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Natural Nutrition Modification for Acclimatization and Hydroponic

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Abstrak
Tissue culture is one step in plant breeding; the most crucial stage is acclimatization. That is a critical stage that requires media compatibility as a means of accelerating growth. That is often not compatible, and is also often for matches from other media. Hydroponic nutrition is one type that is often used as a substitute in finding compatibility with acclimatization media. Important trying to make that are suitable for hydroponics can also be used as nutrients in acclimatization media, from kind of waste; Apple waste, Moringa waste and Tapioca waste. That fermentation processed with Thianfuse, EM4 and MOL. The results of the study obtained a conclusion: (1) Starter Thianfuse fermentation provides the best results on the yield components, the weight of consumption and the total weight. (2) Moringa waste raw materials give the best results on all components
***Keywords**: Acclimatization, Hydroponic, Nutrition, Waste*

INTRODUCTION

Genetic Engineering and Tissue Culture are two techniques that are often used for the development and multiplication of plant breeding. The success of gene insertion through tissue culture has produced several superior plant varieties from transformation (1) (2). Tissue culture is used to multiply in the F1 phase, with stages; (a) Callus growth, (b) Planlet growth, (c) Acclimatization. The principle of this technique is vegetative propagation in conditioned culture bottles, by utilizing the power of Potipotency. Each part of the plant can multiply because it consists of independent living tissue, so that the individual produced will have the same nature as the parent (3) (4) (5).

The essential part of tissue culture activities is the suitability of the media, both growing media during induction and plant media during the process of acclimatization. The type of media in induction is almost similar to the media used during acclimatization, but in the acclimatization medium the nutritional content is slightly more complicated. The type of solid media is generally in the form of gel or agar, where the nutrient content in the media is mixed and dissolved in agar before the media freezes. While the type of liquid-liquid media contained in the media content is nutrients that are dissolved in water, the condition of the water medium itself can be static or flowing. This depends on the needs of the plant being bred or the desired system (6) (7).

The nutritional content and composition of each type of tissue culture media are different, because it depends on the type of plant or plantlets that are grown. This difference will also result in differences in explant growth and development that are grown in vitro, so the type of growth that we want will influence the choice of media to be used (8) (9). Murashige and Skoog (MS) media are often used because they fulfill macro, micro and vitamin nutrients for plant growth (10) (11) (12).

In addition to adding growth regulating substances (PGR), the nutrient content also plays a role in metabolic growth. In the MS media there is no PGR content, so it needs to be added exogenously. Balance and interaction between exogenous and natural PGR in cells (endogenous) determine the direction of the development of a culture where the addition of PGR to parenchymal tissue will restore the tissue to be meristematic (dediferation)

(13) (14) (15) (16).

Next is the acclimatization phase, which is a critical stage because the climate conditions are different from the conditions in the bottle. In addition to adjustments needed, the growing media also plays a vital role in providing nutrients and micro elements. Nutritional elements in acclimatization media are similar to hydroponic media, so in some cases these media are often used in Soilless Culture (SC) especially Hydroponics (17) (18). So it would be perfect if there was a medium that could be multifunctional,
From the description above there are some similarities between tissue culture media, acclimatization media and hydroponic media. So that it would be perfect if there were a media that could be multifunctional, either as a Hydroponic media or an Acclimatization Media.
Of the various alternatives available in the market, various combinations can be tried that can be used as an Acclimatization Media as well as a hydroponic growing medium. Therefore in this study a series of scientific trials were carried out to utilize the much wasted industrial cider waste as well as waste from the moringa juice industry to produce acclimatization media in a series of tissue culture and genetics which can also be used for early media in the field of hydroponics

RESEARCH METHODS

The study was conducted using the Physio research, method using the Factorial model. The design of the experiment in this study was carried out using a Randomized Block Design (RBD), with the first factor being the treatment of enriched media and the second factor was the type of Nutrient Fermentation. The first factor consists of 4 types of treatment, namely Apple industrial waste, Moringa industrial waste, Mocaf industrial waste and one control (without waste). The second factor consisted of 3 fermentation starter treatments, namely the treatment of Thianfuse fermentation starter, EM4 Starter fermentation treatment and MOL Standard Starter. All treatments were repeated four times. So that in this experiment there were three first treatment factors and three-second treatment factors, where the combination of the first factor and this second factor each applied 4 replications. In mathematical form is 4 x 3 x 3 = 36 units of experiment.

