ONLINE ISSN : 2548-5148
PRINT ISSN : 2548-5121

AGROTECH JOURNAL

Volume 6, No. 1, June 2021

Published by USN Scientific Journal Group, Indonesia
http://www.usnsj.com/

Editorial Board

Hardcopy Provider
USN Scientific Journal
Jl. Pemuda, No. 339 Kolaka – 93517
Southeast Sulawesi
Indonesia
Website: www.usnsj.com
Email: info@usnsj.com

All papers in this book are available by online and meet the minimum requirements of the **USN Scientific Journal**.

Agrotech Journal is indexed at Google Scholar

Table of Content

Volume 6, No. 1, June 2021

Agrotech Journal
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

In Vitro Study: The Potential for Papain Production from Papaya Leaf Callus

AUTHORS INFO

Indarwati
Wijaya Kusuma University Surabaya
Ir.indarwati110262@gmail.com

Dwie Retna Suryaningsih
Wijaya Kusuma University Surabaya
sdwiretna@gmail.com

Sri Arijanti
Wijaya Kusuma University Surabaya
arijantiprakoeswa@gmail.com

Alviana Wahyu Qurotin
Wijaya Kusuma University Surabaya
Alvianawahyuq28@gmail.com

ARTICLE INFO

e-ISSN: 2548-5148
p-ISSN: 2548-5121
Vol. 6 No. 1, June 2021
URL : http://dx.doi.org/10.31327/atj.v6i1.1560

Abstract

The advantage of papain are so assorted thatb it has been broadly need for improvement perposes in industry, medication and creature feed. Papain creation can be developmentt with Biotechnology tissue culture with improving the creation of callus plantled outgrowth leaves can expanded the cantaint of papain. The exploration goals were to decide the sorts of papaya assortments whose leaf callus could create the best papain. Realizing the papain content that can be created from three assortments of papaya leaves planted on MS and VW media. The exploration strategy utilized a totally randomized plan. Factor I was papaya assortments with 3 levels (California, Bangkok, and Gantung). The subsequent factor is the sort of culture media (MS and VW). There are 6 mixes. Every treatment mix is rehashed multiple times with 10 test tests. The outcomes appeared; (1) There was a cooperation between the treatment of the concentrate source from the leaves of 3 sorts of Papaya assortments and the utilization of MS and VW media on callus amount and callus quality boundaries. (2 The amount and nature of callus on MS media was better compared to in VW media. (3) Callus of leaves California assortment produce Papain best than Bangkok and Gantung Variety. (3) Research result show that: all callus produces papain. The callus papaya all assortment containing papain range 11,86 % - 19,50%. The best found in treatment papain M1V1 (MS Media - California (19,50 %); M2V1 (VW Media – California) 18,06 % papain content

Keywords: callus, MS media, papaya varieties, papain, VW media

A. Introduction

Papaya organic product is known to have a sweet taste. This natural product has a high nourishing substance and fiber so it is useful for the wellbeing of the body. The cell reinforcement content in papaya as carotenoids and nutrient an and nutrient C will help diminish the danger of coronary illness and stroke because of stopped-up veins. The substance of nutrient E in papaya natural product capacities to shield cells from harm brought about by malignant growth causing free revolutionaries and its fiber content is valuable in restricting disease-causing poisons in the colon and helps smooth the stomach related framework. Papaya additionally creates sap with Papain catalyst content which is helpful as an answer. protein atoms, and are regularly utilized by numerous individuals in different sorts of mechanical fields. Compounds are biomolecules as proteins that capacity as impetuses that speed up responses in natural substance measures. Papaya produces Papain Enzymes, which are proteolytic proteins created through the tapping seclusion of Papaya sap. The sap in papaya can be delivered through the organic product, stems, and leaves

One approach to build the creation of Papain contained in Papaya plants is by utilizing the tissue culture strategy. Indarwati, Sri Arijanti, Jajuk H, Ristani, Primawan Putra N. (2020), stated that tissue culture biotechnology can be utilized to create secundairy metabolites separated from the callus As a deciding component for the accomplishment of expanding papain creation, the elements that should be considered are the utilization of different assortments of papaya; different culture media, just as the expansion of different sorts and centralizations of carbs. A portion of the way of life media utilized has gone through different recipes created in the piece of the media expected to improve the development and advancement of refined plants.

The media that are regularly utilized are Murashige and Skoog (MS); Vacin and Went (VW). These three sorts of media are regularly utilized in the tissue culture measure on the grounds that these media are considered adequate to meet the full-scale and micronutrients and nutrients required for plant development. each plant requires supplements as natural salts or natural substances to help its development. Supplements in tissue culture are provided through media to incorporate macronutrient components (which are given in enormous amounts) as carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, sulfur, and magnesium. Then, microelements (which are given in limited quantities) and should be accessible incorporate chlorine, manganese, iron, copper, zinc, boron, and molybdenum. The expansion of sugars to the media can likewise expand optional metabolic items like papain (Arijanti and Dwie Retno, 2018).

This examination has a direness that so far papain has been gotten from the extraction of the organs of the papaya plant. This extraordinarily upsets the utilization of papaya plants for human requirements. Culture media likewise impact the development of the amount and nature of callus. Creation papain can be expanded by improving the amount and nature of callus that produce with biotechnology tissue culture. Consequently, in this investigation, endeavors were made to acquire papain content through the callus of papaya leaves, as it is realized that not all that a large part of the papaya leaves was utilized as explants.

The after effects of this examination are relied upon to give benefits, among others; (1). Can deliver papain from papaya leaf callus. (2). Get papaya assortments that contain the best papain. (3.) Obtain in vitro media that can deliver the best papain So that it tends to be utilized to create papain which can be utilized as crude material for the drug business and food added substances.

B. Literature Review

1. Overview of Soybean

Carica papaya L. is a plant beginning from Mexico on the South American mainland, and has now spread and is broadly filled in the jungle. *C. papaya* is the solitary species in the sort *Carica* (Wadekar, A. B., Nimbalwar, M. G., Panchale, W. A., Gudalwar, B. R., Manwar, J. V., & Bakal, R. L., 2021). Papaya is an organic product item that has numerous capacities and advantages, both as a new natural product since it contains a ton of good nourishment (The Golden of Fruit) at a generally reasonable value contrasted with different organic products (Hadiyanto, 2020).

Nations that are known to be very huge makers of Papaya are India and Indonesia. Papaya is a natural product ware that has a sweet taste, is exceptionally nutritious, and furthermore has high fiber which is useful for wellbeing. These nutritious organic products feed the body and safe framework (Wadekar, Ashish.B. *et al*., 2021)

Papaya in Indonesia is very well known in light of the fact that it tends to be utilized for different purposes; as a new natural product, the leaves are for vegetables and for restorative fixings. The presence of papain content which has multi-capacities makes papain very well known for modern purposes and to improve the nature of creature feed.

2. Tissue Culture Biotechnology for Papaya

Tissue culture is a method for isolating parts of plants such as protoplasm, cells, tissues, or organs and growing them in aseptic conditions so that these parts can regenerate into whole plants again. Through tissue culture, it is hoped that the seeds can produce the same plant seeds as their parents, as well as the seeds obtained, are free from pests and disease, and produce uniform seeds (Arijanti, Ribkahwati, and Retna, 2009). Given the importance of the role of the papaya plant which is quite a lot and one way of propagation techniques to increase the production of these plants by vegetative propagation methods through tissue culture becomes a business opportunity (Arijanti and Dwie Retno, 2018). Tissue culture technology has also been widely used to produce secondary metabolic compounds (anthocyanin content) in dragon fruit (Indarwati, *et al*., 2020).

In tissue culture techniques, several media are often used in implementation but Murashige and Skoog (MS) and Vacin and Went media are relatively good media because nutrients, both macro and micro, and vitamins for plant growth and development can be fulfilled. In the method of propagation through in vitro culture, the growth and development of the explants are strongly influenced by the type of basic media and growth regulators. MS medium is the basic medium that is generally used for the propagation of a large number of plant species. The basic media is rich in minerals that stimulate organogenesis.

In this study, papain was obtained through in vitro propagation, namely tissue culture techniques by planting explants of young leaves from 3 (three) varieties of papaya plants through secondary metabolite biosynthesis in this case "papain". Biosynthesis is a process of forming metabolic products from simple molecules to more complex molecules that occur in living things. in this biosynthetic process, includes the process of growth and development of living things. whereas metabolism in living things consists of 2 stages, namely primary and secondary metabolism. Secondary metabolism is a process that is not essential for the life of an organism. Secondary metabolism is produced in the respiration process and occurs in cells in the differentiation process stage into more specific cells in the stationary phase (Arijanti, *et al.,* 2009).

