the same column are significantly different in the BNT 0.05 test and very significantly different in the BNT 0.01 test. P1 = watered every day; P2 = watered every 2 days; P3 = watered once every 3 days; M1 = Dried coffee leaves; M1 = dry coffee fruit skin.

2. Number of Leaves (quantity)

Table 8. Number of leaves with interval treatment watering and mulching

Treatment	Month After Planting (BST) 1BST	2BST	3BST
Watering (P)			
P1	16	14	17
P2	14	16	13
P3	14	17	18
Mulch (M)			
M1	15	16	16
M2	15	16	13

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PXM Interaction			
P1M1	16	14	17.00
P1M2	14	16	13.00
P2M1	14	17	18.00
P2M2	14	17	18.00
P3M1	15	16	16.00
P3M2	15	16	13.00

Note: Numbers followed by different letters in the same column are significantly different in the BNT 0.05 test and very significantly different in the BNT 0.01 test. P1 = watered every day; P2 = watered every 2 days; P3 = watered once every 3 days; M1 = Dried coffee leaves; M1 = dry coffee fruit skin.

3. Root length (cm)

Table 9. Root length with interval treatment watering and mulching.

Treatment	Month After Planting (BST) 1	2	3
Watering (P)			
P1	18	19	10
P2	17	19	10
P3	15	18	11
Mulch (M)			
M1	15	17	12
M2	18	15	10
PXM Interaction			
P1M1	10.00	12.33	15.67
P1M2	9.00	12.00	15.33
P2M1	10.67	11.67	14.67
P2M2	9.67	11.33	15.00
P3M1	10.00	11.67	14.67
P3M2	9.00	11.00	14.33

Note: Numbers followed by different letters in the same column are significantly different in the BNT 0.05 test and very significantly different in the BNT 0.01 test. P1 = watered every day; P2 = watered every 2 days; P3 = watered once every 3 days; M1 = Dried coffee leaves; M1 = dry coffee fruit skin.

Abstinence, et al. (2021) added that potassium (K) is used by plants to activate enzymes and also plays a role in photosynthesis. Based on Table 9, the results of the BNT test at the 5% and 1% levels show that the watering interval treatment had no significant effect, whereas mulch also had no significant effect on root length. Coffee plants treated with watering (P2) with a watering interval every two days produced the lowest average, namely 10, and with treatment (P1), watering every day, namely 10, (P3) watering interval every three days, namely 11. Coffee plants treated with various types of roots (M1) and coffee fruit skin produced the lowest average, namely 10, and with treatment (M2) dry coffee leaves i, namely 10, both treatments had no effect on ingestion.

4. Root volume (ml)

Table 10. Number of leaves with interval treatment watering and mulching

Treatment	Month After Planting (BST) 1	2	3
Watering (P)			
P1	11	10	9
P2	10	9	9
P3	10	10	11
Mulch (M)			
M1	10	11	12
M2	12	10	10
PXM Interaction			
P1M1	5.33	7.00	10.00
P1M2	5.00	6.33	9.33
P2M1	5.33	7.33	10.33
P2M2	5.67	8.00	11.00
P3M1	5.67	7.67	11.00
P3M2	4.67	7.00	10.67

Note: Numbers followed by different letters in the same column are significantly different in the BNT 0.05 test and very significantly different in the BNT 0.01 test. P1 = watered every day; P2 = watered every 2 days; P3 = watered once every 3 days; M1 = Dried coffee leaves; M1 = dry coffee fruit skin.

Based on Table 10, the results of the BNT test at the 5% and 1% levels show that the watering interval treatment had no significant effect, whereas mulch also had no significant effect on root volume. Coffee plants treated with watering (P2) with a watering interval every two days produced the lowest average, namely 9, and with treatment (P1), watering every day, namely 9, (P3) watering interval every three days, namely 10. Coffee plants treated with various types of roots (M2) and dry coffee leaves produced the lowest average, namely 10, and with treatment (M1) coffee fruit skin, namely 10, both treatments had no effect on ingestion.

5. Root Dry Weight (g)

Table 11. Dry weight of roots with interval treatment watering and mulching

Treatment	Month After Planting (BST) 1	2	3
Watering (P)			
P1	0.06	0.06b	0.04a
P2	0.07	0.05a	0.04a
P3	0.05	0.04a	0.08c
Mulch (M)			
M1	0.07a	0.06b	0.06
M2	0.07a	0.05a	0.05
PXM Interaction			

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P1M1	0.04	0.04a	0.05
P1M2	0.04	0.04a	0.05
P2M1	0.05	0.05a	0.06
P2M2	0.10	0.04a	0.06
P3M1	0.08	0.05a	0.06
P3M2	0.06	0.04a	0.06

Note: Numbers followed by different letters in the same column are significantly different in the BNT 0.05 test and very significantly different in the BNT 0.01 test. P1 = watered every day; P2 = watered every 2 days; P3 = watered once every 3 days; M1 = Dried coffee leaves; M1 = dry coffee fruit skin

Based on Table 11, the results of the BNT test at the 5% and 1% levels show that the watering interval treatment did not have a significant effect, whereas mulch also had no significant effect on the dry weight of the roots. Coffee plants that were treated with watering (P2) with a watering interval every two days produced the lowest average, namely 0.04, and with treatment (P1) watering every day, namely 0.04 (P3) with a watering interval every three days, namely 0.09.