Table 1 Combination of Raw Material Waste and Strater Fermentation

	Waste		
	Aple	Moringa	Mocaf
Thianfuse	1	2	3
EM4	4	5	6
MOL	7	8	9

Information :

1. Thianfuse Fermented Nutrition + Apple Waste (F1 L1)
2. Thianfuse Fermented Nutrition + Moringa Waste (F1 L2)
3. Thianfuse Fermented Nutrition + Tapioca Waste (F1 L3)
4. EM4 Fermented Nutrition + Apple Waste (F2 L1)
5. EM4 Fermented Nutrition + Moringa Waste (F2 L2)
6. EM4 Fermented Nutrition + Tapioca Waste Nutrition (F2 L3)
7. MOL Fermented Nutrition + Apple Waste (F3 L1)
8. MOL Fermented Nutrition + Moringa Waste (F3 L2)
9. MOL Fermented Nutrition + Tapioca Waste (F3 L3)

Nutrition Making Mix:

- Chicken manure
- Straw

- Bran
- Brown sugar
- Waste in H2O
- Stater

Observations on the results of the study were carried out on indicator plants, with parameters:
- Plant height
- Average leaf area
- Number of Leaves
- Total Stover Weight
- Weight consumption

OBSERVATION RESULT

Table 2 Average Observation on Parameters at Harvest

Treatment	Harvest Average				
	Plant Height (Cm)	Leaf Area Index (Cm^2)	Number of Leaves (sheet)	Total Weight (gram)	Consumption Weight (gram)
$F_1 L_1$	9.48 b	23,70 ab	5,25 a	3,59	3,15
$F_1 L_2$	8,04 a	18,24 a	5,33 a	9,42	6,25
$F_1 L_3$	10,58 bc	33,35 c	5,33 a	6,13	3,24
$F_2 L_1$	9,24 ab	16,60 a	5,17 a	3,61	1,82
$F_2 L_2$	9,43 b	24,58 ab	6,17 bc	6,65	3,48
$F_2 L_3$	7,91 a	19,75 a	5,50 a	6,21	3,58
$F_3 L_1$	7,40 a	15,70 a	5,14 a	6,19	3,29
$F_3 L_2$	11,51 c	48,34 c	6,44 c	6,25	3,34
$F_3 L_3$	10,50 bc	29,05 b	5,75 b	6,11	3,46
Nilai HSD 5%	**1,85**	**9,62**	**0,49**		

Information: the numbers followed by the same letter and in the same column show no significant difference based on the HSD Test at the level of 5%, hst = Day After Transplanting.

From reading table 2, it can be seen that at harvest, the highest consumption weight was obtained from the treatment of Thianfuse Fermentation in Moringa Waste (F1 L2), as well as the total brag weight results obtained from the highest treatment of Fermentation with Thianfuse in Moringa Waste (F1 L2) The difference that is seen is quite far between the highest yield of the anen with the results of other treatments. However, the high yield is out of sync with the growth component, where the highest yield on the growth component is treated by fermentation with MOL on Moringa waste.

Although the yield between the components of growth and components of this harvest is different, it turns out to have similarities to fermented waste. Moringa waste is a waste that produces the highest value both in the growth component and in the harvest component, except that the harvest component is fermented with Thianfuse and in the growth component fermetasi with MOL.

Table 3. Average Plant Height Observation Results (cm) During the Growth Process As a Result of the Effects of the Interaction of the Nutrition Treatment of Apple, Moringa and Tapioca Waste with Starters Thianfuse, EM4, and MOL

Treatment	Average Plant Height (Cm) on Observations to			
	1	2	3	4
$F_1 L_1$	4,16 c	7,28 b	9,26 bc	9,38 b
$F_1 L_2$	3,85 b	6,52 ab	7,48 ab	7,94 a
$F_1 L_3$	3,20 a	5,43 a	8,33 b	10,46 bc
$F_2 L_1$	3,46 a	6,64 ab	7,25 ab	8,13 ab
$F_2 L_2$	3,58 ab	6,11 a	9,28 bc	9,31 b
$F_2 L_3$	3,81 b	6,49 ab	6,89 a	7,79 a
$F_3 L_1$	3,57 ab	6,46 ab	6,70 a	7,38 a
$F_3 L_2$	3,43 a	7,00 b	10,32 c	11,39 c
$F_3 L_3$	3,92 bc	7,92 c	8,92 b	10,38 bc
HSD 5%	0,59	1,62	1,31	1,85

Information: the numbers followed by the same letter and in the same column show no significant difference based on the HSD Test at the level of 5%, hst = Day After Transplanting.