3. Enzim Papain

Normally papaya plants can create sap white when tapped or in hur. Sap white it very well may be delivered on the entirety of its parts like the organic product, blossoms, and leaves petiole (Yuniarti, T., 2008). Nonetheless, the part that contains the most papain is the organic product. Moussaoui A, Nijs M, Paul C, Wintjens R, Vincentelli J, Azarkan M, Looze Y. (2001) said the sap contains water (85%) and the rest is disintegrated materials comprising of salt, fat, starches, and a few other biomolecules. Papaya sap contains a few components, for example, the catalyst papain, lysosin, and other synthetic segments. Aravind, G (2013) added a few phytochemical parts contained in papaya sap,among others, a combination of terpenoids, natural acids,and alkaloids which can restrain the development of a few sorts of microorganisms like flavonoids, glycisides, saponins, and steroids wich have antibacterial properties. Fajriyah, S. N., Lestari, Y. E., Suaka, N. I., & Darmawan, E. (2021), further exspressed that the entire plant papaya contains, lycopene,isothiocyanide,flavonoids and papain compound.

Papain is a proteolytic protein that is created by separating papaya sap (Suryaningsih, D. R., Prakoeswa, S. A., & Eryanto, A. (2021). Papain chemical is known as a calming which can diminish aggravation, including joint inflammation and different illnesses. Osman, A., Merwad, A. R. M., Mohamed, A. H., & Sitohy, M. (2021) said, papain likewise can deliver peptides with natural exercises. The advantage of papain is so assorted that it has been generally needing for improvement purposes in industry, medication, and creature feed. Papain creation can be developed with tissue culture technology. Improving the creation of callus plant-led outgrowth leaves can improve the content of papain. Papain is helpful as a breakdown of protein particles and is frequently utilized by numerous individuals in different kinds of modern fields.

Amri and Mamboya, (2012) said compound papain is a proteolytic chemical fit for separating proteins to amino corrosive to be all the more effectively absorbable. Such as the statement of Khati, A., M. Danish, K. S. Mehta dan N. Pandey. 2015, that the papain enzyme is a protease catalyst that hydrolyzes protein, which is a vital factor for expanding protein edibility and absorption, which at last influences development. Chemical papain goes about as an impetus to improve the

natural summary feed of bad quality, with the goal that the feed cost can be minimized. Further (Amri & Mamboya, 2012), clarifying that this compound is fit for separating natural atoms made of amino acids, known as polypeptides and assumes a significant part in different organic cycles in physiological states, drug plan, mechanical uses like meat tenderizers and drugs. Papain's extraordinary construction gives usefulness that clarifies how proteolytic catalysts work and makes them significant for different purposes.

Chemical papain can lessen the negative factor of phytic corrosive determined of elementary substance vegetable feed. In the tobacco business compound papain used to assemble quality tobacco. Wulan M. (2017), further added that chemical papain is a compound of proteases that can catalysis just as proteolytic microbes actives on tobacco in a cycle of debasement nicotine. The cycle produces a compound that is less difficult yet didn't rever to nicotine content. The compound papain in response is required to help the movement of catabolism microscopic organisms proteolytic religation in the process with the goal that the nicotine isn't just the metabolism but additionally a decrease tobacco nicotine levels. A few investigations of papain treatment showed the treatment of papain compound focus level had had a genuine effect (alfa 5 %) on nicotine and the all-out sugar of tobacco leaves treatment; yet not actually affected the water content, levels protein content, splendor, ruddy, and yellowish. Best treatment dependent on substance examination; physical and organoleptic found in the treatment splashing with the compound papain level of grouping of 1,200 ppm. (Jeki, D., & Isna R., 2017). Papain likewise can be utilized to caffeine espresso beans (Arif, M. M., 2020).

The natural impacts of papain are different to the point that is broadly utilized for different motivations behind the food business as well as improving the nature of creature feed and fish feed. Alongside the advancement of biotechnology.

Normally papain can be created by tapping the sap; likewise can be delivered with biotechnology tissue culture. Papain can be conveyed from ekstraktion callus by planting organ papayas in tissue culture. Cultur media additionally impact the development of the amount and quality of callus. Creation papain can be extanded with improving the amount and nature of callus that produce with biotechnology tissue culture.

.

C. Methodology

1. Place and Time

The study was conducted at the Tissue Culture Laboratory; Faculty of Agriculture, University of Wijaya Kusuma Surabaya., Starting in September 2020 and finishing off in Februari 2021.

2. Material and Method

The materials utilized during this exploration are: explants starting from the youthful leaf of 3 assortments of papaya (California, Bangkok dan Gantung) just as the fundamental media of Murashige and Skoog (MS). what's more, VW Media. NAA and BAP Growth Regulators, Coconut Water, Glucose, Fructose, Sucrose, 70%, and 90% Alcohol. Plantlet from leaves 3 Papaya assortment.

Equipment required during this research are: Sartorius Scales, Autoclave, Oven, LAF, pH meter, Tweezers, Scalpel, Erlenmeyer, Measuring cup, Measuring pipette Petri dish, Dropper Pipette, tweezers, spatula, Culture tube, Magnetic stirrer, and other.

3. Research Design

The study was conducted using a completely randomized design with two factors. The Factor I: sorts of culture media there are 2 levels; M1 = MS media; M2 =VW media (Table 1). Factor II. Kinds of papaya varieties there are 3 levels; V1 = California; V2 =Bangkok ; V3 : Gantung. Each treatment was repeated 4 times, with 10 replications each.

4. Instrumens

The gear utilized was enveloped by earthy colored paper and cleaned at 121 ° C for 30 minutes. Sterile culture tubes with Autoclave 17 psi 30 minutes. essential media utilized by MS media and the other treatment utilized VW Media.

Sterile youthful leave explants from 3 sorts assortment of Papaya at that point cut into ± 1 cm pieces and absorbed betadine, planted in culture tubes that as of now contain media as indicated by treatment. In the wake of planting it is set on a brooding rack which comprises hatching stages.

5. Variable

a. Callus quality. Seen at timespans weeks outwardly utilizing scoring: 1 = no callus; 2 = reduced callus; 3 = friable.callus

b. Callus Quantity: Observed at timespans weeks outwardly by scoring: Scor 1 = no callus; 2 = growing of explants; 3 = little callus (<1 times the explant size); 4 = medium callus (1-2 times the explant size); 5 = many callus (> multiple times the explant size)

c. The content of secondary metabolites in the callus (Enzim Papain): Observed ruinously through papain content examination at about two months subsequent to planting (56 days) Secondary Metabolite Analysis of the material extricated utilizing total liquor at that point broke down by gas chromatography

Table 1 . Comparison of composition between MS media and VW media (Arijanti and Dwi Retno S. 2018)

Media Murashige & Skoog (MS)			Media Vacin Went (VW)		
	Unsur Hara	Jumlah (mg/L) Media		Unsur Hara	Jumlah (mg/L) Media
1	*Unsur Hara Makro*				
	KNO_3	1.900	1	*Unsur Hara Makro :*	
	NH_4NO_3	1.650		NH_4NO_3	200 mg/L
	$CaCl_2.2H_20$	440		KNO_3	525 mg/L
	$MgSO4.7H_20$	370		KH_2PO_4	250 mg/L
	KH_2PO_4	170		$MgSO_4.7H_2O$	250 mg/L
2	*Unsur hara mikro*			$(NH_4)_2SO_4$	500 mg/L
	$FeSO_4.7H_2O$	27.8	2	*Unsur Hara Mikro :*	
	Na_2EDTA	37.3		Fe(EDTA)	37 mg/L
	$CoCl_2.6H_2O$	0.025		$FeSO_4.7H_2O$	28 mg/L
	$CuSO_4.5H_2O$	0.025		$MnSO_4.7H_2O$	7,5 mg/L
	H_3BO_3	6.2	3	*Sumber Energi :*	
	Kl	0.83		Sukrosa	20 g/L
	$MnSO_4.H_2O$	16.9	4	*Pemadat*	
	$Na_2MoO_4.2H_2O$	0.25		Agar - agar	8 g/L
	$ZnSO_4.7H_2O$	8.6			
3	*Senyawa organic*				
	Sukrosa	30			
	Myo-inositol	100			
	Asam Nikotinat	0.5			
	Pyridoxine	0.5			
	Thiamin-HCl	0.1			
4	*Pemadat*				
	Agar-agar	8			

6. Technique of Data Analysis

The data obtained were processed using Variance Analysis (Test F) using a completely randomized design patterns at the level of 5%. If there were any real differences between treatments. If there is an influence that is a significant difference between treatments then the test is continued with a comparison test between treatments using the Least Significant Difference Test (LSD) at the 5% level.