6. Header Dry Weight(g)

Table 12. Dry weight of canopy with interval treatment watering and mulching

Treatment	Month After Planting (BST) 1	2	3
Watering (P)			
P1	1.23a	0.98b	1.21
P2	1.25a	0.91a	0.98
P3	1.45b	0.98b	0.94
Mulch (M)			
M1	1.21	1.2	0.97
M2	1.11	0.96	1.27
PXM Interaction			
P1M1	0.57	0.78	1.14
P1M2	0.58	0.79	1.05
P2M1	0.63	0.91	1.12
P2M2	0.72	1.12	1.45
P3M1	0.67	0.88	1.13
P3M2	0.65	0.87	1.11

Note: Numbers followed by different letters in the same column are significantly different in the BNT 0.05 test and very significantly different in the BNT 0.01 test. P1 = watered every day; P2 = watered every 2 days; P3 = watered once every 3 days; M1 = Dried coffee leaves; M1 = dry coffee fruit skin

Based on Table 12, the results of the BNT test at the 5% and 1% levels show that the watering interval treatment had a significant effect, whereas mulch also had no significant effect on the dry weight of the canopy. Coffee plants treated with watering (P3) with a watering interval every three days produced the lowest average, namely 0.91, and with treatment (P2) with a watering interval every two days, namely 0.94 (P1) every day of watering, namely 1.21. Coffee

plants that were treated with various types of roots (M1) and coffee fruit skin produced the lowest average, namely 0.97, and those treated with (M1) dry coffee leaves, namely 1.27.

7. Head Root Ratio (NAT)

Table 13. Shoot root ratio with interval treatment watering and mulching

Treatment	Month After Planting (BST) 1	2	3
Watering (P)			
P1	0.49a	0.61	0.33
P2	0.56b	0.44	0.41
P3	0.34a	0.41	0.43
Mulch (M)			
M1	0.58	0.50	0.62
M2	0.63	0.52	0.39
PXM Interaction			
P1M1	0.02	0.53	0.48
P1M2	0.08	0.45	0.47
P2M1	0.09	0.55	0.39
P2M2	0.11	0.43	0.40
P3M1	0.11	0.53	0.57
P3M2	0.10	0.54	0.51

Note: Numbers followed by different letters in the same column are significantly different in the BNT 0.05 test and very significantly different in the BNT 0.01 test. P1 = watered every day; P2 = watered every 2 days; P3 = watered once every 3 days; M1 = Dried coffee leaves; M1 = dry coffee fruit skin

Based on Table 13, the results of the BNT test at the 5% and 1% levels show that the watering interval treatment has a significant effect on 1 BST, whereas mulch also has no significant effect on the shoot root ratio. Coffee plants that were given the watering treatment (P1), watering once a day, produced the lowest average, namely 0.33, and with the treatment (P2), the watering interval was once every two days, namely 0.01 (P3), the watering interval was once every three days, namely 1.21. Coffee plants that were treated with various types of roots (M2) and dried coffee leaves produced the lowest average, namely 0.39, and those treated with (M1) coffee fruit skins, namely 0.62.

8. Coffee stomata (%)

Table 14. Coffee stomata with interval treatment watering and mulching

Mulch	Sprinkling			Flat
	P1	P2	P3	
M1	50	40	51	47.0b
M2	52	42	48	47.3b
Flat	51.0b	41.0a	49.5b	

Note: Numbers followed by different letters in the same column are significantly different in the BNT 0.05 test and very significantly different in the BNT 0.01 test. P1 = watered

every day; P2 = watered every 2 days; P3 = watered once every 3 days; M1 = Dried coffee leaves; M1 = dry coffee fruit skin

Based on Table 14, the results of the BNT test at the 5% and 1% levels show that the watering interval treatment has a significant effect, while mulch also has a significant effect on coffee stomata. Coffee plants that were treated with watering (P2) with watering intervals every two days produced the lowest average, namely 41.0 and with treatment (P3) with watering intervals every three days, namely 49.5 (P1), watering once every day, namely 51.0. Coffee plants that were treated with various types of roots (M1) and coffee fruit skin produced the lowest average, namely 47.0, and those treated with (M2) dry coffee leaves, namely 47.3.

4. CONCLUSION

Research I:

1. The results of the research showed that providing watering intervals had a significant effect on drought resistance in coffee seedlings for all observed variables, namely fresh weight, fresh weight and coffee stomata.
2. The results of the research showed that the provision of various types of roots had a significant effect on drought resistance in coffee seedlings for all observed variables, namely coffee stomata.
3. There was no interaction between watering intervals and various types of coffee roots.

Research II:

1. The research results showed that providing watering intervals had a significant effect on drought resistance in coffee seedlings for all observed variables, namely root dry weight 2 and 3 WST, shoot dry weight 1 and 2 WST, shoot root ratio 1 WST and coffee stomata.
2. The results of the research showed that the provision of various types of roots had a significant effect on drought resistance in coffee seedlings for all observed variables, namely root dry weight 1 and 2 BST and coffee stomata.
3. There is an interaction between watering intervals and various types of coffee roots for all observation variables, namely root dry weight 2 BST.

Suggestion:

1. It may be necessary to pay more attention to the intervals and watering measures and can study further regarding various types of roots and various types of mulch.

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