From reading table 3, it can be seen that for the growth component of plant height, the measurement results are obtained as follows; on the 1st observation the fermentation treatment using Thianfuse on Apple Waste (F 1 L 1) gave the highest yield of 4.16 Cm. But on observation 2, the highest results were shown by the treatment of Fermentation with MOL on Tapioca waste (F 3 L 3) which is 7.92 Cm. Starting at observation 3 to Harvest (Table 2), the measurement results show the highest yield stability in the treatment of Fermentation using MOL on Moringa Waste (F 3 L 2). The height of plants that are shown successively is 10.32 cm, 11.39 cm and 11.51 cm. In general, all the results of the highest measurements show statistically significantly different results compared to other treatments.

Table 4 Average Leaves / LAI (cm2) Observation Results During the Growth Process As a Result of the Effects of the Interaction of Nutrient Treatment of Apple, Moringa and Mocaf Waste with Thianfuse Starters, EM4, MOL

Treatment	Average of LAI (Cm^2) at each observation			
	1	2	3	4
$F_1 L_1$	9,33 b	12,97 ab	19,93 a	22,76 ab
$F_1 L_2$	10,22 bc	13,26 ab	14,09 a	17,23 a
$F_1 L_3$	5,76 a	23,07 c	23,33 a	30,35 c
$F_2 L_1$	7,46 ab	11,93 ab	14,69 a	15,62 a
$F_2 L_2$	6,53 a	16,47 b	19,55 a	22,58 ab
$F_2 L_3$	9,19 bc	9,80 a	12,27 a	18,75 a
$F_3 L_1$	7,78 ab	9,44 a	15,36 a	16,63 a
$F_3 L_2$	8,71 ab	13,45 ab	38,35 b	48,21 c
$F_3 L_3$	10,08 c	10,20 a	13,12 a	27,84 b
HSD 5%	3,55	6,87	15,06	9,62

Information: the numbers followed by the same letter and in the same column show no significant difference based on the LSD Test at the level of 5%, hst = Day After Transplanting.

From reading table 4 to harvest (Table 2) it can be seen that the highest average LAI at the first observation was

obtained in the treatment of Fermentation with MOL on Tapioca waste (F 3 L 3) which is 10.80 cm 2. This result changes at the time of observation second, the highest measurement results obtained on the treatment of Thianfuse fermentation on Tapioca Waste (F1 L3) is 23.07 cm 2. The third measurement until harvest shows the highest leaf area stable in the treatment of Fermentation with MOL on Moringa waste. The results of scattered sequentially are 38.35 cm2, 48.21 cm2 and 48.34 cm2 at harvest. In general, all the results of the highest measurements show statistically significantly different results compared to other treatments.
If seen in general on the growth component, it will be seen from the results that at the beginning of the growth the treatment was less stable. In table 2 to table 4, it can be seen that after growth and entering into observations 3. Visible results of observations on the growth component (Plant Height, Leaf Area and Number of Leaves) in the treatment of Fermentation with MOL on Moringa Waste. This is possible as a slow reaction from Nutrition in the Sigmoid growth curve of Mustard plants. Where at the beginning of the growth of indicator plants will absorb nutrients but the slow vegetative phase factor is still very dominant, when entering the third observation the growth rate has penetrated the rapid vegetative phase and the nutrient uptake has increased (19) (20). Nutrient interactions (Nutrition) with these plants have a significant effect on the components of growth.
The results of the growth component will be different if we look at it and compare it with the results of observations on the harvest component (Table 2), where the harvest component clearly shows that the best results are obtained from the treatment of Fermentation with Thianfuse in Moringa Waste. The results obtained were 9.42 grams of plant average for harvest weight and 6.25 grams of cropping average for consumption weight. This can happen because the yield is not only influenced by the growth component, but also influenced by the water content as a result of the effect of Mass Flow on plant nutrient uptake in the root system (21) (22) (23) (24).

From the overall results, it can be seen that the Nutrition Formation carried out with Thianfuse provides better results than those fermented with EM4. This can happen because the primary ingredient of Thianfuse is Trichoderma sp in cocopeat, so that when the fermentation process occurs Trichoderma will release a type of humic acid into the nutritional media produced. The content of humic acid is able to improve the quality of nutrients produced at the end of the incubation period, so that it can be an excellent nutrient for the growth of mustard plants. Conversely with EM4, although it also gives good results compared to controls, it cannot be as maximal as fermentation with Thianfuse (25) (26) (27) (28) (29) (30).