D. Result

1. Observation of Callus Quantuty

Analysis of callus quantity showed that there were no interactions between the single factor of kinds media and the Varieties of papaya on callus quantity parameter at 1,.3, 5, and 7 WAP. The interaction between the treatment of the use of kinds of Media Culture and kinds varieties of papaya (California, Bangkok, and Gantung) were seen in the callus quantity parameters at 8, 9, and 10 WAP observation. The results of observations of the growth of the quantities callus of papaya starting from the age of 1 to 7 weeks after planting can be seen in Table 2

Table 2. Average scoring Quality callus due to kinds of Media Cultur at Various Age Obsevation

Treatment	Weeks after planting (wap)			
	1	3	5	7
MS Media	1.0	1.0	1.0	1.1
VW Media	1.0	1.0	1.0	1.0
LSD 5%	ns	ns	ns	ns

Note: ns = Not Significant

Table 2 it can be seen that there until the age of 7 weeks the treatment of different kinds of culture media had the same affect on quantities of callus with score of 1,00 , both MS and VW

media callus had not been formed. While from the age of 7 WAP on MS media calus growth began to occur with a score of 1,10 and on the VW media had a score still 1,00. In this study pertumbuhan kalus dari plantlet daun pepaya pada media MS baru terlihat pada minggu ke 7 dengan nilai scor kuantitas calllus 1,1.

Table 3. Average skoring Quantity of calus due to Kinds of Varieties Papaya

Treatment	Weeks after planting (wap)			
	1	3	5	7
California	1.0	1.0	1.0	1.0
Bangkok	1.0	1.0	1.0	1.0
Gantung	1.0	1.0	1.0	1.0
LSD 5%	ns	ns	ns	ns

Note: ns = Not Significant

Table 3 it can be seen that there until the age of 7 weeks the treatment of different kinds varieties of papaya had the same affect on quantities of callus with score of 1,00 , both Varieties California, Bangkok and Gantung callus had not been formed. Until the age of 7 WAP the score quantities calis still of 1,00. The interaction between culture media typies and papaya varieties on callus quantity parameters occurred starting at the 8 -10 week observation has seen at figure1.

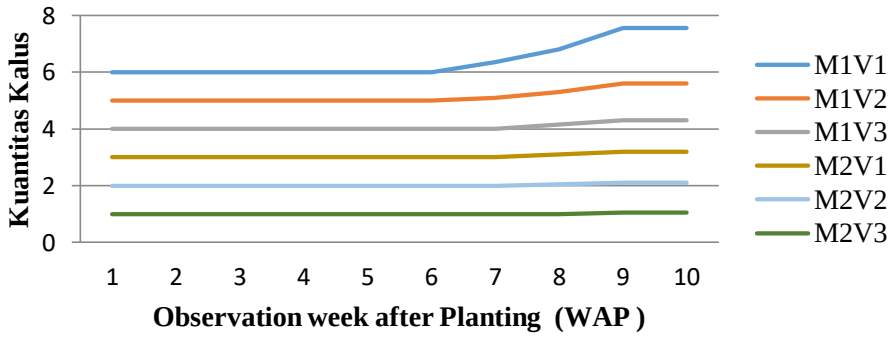

Figure 1. A curve tren quantity of callus growth observation 1 – 10 WAP

On Figure 1; It look that from time to time observation all treatment that is trying show trent better growth. Combination M1V1 Treatment exhibit picture growth quantity callus is better than the other treatment.

2. Observation of Callus Quality

Analysis of callus quality showed that there were no interactions between the single factor of kinds media and the Varieties of papaya on calus qualiy parameter at 1, 3, 5, and 7 WAP. The interaction between the treatment of the use kinds of Media Cultur and kind of papaya varieties (California, Bangkok and Gantung) were seen in the callus quality parameters at 9 and 10 WAP observation. The results of observations the growth of the callus qulity of papaya starting from the age of 1 to 8 Weeks after planting can be seen in Table 4.

Table 4. Average scoring quality callus due to kinds of Media Cultur at Various Age Obsevation

Treatment	Weeks after planting (wap)			
	1	3	5	7
MS Media	1.0	1.0	1.0	1.1
VW Media	1.0	1.0	1.0	1.0
LSD 5%	ns	ns	ns	ns

Note: ns = Not Significant

From table 4. It can be seen that until the age of 7 weeks the treatment of different kinds of culture media had the same affect on quality of callus with score of 1,00 , both MS and VW media callus had not been formed. While from the age of 8 WAP on MS media callus growth began to occur with a score of 1,0 and the VW media had a score of 1,0. The results of

observations the growth of the callus qulity of papaya starting from the age of 1 to 7 Weeks after planting can be seen in Table 5.

Table 5. Average skoring quantity of calus due to Kinds of Varieties Papaya at various age observation

Treatment	Weeks after planting (wap)			
	1	3	5	7
California	1.0	1.0	1.0	1.0
Bangkok	1.0	1.0	1.0	1.0
Gantung	1.0	1.0	1.0	1.0
LSD 5%	ns	ns	ns	ns

Note: ns = Not Significant

From table 5 It can be seen that until the age of 7 weeks the treatment of different kinds varieties of papaya had the same affect on quality of callus with score of 1,00 . Both of Varieties California, Bangkok and Gantung had not been formed callus until the age of 7 WAP the quanlity of callus still ascore of 1,00 . The interaction between culture media typies and papaya varieties on callus quality parameters occurred starting at the 9 -10 weeks observation has seen at figure 2. Figure 2. It can be seen that interaction M1V1 ; On calus quality parameter treatment between culture media MS and papaya California resulting the best score of quality callus (score 1,70) and significanly different than other treatments. It is also shows that the use of MS media treatment resulted better callus quality growth than VW media.

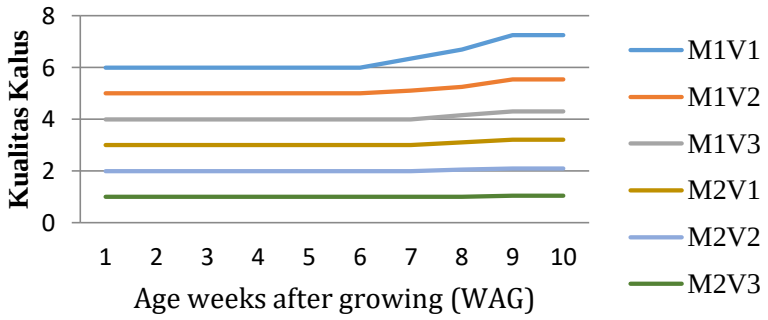

Figure 2. Trend Curve of Callus Quality Development at 1-10 WAG

On Figure 2; It look that from time to time observation all treatment that is trying show trent better growth . M1V1 Treatment show trent growth the quality of a callus most better than another treatment. From a analysis data it seen that scor Quality of calus (1,70) was the best callus seen in treatment M1V1; combination MS media treatment and varietas California papaya .

3. Observation of Callus Quality

The analysis of the papain content of three leaf callus varieties can be seen in table 6. Table 6. shows that the lab analisys, the callus formed in M1V1 Treatmant (MS – California) can produced the best papain content (19,5 %) higher than other treatment. The network culture technology with various varieties of papaya leaf plantlets that were tried was able to form callus with papain content ranging from 11,86 % - 19,5 %. While in M2V1 treatment (VW- California) callus which is formed from papaya leaves contains 18,06 % papain.

Table 6. Analisis of the *papain* content of three varieties of papaya leaf callus on MS and VW media

Treatmant	Papain %
M1V1 (MS Media + California)	19,50
M1V2 (MS Media + Bangkok)	17,20
M1V3 (MS Media + Gantung)	14,80
M2V1 (VW Media + California)	18,06
M2V2 (VW Media + Bangkoak)	14,05
M2V3 (VW Media + Gantung)	11,86

E. Discussion

Osman *et al.,* (2021), from the results of observations on the quantity of callus can be seen at the treatment. From the result of analysis of the observation score for the quantity and quality of callus table 1; 2; 4 and table 5; it can be seen that the leaf plantlets of some papaya varieties show slow growth. Until the 7th week after planting; the use of MS media plant-let still looks fresh and It is just starting to show callus growth with a score of 1,1. Meanwhile, the use of VW media in response to callus growth was greater; the quantity and quality of the callus still showed a score of 1,1 (Figure 1). Until week 7, the use of MS and VW media for the papaya leaf plant-tet culture activities showed a low response. It is assumed that up to7 weeks the planting material/plant-let that was tried was still in the stage of adapting to the media and the environment.

The interaction between the use of various culture media (MS and VW)and the varieties of papaya leaf plantlets (California, Bangkok, and Gantung only visible from 8 – 10 week after planting (WAP). This showed that the explant is starting to adapt and begins to respond to callus growth.) The success of engineering the tissue culture of the plant is highly dependent on the medium used. Further Indarwati *et al.* (2020), added that MS media has a real effect and is very good to use as a culture medium to produce metabolic sekundair (Anthocyanin) from the shoots of dragon fruit stems.

Once of factors that determine the succes of plant regeneration is the availability of carbohydrate sources. For plants bred through tissue culture, carbohidrates serve as a sources of carbon needed to produce energi. From thebresult of the analysis of calus quality observation on table 6. It can also be seen that were tried was to produce various callus qualities. This is inaccordance with Ariani R, Anggraito YU, Rahayu ES. (2016), that the ability of explant to form callus in influenced by the genotype of the explants, the age of the explants, the culture infironment and the responsiveness of each explant

The aftereffects of the experiment of papain content (table 7) show that the callus delivered from different papaya leaf assortments all contain papain. Auxiliary metabolites can be shaped through the biosynthetic pathway in plant cells in papaya, which results from an optional metabolite called papain. Further Arijanti, Ribkahwati, and Retna (2009) clarified that optional digestion is an interaction that isn't fundamental for the existence of an organic entity. Optional digestion is created in the breath interaction and happens in cells in the separation cycle stage into more explicit cells in the fixed stage .

The aftereffects of the investigation showed that the mix of M1V1 treatment delivered the most quieting and was altogether unique in relation to the others. California variety was likewise seen to contain higher papain both on MS medium and on VW medium than in Bangkok and Gantung assortments. This is on the grounds that California papaya leaves have generally many leaf bones so they have high papain content contrasted with Bangkok papaya assortments which have slender leaf bones and Hanging papaya has uncommon leaf bones (Hadiyanto, 2020). The papain content in varietas papaya plants is hereditary.

F. Conclusion

There was an interaction between the treatment of the extract source from the leaves of 3 kinds of Papaya varieties and the use of MS and VW media on callus quantity and callus quality parameters. The quantity and quality of callus on MS media were better than in VW media. Callus of leaves California variety produce Papain best than bangkok and Gantung Variety. Research result show that : all callus produce papain. The callus papaya all variety containing papain range 11,86 %-19,50%. The best faund in treatment papain M1V1 (MS Media- California (19,50 %); M2V1 (VW Media – California) 18,06% papain content.

G. Akcnowledgements

We thank to University of Wijaya Kusuma Surabaya for their support and info

H. References

Amri, E. & F. Mamboya. (2012). Papain, a Plant Enzyme of Biological Importance: A Review. American Journal of Biochemistry and Biotechnology, 8(2):99-104.

Aravind G, Debjit B, Duraivel S, & Harish G. (2013). Traditional and Medicinal Uses of Carica papaya. J Med Plant Stu 1:7 15.

Ariani R, Anggraito YU, Rahayu ES. (2016). Respon Pembentukan Kalus Koro Benguk (Mucuna pruriens L) Pada Berbagai Konsentrasi 2,4-D Dan BAP. Jurnal MIPA 39. Unnes.

Arif, Maulana M. (2020) *Studi Dekafeinasi Kopi Robusta (Coffea Canephora) Dengan Enzim Papain Dan Aplikasi Serbuk Kopi Dekafeinasi Pada Tablet Effervescent.* Undergraduate Thess, Universitas Muhammadiyah Malang.

Arijanti, Ribkahwati dan Retna D. (2009). *Teknik Kultur Jaringan Tanaman*. Fakultas Pertanian Universitas Wijaya Kusuma Surabaya.

Arijanti Sri, Dwie Retno S. (2018). *Kultur Jaringan. Fakultas Pertanian Universitas Wijaya Kusuma Surabaya*:ISBN 979-97382-1-0.

Fajriyah, S. N., Lestari, Y. E., Suaka, N. I., & Darmawan, E. (2021). Narrative Review: Nano Kapsul Ekstrak Biji papaya (Carica Papaya L.) sebagai Antifertilitas. *Jurnal Surya Medika (JSM)*, *6*(2), 10-24.

Hadiyanto, (2020). Pepaya. https://infobuah.com/pepaya/.

Indarwati, Sri Arijanti, Jajuk H, Ristani, Primawan Putra N. (2020). *In Vitro Study : The Addition Of Elicitor Glucose Agsaintt Accumulation Of Anthocyanin On A Callus Dragon Fruits. Eco.Env. & Cons. (Suppl.Issue)pp (S141-S144) .* Available at: http://www.envirobiotechjournals.com/issue_articles.php?iid=317&jid=3

Jeki D, Evy R dan Isna R D. (2017). Pemanfaatan Ekstrak Kasar Enzim Papain Pada Proses Dekafeinasi Kopi Robusta. Jom Faperta Vol. 4 No. 1 Februari 2017. Hal 2-3.

Khati, A., M. Danish, K. S. Mehta dan N. Pandey. (2015). Estimation of Growth Parameters in Fingerlings of Labeo rohita (Hamilton, 1822) Fed with Exogenous Nutrizyme in Tarai Reg ion of Uttarakhand, India. African Journal of Agricultural Research. 10(30), pp. 000 – 3007.

Moussaoui A, Nijs M, Paul C, Wintjens R, Vincentelli J, Azarkan M, Looze Y. (2001). Review : Revisiting the Enzyme Storage in the Laticifers of Catica Papaya in the Contxt of their possible participation in the plant defence mechanism. Cell Mol Life Sci 58:556-579.

Osman, A., Merwad, A. R. M., Mohamed, A. H., & Sitohy, M. (2021). Foliar Spray with Pepsin-and Papain-whey Protein Hydroly-sates Promotes the Productivity of Pea Plants Cultivated in Clay Loam Soil. *Molecules*, *26*, 2805.

Siddiqui, Z.H., Abdul Mujib.,Mahmooduzzafar.,Junaid Aslam.,Khalid Rehman Hakeem., Talat Parween. (2013). In vitro Production of Secondary Metabolites Using Elicitor in Catharanthus roseus: A Case Study. Book Chapter : Crop Improvevement pp 401-4019 Available at: https://link.springer.com/book/10.1007/978-1-4614-7028-1.

Suryaningsih, D. R., Prakoeswa, S. A., & Eryanto, A. (2021). Analysis of Growth and Enzyme Contents of Papain Callus Papaya (Carica papaya L.) Through Tissue Culture Engineering with Saccharomyces cerevisiae Elicitors on MS and VW Media. *Available at SSRN 3799777*.

Wadekar, A. B., Nimbalwar, M. G., Panchale, W. A., Gudalwar, B. R., Manwar, J. V., & Bakal, R. L. (2021). Morphology, phytochemistry and pharmacological aspects of Carica papaya, an review. *GSC Biological and Pharmaceutical Sciences*, *14*(3), 234-248.

Wulan , Maharani, (2017) *Pengaruh Konsentrasi Enzim Papain Pada Proses Perendaman Daun Tembakau (Nicotiana Tabacum) Sebagai Upaya Untuk Penurunan Kadar Nikotin.* Sarjana thesis, Universitas Brawijaya.

Yuniarti, T, (2008). Ensiklopedia Tanaman Obat Tradisional, Cetakan Pertama MedPress, Yogyakarta.