From the explanation above can be drawn an assumption that the most influential in the growth of indicator plants is the essential ingredient of moringa waste. Indeed, in moringa medical science daikenal as plants that are rich in nutrients, and can be used as alternative medicine ingredients (31) (32).

Therefore a content study is needed in Moringa waste, so that the list is obtained as follows:

Table 5 Results of Moringa Content Analysis

Water Content	14.8%
Ash Analysis	3.8%
Fat Content	4.5%
Protein Content	24.2%
Carbohydrat content	50.4%
EGCG (epigallocatechin-3gallate)	13.9%

Ash content has a close relationship with the mineral content and purity of material content, besides that Moringa is a leaf with high minerals such as Sodium (Na), Potassium (K), Magnesium (Mg), Calcium (Ca), Phosphorus (P), and Iron (Fe) (33). So that a more in-depth analysis of the contents of Moringa waste is needed:

Table 6 Results of Moringa Waste Analysis

Element	Unit	Total	Element	Unit	Total
Ca	%	3.65	**Zn**	mg/kg	31,03
P	%	0.30	**Cu**	mg/kg	8,25
Mg	%	0.50	**Mn**	mg/kg	86,80
K	%	1.50	**Fe**	mg/kg	490,00
Na	%	0,17	**Se**	mg/kg	363,00
S	%	0.63	**Br**	mg/kg	49,93

CONCLUSION:

From the results of the research and discussion, there were some conclusions;

1. Starter Thianfuse fermentation gives the best results on the yield components, namely consumption weight and wet stover weight. This is caused by the active ingredient Thianfuse which is Trichoderma which will produce Humic Acid in addition to the fermentation process itself.
2. Moringa waste materials provide the best results on all components, because the content of moringa waste does not fall too far and has a variety of minerals

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REFERENCES

i. *Admojo L, Indrianto A, Hadi H. PERKEMBANGAN PENELITIAN INDUKSI KALUS EMBRIOGENIK PADA JARINGAN VEGETATIF TANAMAN KARET KLONAL (Hevea brasiliensis Muell. Arg). War Perkaretan. 2016;*

ii. *FITRAMALA E, KHAERUNNISA E, DJUITA NRDR, SUNARSO H, RATNADEWI D. Kultur in vitro pisang Kepok Merah (Musa paradisiaca) untuk mikropropagasi cepat. E-Journal Menara Perkeb. 2017;*

iii. *Suryani R, Sari MN. PENGGUNAAN BERBAGAI MACAM MEDIA TANAM DAN PEMBERIAN PUPUK ORGANIK CAIR PADA TAHAP AKLIMATISASI TERHADAP PERTUMBUHAN PLANLET ANGGREK BULAN (Phalaenopsis amabilisi) HASIL KULTUR JARINGAN. J Appl Agric Sci Technol. 2019;*

iv. *Anggraeni TDA, Sulistyowati E, Purwati RD. Pengaruh Komposisi Media dan Sumber Eksplan Terhadap Induksi Kalus, Perkecambahan, dan Pertumbuhan Tunas Embrio Somatik Jarak Pagar. Bul Tanam Tembakau, Serat Miny Ind. 2016;*

v. *Bhatia S. Plant Tissue Culture. In: Modern Applications of Plant Biotechnology in Pharmaceutical Sciences. 2015.*

vi. *De Filippis LF. Crop improvement through tissue culture. In: Improvement of Crops in the Era of Climatic Changes, Volume 1. 2014.*

vii. *Kumar PP, Loh CS. Plant tissue culture for biotechnology. In: Plant Biotechnology and Agriculture. 2012.*

viii. *Kristina NN, Syahid SF. Induksi Perakaran dan Aklimatisasi Tanaman Tabat Barito Setelah Konservasi In Vitro Jangka Panjang. Bul Littro. 2012;*

ix. *Kurniasih W, Nabiila A, Nurul Karimah S, Farhan Fauzan M, Riyanto A, Putra RR. PEMANFAATAN BATU ZEOLIT SEBAGAI MEDIA AKLIMATISASI UNTUK MENGOPTIMALKAN PERTUMBUHAN ANGGREK BULAN (Phalaenopsis) HIBRIDA. BIOMA J Ilm Biol. 2017;*

x. *Plan Tissue Culture Engineering. Plan Tissue Culture Engineering. 2007.*

xi. *Pollard JW, Walker JM, Stepan-Sarkissian G. Selection of Media for Tissue and Cell Culture. In: Plant Cell and Tissue Culture. 2003.*