Agrotech Journal
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Yield Component and Productivity of SINHAS 1 Maize on the Application of Different Types and Spraying Frequency of Biofertilizer

AUTHORS INFO

Rusnadi Padjung
Hasanuddin University
Rusnadi2015@gmail.com

Muh Farid Bdr
Hasanuddin University
farid_deni@yahoo.co.id

Rinaldi Syahrir
Hasanuddin University
rinaldi.sjahril@gmail.com

Muhammad Fuad Anshori
Hasanuddin University
fuad.pbt152@gmail.com

Ifayanti Ridwan
Hasanuddin University
ifayanti@unhas.ac.id

ARTICLE INFO

e-ISSN: 2548-5148
p-ISSN: 2548-5121
Vol. 6 No. 1, June 2021
URL: http://dx.doi.org/10.31327/atj.v6i1.1561

Abstract

The purpose of this study was to determine the effect of biofertilizer application based on the types and spraying frequencies on the yield components of maize variety SINHAS 1. The research was conducted in Tarowang Village, Galesong Selatan District, Takalar Regency from August to November 2020. Three types of biofertilizer were used applied in five different frequencies of spraying. The study employed a split plot design with types of biofertilizer as the main plot and application frequencies as the sub plots. The research was repeated 3 times, resulted in a total of 45 experimental units. The maize variety used was SINHAS 1 and observations were made on the yield components of the ear height, wet weight of peeled cobs, ear length and diameter, percentage of seed yield, weight of 1000 seeds at 15% moisture content, and productivity. The results shows that the frequency of biofertilizer application had more dominant effect than the type of biofertilizer. The type of biofertilizer used has relatively the same role in the growth of the yield components of SINHAS 1 corn. Based on the results, it is recommended to apply the biofertilizer in four times in fertilizing the SINHAS 1 maize crop

Keywords: biofertilizer, maize SINHAS 1, spraying frequency

A. Introduction

Maize (*Zea mays* L.) is one of the most cultivated food crops in the world, including in Indonesia and is one of the third leading cereals after rice and wheat to supply the consumption of the global population. Corn is a type of food plant that has a good economic prospect because it can be used as a source of carbohydrates, protein and raw materials for animal feed (Fadhli, N., M. Farid,

Rafiuddin, R. Effendi, M. Azrai, & M.F. Anshori, 2020). However, increasing in population more often correlates with high demand for food and feed (Hasan, 2012), hence to address the gap in demand and production of maize in Indonesia, increasing corn production is inevitable. One of the efforts to increase productivity is fertilization technology.

Fertilization technology consists of several important components such as the type of fertilizer, fertilizer dosage, fertilization method and frequency of fertilizer application. However, at early stage in developing the fertilization technology for a new variety, the type and frequency of fertilization can be the focus of the study (Gofar, 2015). Selection of fertilizer types can be based on inorganic fertilizers, organic fertilizers and biofertilizers. The continuous use of inorganic fertilizers can deplete soil organic matter and degrade soil bio-fertility, the environment, and the balance of soil microorganisms, therefore the use of organic and biofertilizers is important in supporting plant potential. Although both fertilizers are important in supporting soil fertility, the use of biofertilizers is more effective because it involves the potential use of microorganisms in altering the environment becoming more favorable for optimal and efficient plant grow (Schmidt and Gaudin 2018; Nascimento, A.D.M, A.M. Maciel, J.B.G. Silva, H.V. Mendonça, V.R. Paula, & M.H. Otenio (2020). According to Roupahim, I.S. Aminah, & Gusmiatun (2016), biofertilizers play a role in influencing the availability of macro and micro nutrients, nutrient efficiency, performance of enzyme system, increasing plant metabolism, growth and yield. In addition, the use and success of biofertilizers in increasing crop productivity have been widely reported (Kouchebagh, S.B., B. Mirshekari, & F. Farahvash, 2012); Mukhlis and Lestari 2013; Sitorus, M.P., E. Purba, & N. Rahmawati, 2015; Habibullah 2018; Flores 2020). Therefore, research and development of biofertilizers must continue to be developed, especially for newly released varieties. However, the potential for biofertilizers cannot be separated from the fertilizer application process. One of them is the frequency of applying the biofertilizers.

The application of biofertilizers must take into account the concentration and frequency of application to get optimal results. The application of biofertilizers with a certain concentration level and frequency of application can provide optimum results for maize. According to Bastari (2006), the frequency of fertilization, the method of application, and the form of fertilizer appropriately used are important factors in efforts to maintain nutrient availability in the soil, hence determining the correct concentration and frequency of fertilization in corn plants is important in order to increase growth and productivity. The more frequent application of the biofertilizers carried out on plants, the higher the nutrient content will be. However, giving excessive doses will actually cause wilting symptoms or reduce vigor in plants (Suwandi and Nurtika, 1987; Cheema, M.A., M.A. Wahid, A. Sattar, F. Rasul, & M.F. Saleem (2012). Therefore, the right frequency of administration is needed to get the most optimal plant growth.

The SINHAS 1 variety is one form of overcoming the problem of maize production, especially against drought stress and low nitrogen content (Farid, M., Y. Musa, H. Jamil, I. Ridwan, S. Pati, & Nursini, 2020). Several studies have reported the superiority of this variety (Ridwan, I., M.F. Bdr, Y. Musa, H. Jamil, A.R. Amin, M.F. Anshori, S. Pati, N. Nursini, & A.N. Fadhilah (2020); Padjung, R., M.F. Bdr, N. Nasaruddin, I. Ridwan, M.F. Anshori, A.D.M. Abduh, & A.A. Fachri (2020). However, the use of bio-fertilization on this variety has not been widely reported, especially for the combination of biofertilizers and the frequency of application of the fertilizers. Therefore, it is necessary to study the combination of types and frequency of application of biofertilizers. The purpose of this study was to determine the effect of bio-fertilization based on the types and frequencies of spraying on the production components of SINHAS 1 maize

B. Methodology

This research was conducted in Tarowang Village, Galesong Selatan District, Takalar Regency from August to November 2020. The research was carried out in the form of a split plot design (SPD) experiment. The main plot was the application different types of biofertilizers (P) consisted of three levels, namely Ecofarming (p1), Microbat (p2), and Biotani Plus (p3). Subplots were the frequency of biofertilizer application (F) consisted of five levels, namely spraying once at 50 days after sowing (DAS) (f1), spraying twice at 20 and 40 DAS (f2), spraying 3 times at 10, 30, and 50 DAS (f3), spraying 4 times at 10, 20, 30, and 40 DAS (f4), and spraying 5 times at 10, 20, 30, 40, and 50 DAS (f5). Thus, there were 15 treatment combinations that were repeated 3 times resulted in a total of 45 experimental units.

1. Research Implementation Procedurs

Prior to planting, 90 beds, sized of 6 m x 1 m each, were made by previously clearing the land using a tractor and making the beds made manually with a hoe. The beds were set 10 cm high and 50 cm spacing between beds. SINHAS 1 maize seeds were first soaked in furadan solution for 3-5 hours. Planting was carried out by making a hole of 4 cm deep then inserting 2 corn seeds per hole and then covered with soil. Plant spacing used was 40 cm × 100 cm. At 40 DAS, soil heaping and bulking were conducted to maintain better soil aeration. Plant thinning was carried out on two weeks old plants by cutting one of the plants with the least growth, using scissors. Irrigation was done by inundating the plots to the height of the beds. The irrigation was carried out at 7 days intervals from planting to harvest.

Fertilization consisted of two types, namely basic fertilizers and fertilizers as treatment. The basic fertilizer was applied in three times during the plant growth stages. The first fertilization was carried out by providing basic fertilizers in the form of Urea 100 kg ha^{-1} and SP36 50 kg ha^{-1}. Further fertilization was carried out by mixing the fertilizers and applied as much as 6 g/plant placed next to the planting holes by means of a planning stick at 10 and 35 DAS, especially at 35 DAS, the dose of Urea given was reduced to 4 g / plant. Pest control was carried out when an attack occurs and was controlled using pesticides. Harvesting was done after the seeds on the cobs reach the harvest criteria with signs of dry leaves, yellow husks, dry and shiny seeds. Harvesting was carried out manually by twisting the corn cobs with the husk from each plant. Following harvesting, the corn was placed into plastic according to each treatment.

2. Biofertilizer Application

The application of Ecofarming, Microbat, and Biotany Plus biofertilizers to the plants started when the plants were 10 days old by dissolving 5 mL of each of these biofertilizers into 1 liter of water or by dissolving 75 mL of biofertilizer into a 15 liter tank pump. The application was carried out by spraying the upper and lower surfaces of the plant leaves in the morning. The time interval for applying biofertilizers is adjusted to the frequency of spraying. Spraying on the leaves of the plant is a problem in the treatment of biofertilizers, because the tools used did not function properly, so the spraying of biofertilizers may not be evenly distributed throughout the plant leaves. Plant maintenance carried out included weeding by cleaning weeds around the plants. The first and second weeding were carried out at the plant age of 7 DAS and 40 DAS, respectively.

3. Spraying Frequency

Spraying was carried out according to the treatment, namely by spraying 1 time (age 50 DAS), spraying 2 times (age 20 and 40 DAS), spraying 3 times (age 10, 30 and 50 DAS), spraying 4 times (age 10, 20, 30, and 40 DAS), and 5 sprays (aged 10, 20, 30, 40, and 50 DAS). For the five times spraying treatment at 10 DAS, 20 DAS, 30 DAS, 40 DAS, and 50 DAS, the volume of fertilizer application per plot was 2.1 L, 3.45 L, 4.8 L, 6.15 L, and 7 L, respectively. Based on the total number of plants per plot of 30 plants, then for the 5 L volume of spraying the average volume applied per plant was 70 mL for spraying at 10 DAS, 115 mL for spraying at 20 DAS, 160 mL for spraying at 30 DAS, 205 mL for spraying at 40 DAS, and 250 mL for spraying at 50 DAS. Spraying of biofertilizers at 30 DAS was postponed, because on that day pesticides were sprayed to cope with pests that attack the leaves of corn plants, so spraying was carried out the day after.

4. Observation Parameters and Data Analysis

Parameters observed in this study were ear height, wet weight of peeled ear (kg), ear length (cm), ear diameter (mm), seed yield (%), weight of 1000 seeds (g) on moisture content of 15%, and productivity (ton ha^{-1}). The data were collected and then tabulated in tabular form. The tabulated data was then analysed using analysis of variance (ANOVA) to test the effect of the treatment given. If there is a significant or very significant effect, then analysis was proceed with a follow-up test using the Least Significant Difference (LSD) test at the 5% level.

C. Result

Results of the analysis of variance shown in table 1 indicate that the weight of 1000 seeds is the only character that was influenced by the types of biofertilizers treatment. On the other hand, the frequency of application of the biofertilizer had a significant effect on all components of SINHAS 1 yield characters, except for the weight character of 1000 seeds. Meanwhile, there was no significant interaction found between the types of biofertilizers and the frequency of application treatments on the yield component characters of the SINHAS 1 corn.

Table 1. Analysis of variance on the production component characters of SINHAS 1 Maize.

Character	Biofertilizer (P)	Frequency (F)	PxF	Cva	Cvb
Ear height	265.42	228.86*	50.1	19.76	9.45
Wet weight of peeled ear	0.54	3.36*	0.22	6.25	6.36
Ear length	0.29	2.55**	0.13	6.33	3.39
Ear diameter	1.25	5.58*	0.4	2.42	2.51
Seeds yield	2.9	20.57*	5.79	2.42	3.04
Weight of 1000 seeds	3026.14**	96.43	779.5	3.21	6.34
Productivity	0.31	1.39**	0.18	5.78	7.57

***=significant, **=highly significant**

The results of the LSD α=0.05 on the ear height (Table 2) show SINHAS1 maize applied with biofertilizer four times during plant growth resulted in the best average values on the ear height (Table 2) and wet weight of peeled cobs (Table 3). The tallest average of ear height was obtained in the treatment of 4 times spraying frequency (f4), namely 82.84 cm. On the contrary, shortest ear height of 70.58 cm was resulted from the once spraying frequency (f1). Meanwhile, for the character of wet weight of peeled cob (Table 3), the frequency of 4 times spraying (f4) show the highest value for the parameter (15.30 kg) while spraying the plants only once at 50 DAS (f1) showed the lowest average wet weight of peeled cobs of 13.67 kg.

Table 2. Average ear height (cm) of SINHAS 1 maize on different spraying frequency treatment.

Type of biofertilizer (P)	Frequency of spraying (F)					Average
	1 time (f1)	2 times (f2)	3 times (f3)	4 times (f4)	5 times (f5)	
Ecofarming (p1)	70.37	72.50	80.67	87.20	80.20	78.19
Mikrobat (p2)	67.27	81.57	78.07	74.93	77.43	75.85
Biotani plus (p3)	74.10	85.70	84.20	86.40	89.70	84.02
Ave	70.58_{b}	79.92_{a}	80.98_{a}	82.84_{a}	82.44_{a}	
$LSD_{0.05}$	7.30					

Numbers followed by the same letter on the row (a.b) are not significantly different in the LSD test at the confidence level of α 0.05.

Table 3. Average weight of wet weight of peeled cobs (kg) of SINHAS 1 maize on different spraying frequency treatment.

Type of biofertilizer (P)	Frequency of spraying (F)					Average
	1 time (f1)	2 kali (f2)	3 times (f3)	4 times (f4)	5 times (f5)	
Ecofarming (p1)	13.46	14.32	14.54	15.31	13.70	14.27
Mikrobat (p2)	14.04	14.54	14.45	15.24	14.62	14.55
Biotani plus (p3)	13.52	13.85	14.55	15.36	13.85	14.23
Average	13.67_{b}	14.24_{b}	14.51_{ab}	15.30_{a}	14.06_{a}	
$LSD_{0.05}$	0.88					

Numbers followed by the same letter on the row (a.b) are not significantly different in the LSD test at the confidence level of α 0.05.

The results of the LSD α=0.05 on ear length and diameter characters are shown in Table 4 and Table 5, respectively. The highest average of ear length was produced in the treatment of spraying frequency of 4 times (f4), namely 20.48 cm, but it was not significantly different from the treatment of spraying frequency of 3 times (f3). On the other hand, the frequency of spraying 1 time (f1) showed the lowest average of ear length of 19.13 cm. For the ear diameter character, use of spraying frequency of 5 times (f5) resulted in the highest value on the characters (48.78 mm), however, it was not significantly different from the spraying frequency of 3 times (f3) and 4 times (f4). On the other hand, the frequency of spraying 1 time (f1) treatment showed the lowest average ear diameter of 46.72 mm.

Table 4. Average ear length (cm) of maize on different spraying frequency treatment.

Type of biofertilizer (P)	Frequency of spraying (F)					Average
	1 time (f1)	2 times (f2)	3 times (f3)	4 times (f4)	5 times (f5)	
Ecofarming (p1)	19.12	19.97	20.23	20.48	19.73	19.91
Mikrobat (p2)	19.26	19.21	20.09	20.29	19.48	19.66
Biotani plus (p3)	19.00	19.31	19.91	20.67	19.45	19.67
Average	19.13_{c}	19.49_{bc}	20.08_{ab}	20.48_{a}	19.55_{bc}	
$LSD_{0.05}$	0.65					

Numbers followed by the same letter on the row (a.b) are not significantly different in the LSD test at the confidence level of α 0.05.

Table 5. Average ear diameter (mm) of SINHAS 1 maize on different spraying frequency treatment

Type of biofertilizer (P)	Frequency of spraying (F)					Average
	1 time (f1)	2 kali (f2)	3 times (f3)	4 times (f4)	5 times (f5)	
Ecofarming (p1)	46.50	46.63	47.55	47.72	49.00	47.48
Mikrobat (p2)	47.41	47.60	48.22	48.44	48.60	48.05
Biotani plus (p3)	46.26	47.56	47.88	48.13	48.73	47.71
Average	46.72_{c}	47.26_{bc}	47.88_{abc}	48.10_{ab}	48.78_{a}	
$LSD_{0.05}$	1.17					

Numbers followed by the same letter on the row (a.b) are not significantly different in the LSD test at the confidence level of α 0.05

Table 6. Average seed yield (%) of SINHAS 1 maize on different spraying frequency treatment.

Type of biofertilizer (P)	Frequency of spraying (F)					Average
	1 time (f1)	2 times (f2)	4 times (f1)	4 times (f4)	5 times (f1)	
Ecofarming (p1)	71.80	71.21	75.30	76.88	71.58	73.35
Mikrobat (p2)	73.18	73.07	73.86	75.36	75.52	74.20
Biotani plus (p3)	71.58	74.32	73.60	76.17	74.29	73.99
Average	72.19_{b}	72.86_{b}	74.26_{ab}	76.14_{a}	73.80_{b}	
$LSD_{0.05}$	2.19					

Numbers followed by the same letter on the row (a.b) are not significantly different in the LSD test at the confidence level of α 0.05.

Table 7. Average weight of 1000 seeds (g) of SINHAS 1 maize on different type of biofertilizer treatment

Type of biofertilizer (P)	Frequency of spraying (F)					Average	$LSD_{0.05}$
	1 time (f1)	2 times (f2)	3 times (f3)	4 times (f4)	5 times (f5)		
Ecofarming (p1)	376.04	368.72	381.93	380.34	395.13	380.43^{q}	
Mikrobat (p2)	372.22	386.10	380.64	358.42	347.14	368.90^{q}	12.45
Biotani plus (p3)	402.93	402.28	373.00	397.71	409.84	397.15^{p}	
Average	383.73	385.70	378.52	378.82	384.04		

Numbers followed by the same letter on the column (a.b) are not significantly different in the LSD test at the confidence level of α 0.05.