xii. *George EF, Hall MA, Klerk GJ De. Plant propagation by tissue culture 3rd edition. Plant Propagation by Tissue Culture 3rd Edition. 2008.*

xiii. *Media-composition TC. Media-composition, Tissue Culture. PhytoTechnology Lab Inc Prod Inf sheet. 2003;*

xiv. *Jiménez VM. Involvement of plant hormones and plant growth regulators on in vitro somatic embryogenesis. Plant Growth Regul. 2005;*

xv. *Guo B, Abbasi B, Zeb A, Xu L, Wei Y. Thidiazuron: A multi-dimensional plant growth regulator. African Journal of Biotechnology. 2013.*

xvi. *Gaspar T, Keveks C, Penel C, Greppin H, Reid DM, Thorpe TA. Plant hormones and plant growth regulators in plant tissue culture. In Vitro Cellular and Developmental Biology - Plant. 1996.*

xvii. *Saha S, Monroe A, Day MR. Growth, yield, plant quality and nutrition of basil (Ocimum basilicum L.) under soilless agricultural systems. Ann Agric Sci. 2016;*

xviii. *Roosta HR. Comparison of the Vegetative Growth, Eco-Physiological Characteristics and Mineral Nutrient Content of Basil Plants in Different Irrigation Ratios of Hydroponic:Aquaponic Solutions. J Plant Nutr. 2014;*

xix. *Yin X, Goudriaan J, Lantinga EA, Vos J, Spiertz HJ. A flexible sigmoid function of determinate growth. Ann Bot. 2003;*

xx. *Birch CPD. A new generalized logistic sigmoid growth equation compared with the Richards growth equation. Ann Bot. 1999;*

xxi. *Nguyen NT, McInturf SA, Mendoza-Cózatl DG. Hydroponics: A Versatile System to Study Nutrient Allocation and Plant Responses to Nutrient Availability and Exposure to Toxic Elements. J Vis Exp. 2016;*

xxii. *Matimati I, Verboom GA, Cramer MD. Nitrogen regulation of transpiration controls mass-flow acquisition of nutrients. J Exp Bot. 2014;*

xxiii. *White PJ. Long-distance Transport in the Xylem and Phloem. In: Marschner's Mineral Nutrition of Higher Plants: Third Edition. 2011.*

xxiv. *Lita RF, Dan, D. SA. Sumber dan Frekuensi Aplikasi Larutan Hara sebagai Pengganti AB Mix pada Budidaya Sayuran Daun secara Hidroponik. Hortik Indones. 2014;*

xxv. *Bolar JP, Norelli JL, Harman GE, Brown SK, Aldwinckle HS. Expression of fungal chitinolytic enzymes in transgenic apples confers high levels of resistance to scab. In 2011.*

xxvi. *Martínez-Medina A, Van Wees SCM, Pieterse CMJ. Airborne signals from Trichoderma fungi stimulate iron uptake responses in roots resulting in priming of jasmonic aciddependent defences in shoots of Arabidopsis thaliana and Solanum lycopersicum. Plant Cell Environ. 2017;*

xxvii. *Harman GE, Herrera-Estrella AH, Horwitz BA, Lorito M. Special issue: Trichoderma-from Basic*

Biology to biotechnology. Microbiology. 2012;

xxviii. Tala S, Irfan M. EFEK LAMA PENYIMPANAN FERMENTASI JERAMI PADI OLEH TRICHODERMA SP TERHADAP KANDUNGAN PROTEIN DAN SERAT KASAR. J GALUNG Trop. 2018;

xxix. De Pascale S, Rouphael Y, Colla G. Plant biostimulants: Innovative tool for enhancing plant nutrition in organic farming. European Journal of Horticultural Science. 2017.

xxx. Restida M, Ginting Ca, Yohanes. Pengaruh Pemberian Asam Humat (Berasal dari Batu Bara Muda) dan Pupuk N terhadap Pertumbuhan dan Produksi Tanaman Tomat (Lycopersicum esculentum Mill). J Agrotek Trop. 2014;

xxxi. Busani M, Patrick JM, Arnold H, Voster M. Nutritional characterization of Moringa (Moringa oleifera Lam.) leaves. African J Biotechnol. 2016;

xxxii. Palada MC. The moringa industry in the Philippines: Status, challenges and opportunities. In: Acta Horticulturae. 2017.

xxxiii. El-Sohaimy SA, Hamad GM, Mohamed SE, Amar MH, Al-hindi RR. Biochemical and functional properties of Moringa oleifera leaves and their potential as a functional food. Glob Adv Res J Agric Sci. 2015;