The results of the LSD a 0.05 on the character of seeds yield, weight of 1000 seeds and productivity are shown in Table 6, Table 7, and Table 8, respectively. Based on Table 5, the highest average seeds yield was produced in the treatment of spraying frequency of 4 times (f4), namely 76.14%, but not significantly different from the treatment of spraying frequency of 3 times (f3). The treatment of spraying frequency 1 time (f1) showed the lowest average seed yield, namely 72.19%. In Table 6, the highest average weight of 1000 seeds was produced in the Biotani plus

(p3) biofertilizer treatment, namely 397.15 g. On the other hand, the Microbat biofertilizer treatment (p2) showed the lowest average weight of 1000 seeds of 368.90 g. As for the productivity character, the treatment frequency of spraying 4 times (f4) was the treatment with the highest productivity of 7.17 ton ha^{-1}. On the other hand, the one-time spraying treatment (f1) showed the lowest average productivity, namely 6.22 tonnes ha^{-1}.

Table 8. Average productivity (ton ha^{-1}) of SINHAS 1 maize on different spraying frequency treatment.

Type of biofertilizer (P)	Frequency of spraying (F)					Average
	1 time (f1)	2 times (f2)	3 times (f3)	4 times (f4)	5 times (f5)	
Ecofarming (p1)	6.05	5.77	6.67	7.30	6.14	6.39
Mikrobat (p2)	6.48	6.67	6.66	6.95	6.55	6.66
Biotani plus (p3)	6.13	6.38	6.77	7.26	6.49	6.61
Average	6.22_{b}	6.27_{b}	6.70_{ab}	7.17_{a}	6.40_{ab}	
$LSD_{0.05}$	0.48					

Numbers followed by the same letter on the column (a.b) are not significantly different in the LSD test at the confidence level of α 0.05.

D. Discussion

Based on the ANOVA results, the frequency of biofertilizers application was the dominant treatment in determining the yield components and productivity of SINHAS 1 maize. Meanwhile, types of biofertilizers had a minor effect on the growth of these characters. The low impact of the types of biofertilizers resulted in no significant effect of the interaction between types of biofertilizers and the frequency of application. This result is different from several other studies, where the difference in the frequency of spraying dis not have a significant effect on the character of growth and yield components of corn (Sitorus *et al.* 2015; Habibullah 2018). Similar result was also reported by Wahyuningratri, A., N. Aini, & S. Heddy (2017), on large chilies and Amalia, R., A. Nikmatullah, & K. Zawani (2019). on carrots in a pot. The difference between the results of this study and the previous study was due to the presence of other treatments that were more dominant, such as the dosage of fertilizers, the combination with other types of inorganic fertilizers. Therefore, the provision of biofertilizer frequency is important in the cultivation of SINHAS 1 maize.

The insignificant of the effect of types of fertilizers treatment on most of the yield component characters was due to the composition between fertilizers that was relatively similar, especially on the role of microbes in biofertilizers. However, in the weight of 1000 seeds character, different types of biofertilizers was important, which is indicated by the significant effect of the fertilizer types in the ANOVA table (Table 1). This may be due to differences in potassium content between fertilizers. Based on the macro nutrient content (N, P, K) between fertilizers, Biotani plus has a high K_2O content of 3.69, while Ecofarming is 1.47% and Microbat only focuses on microbial content and does not include potassium content. In general, potassium has a role in the photosynthesis process and seed filling, so an increase in potassium can increase seed weight (Zou, T.X., T.B. Dai, D. Jiang, Q. Jing, & W.X. Cao, 2007). In addition, according to Hasanuzzaman, M., M.H.M.B. Bhuyan, K. Nahar, M.S. Hossain, J.A. Mahmud, M.S. Hossen, A.A.C. Masud, Moumita, & M. Fujita (2018) and Adnan (2020) potassium has a role in the process of transferring food material or phloem loading in seed development, so that the number of empty seeds decreases with the increase in potassium. Therefore, different types of fertilizers due to differences in K content differentiate the character of 1000 seeds weight.

Based on the frequency treatment of biofertilizers, spraying the fertilizers 4 times during the plant growth was the best treatment for yield component characters. As for the spraying frequency of 5 times, several characters experienced a decline in growth. This indicates that the optimization level of the fertilization frequency is in 4 times application. In general, the effect of fertilizer increases gradually and will stagnate or decrease when fertilization has reached the peak dose or frequency. Curve or exponential decline has also been reported by Kyveryga, P.M., A.M. Blackmer, & T.F. Morris (2007), on the application of nitrogen fertilizer to maize crops, also reported by Soro, D., K. Ayolié, F.G.B. Zro, F.Y. Yéboua, H.K. Kouadio, S. Bakayoko, P.T. Angui, & J.Y. Kouadio (2015). on the application of organic fertilizers to maize production, and Cheema *et al*. (2012) on dosing potassium fertilizer on canola plants. In addition, spraying the biofertilizer

4 times up to 40 DAS means that the fertilization was carried out at the stage of vegetative optimization. During this stage, optimal leaf growth is in progress and can alter the photosynthesis process. In contrast, at the spraying frequency of 5 times up to 50 DAS, the leaves have started to turn yellow because the plants are focused on mobilizing seed filling. This was exacerbated in the SINHAS 1 corn cultivation process, where the corn was not defoliated on the dead leaves. Defoliation has a role in efficient use of photosynthate or plant energy (Ridwan *et al*. 2020). Yellow leaves are not optimal in the process of photosynthesis, but the leaves still use energy (Sugito, 2009). Therefore, the use of biofertilizer application of 5 times is considered less than optimal in SINHAS 1 corn production. Meanwhile, biofertilizer application with a frequency of 4 times is recommended in SINHAS 1 corn cultivation.

E. Conclusion

The frequency of biofertilizer fertilization has a more dominant effect than the type of biofertilizer. The type of biofertilizer used has relatively the same role in the growth of the yield components of SINHAS 1 corn. Application of biofertilizer with spraying frequency of 4 times is recommended in fertilizing the SINHAS 1 maize crop.

F. Akcnowledgements

We Authors are in debt to Rachmat Hidayat AM who helped in completing this research. Also, the authors would like to thank the Head of the Village of Tarowang, Takalar Regency, Mr. Halim who has facilitated the site for conducting the research.

G. References

Adnan, M. (2020). Role of Pottasium in Maize Production: A Review. *Op Acc J Bio Sci & Res*. 3(5). http://doi.org/10.46718/JBGSR.2020.03.000083.

Amalia, R., A. Nikmatullah, & K. Zawani. (2019). Pengaruh Kosentrasi dan Frekuensi Pemberian Pupuk Hayati Bio-EXTRIM Terhadap Pertumbuhan dan Hasil Tanaman Wortel (*Daucus carota* L.) dalam Pot di Dataran Rendah. *Jurnal Sains Teknologi & Lingkungan*. 5(2): 112-122. https://doi.org/10.29303/jstl.v5i2.115.

Bastari, T. (2006). *Penetapan Anjuran Teknologi untuk Meningkatkan Efisiensi Penggunaan Pupuk.* Pusat Penelitian Tanah dan Agroklimat, Badan Litbang Pertanian, Bogor.

Cheema, M.A., M.A. Wahid, A. Sattar, F. Rasul, & M.F. Saleem. (2012). Influence of Different Levels of Potassium on Growth, Yield and Quality of Canola (*Brassica napus* L.) Cultivars. *Pak J Agri Sci*. 49(2): 163-168.

Fadhli, N., M. Farid, Rafiuddin, R. Effendi, M. Azrai, & M.F. Anshori. (2020). Multivariate Analysis to Determine Secondary Trait in Selecting Adaptive Hybrid Corn Lines Under Drought Stress. *Biodiversitas.* 21(8): 3617-3624. https://doi.org/10.13057/biodiv/d210826.

Farid, M., Y. Musa, H. Jamil, I. Ridwan, S. Pati, & Nursini. (2020). Pengembangan dan Hirilisasi Produk Jagung Sintetik Unhas (Sinhas 1) Dalam Pemenuhan Kebutuhan Benih dan Produksi Jagung Nasional. Makassar: Penelitian Inovasi dan Pengembangan Unhas Pelaksanaan Tahun 2020.

Flores, M.A.L. (2020). Use of Biofertilizer and Different Timings of Nitrogen Application: A Scheme for Improving Performance of Corn. *IJHCSR*. 10(2): 83-99.

Gofar, N. (2015). *Pupuk dan Pemupukan di Lahan Suboptimal*. Polimedia, Jakarta.

Habibullah, M.H. (2018). Pengaruh Frekuensi Pemberian Pupuk Hayati Terhadap Pertumbuhan dan Hasil Tanaman Jagung (*Zea mays* L.) Serta Kedelai (*Glycine max* L.) di Dataran Sedang. *Thesis*. Universitas Muhammadiyah Malang, Malang.

Hasan, S. (2012). Perkembangan dan Penerapan Teknologi Peternakan dalam Mendorong Industri Perbibitan Sapi di Sulawesi Selatan. *Seminar Nasional dan Forum Komunikasi Industri Peternakan*. International Convention Center. 18-19 September 2012 Bogor. Jawa Barat.

Hasanuzzaman, M., M.H.M.B. Bhuyan, K. Nahar, M.S. Hossain, J.A. Mahmud, M.S. Hossen, A.A.C. Masud, Moumita, & M. Fujita. (2018). Potassium: A Vital Regulator of Plant Responses and Tolerance to Abiotic Stresses. *Agronomy*. 8(31). http://doi:10.3390/agronomy8030031.

Kouchebagh, S.B., B. Mirshekari, & F. Farahvash. (2012). Improvement of Corn Yield by Seed Biofertilization and Urea Application. *World Appl Sci J*. 16(9): 1239-1242.

Kyveryga, P.M., A.M. Blackmer, & T.F. Morris. (2007). Alternative Benchmarks for Economically Optimal Rates of Nitrogen Fertilization for Corn. *Agron J.* 99: 1057-1065.

Mukhlis and Y. Lestari. (2013). Effects of Biofertilizer "M-Star" on Land Productivity and Growth of Sweet Corn in Acid Sulphate Soil of Swampland. *Agrivita.* 35(3): 242-248.

Nascimento, A.D.M, A.M. Maciel, J.B.G. Silva, H.V. Mendonça, V.R. Paula, & M.H. Otenio. (2020). Biofertilizer application on corn (*Zea mays*) increases the productivity and quality of the crop without causing environmental damage. *Water Air Soil Pollut.* 231: 414. http://10.1007/s11270-020-04778-6.

Padjung, R., M.F. Bdr, N. Nasaruddin, I. Ridwan, M.F. Anshori, A.D.M. Abduh, & A.A. Fachri. (2020). Growth and Production of Corn in Various Planting Distances Systems. *Agrotech J*. 5(2). DOI: https://doi.org/10.31327/atj.v5i2.1352.

Ridwan, I., M.F. Bdr, Y. Musa, H. Jamil, A.R. Amin, M.F. Anshori, S. Pati, N. Nursini, & A.N. Fadhilah. (2020). SINHAS-1 Maize Seed Production Through Male-Female Ratio and Pruning Technique. DOI: https://doi.org/10.31327/atj.v5i2.1348.

Roupahim, I.S. Aminah, & Gusmiatun. (2016). Pengaruh Pemberian Jenis Pupuk Hayati terhadap Pertumbuhan dan Produksi Beberapa Varietas Jagung Hibrida (*Zea mays* L.). *Klorofil*. 11(1): 26-31.

Schmidt, J. & A. Gaudin. (2018). What is the agronomic potential of biofertilizers for maize? A meta-analysis. *FEMS Microbiology Ecology*. 94(7). http://dx.doi.org/10.1093/femsec/fiy094.

Sitorus, M.P., E. Purba, & N. Rahmawati. (2015). Respon Pertumbuhan dan Produksi Tanaman Jagung Terhadap Frekuensi Pemberian Pupuk Organik Cair dan Aplikasi Pupuk NPK. *Jurnal Agroteknologi Universitas Sumatra Utara*. 3(4): 1303-1308. https://dx.doi.org/10.32734/jaet.v3i4.11650.

Soro, D., K. Ayolié, F.G.B. Zro, F.Y. Yéboua, H.K. Kouadio, S. Bakayoko, P.T. Angui, & J.Y. Kouadio. (2015). Impact of Organic Fertilization on Maize (*Zea mays* L.) Production in a Ferralitic Soil of Centre – West Côte D'Ivoire. *JEBAS*. 3(6): 556-565. http://dx.doi.org/10.18006/2015.3(6).556.565.

Sugito, Y. (2009). *Ekologi Pertanian*. Malang: UB Press.

Suwandi and Nurtika (1987). Pengaruh Pupuk Biokimia "Sari Humus" pada Tanaman Kubis. *Bulein Penelitian Hortikultura.* 15(20): 213-218.

Wahyuningratri, A., N. Aini, & S. Heddy. (2017). Pengaruh Konsentrasi dan Frekuensi Pemberian Pupuk Hayati terhadap Pertumbuhan dan Hasil Cabai Besar (*Capsicum annum* L.). *Jurnal Produksi Tanaman*. 5(1): 84-91.

Zou, T.X., T.B. Dai, D. Jiang, Q. Jing, & W.X. Cao. (2007). Effects of Nitrogen and Potassium Application Levels on Flag Leaf Photosynthetic Characteristics After Anthesis in Winter Wheat. *Acta Agron Sin*. 33: 1667-1673.

Agrotech Journal
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Effect of Biological Organis Fertilizers and Growth Regulators for Yield of Shallot (*Allium ascalonicum* L.)

AUTHORS INFO

Asrijal
Faculty of Agriculture, Puangrimaggalatung University
Rijalku238@gmail.com

ARTICLE INFO

e-ISSN: 2548-5148
p-ISSN: 2548-5121
Vol. 6 No. 1, June 2021
URL: http://dx.doi.org/10.31327/atj.v6i1.1562

Abstract

Shallot production and productivity of Indonesia is still low; thus, needs to be increased by providing biological organic fertilizers (POH) and growth regulators (ZPT). The research was carried out in the Covid-19 Pandemic Area from December 2019 to March 2020 in Talotenreng Village, Wajo Regency. The aim of this study was to determine the shallot (*Allium ascalonicum* L.) productivity by using POH and ZPT. Two experimental factors with the Randomized Block Design were used as method for this study. The first factor was the POH (P) concentration of 0 ml liter of water^{-1}, 10 ml liter of water^{-1}, 20 ml liter of water^{-1}, and 30 liter of water^{-1}. The second factor was the ZPT concentration (Z) of 0 ml liter of water^{-1}, 1.0 ml liter of water^{-1}, 1.5 ml liter of water^{-1}, and 2.0 ml liter of water^{-1}. The experimental results showed that the POH concentration significantly affected the weight of fresh blubs per plot and the concentration of growth regulators had a significant effect on the number of bulbs per plot and the productivity of shallots as much as 8.09 t ha^{-1}

Keywords: Biological organics, fertilizer, growth regulators, shallots, yield

A. Introduction

Shallots are one of the horticultural vegetable commodities commonly used as basic needs and almost always needed by household consumers as seasoning ingredients and food industry ingredients. In addition, shallots are being used for other purpose like traditional medicine and are preferred due to its distinctive aroma and taste (Surajudin, As'ad, Yusuf, and Mas'ud, 2015). The use of shallots by the community tends to increase along with the population growth. Nowadays, the increasing consumption of fast food in the community (fried rice, satay, *tongseng*, etc.) increases the shallot needs. Furthermore, there are also some preserved food products that use fried shallots (Iriani, 2013).

Shallots contain high vitamins and minerals; hence, this spice hold an important meaning for the community, both from an economic point of view and nutritional content. In every 100 grams of shallots contains 88.00 g of water, 9.20 mg of carbohydrates, 1.50 g of protein, 0.30 g of fat, 0.03 g of vitamin B1, 2.00 mg of vitamin C, 36.00 mg of Ca, 0.80 mg of Fe, 40.00 mg of phosphorus and 39.00 calories of energy (Berlian and Rahayu, 2004).

The low productivity of shallots can be improved should the factors that affect the shallot farming system such as soil, climate, production technology, capital, and labor are managed optimally.

Fertilization is an effort to increase land and shallot productivity. In general, shallot farmers tend to use inorganic fertilizers (NPK) higher than the recommended dose, which causes soil damage, environmental pollution (Righi, Lucialli, & Bruzzi, 2005), and certain pests development, which can ultimately lead to a decrease in shallot productivity. To overcome this problem, alternative technologies that can reduce the input of artificial fertilizers are needed (Zafari & Kianmehr, 2012), preserve land fertility, increase the quantity and quality of yields, and increase farmers' income. One of them is by replacing some of the inputs of chemical fertilizers with organic, natural and biological fertilizers (useful microorganisms).

Using certain effective microbes, organic fertilizers that have not been completely decomposed can be decomposed into useful organic fertilizers for plants. According to Simanungkalit (2007), biofertilizers are living microorganisms provided for the soil as inoculants to facilitate or provide certain nutrients for the plants. Alternative biofertilizers have been distributed and used by the community, which indicate the good prospects of biofertilizers in developing farming as an alternative in environmentally friendly nutrient management. The use of certain organic fertilizers and biofertilizers is suspected to be able to substitute the use of >50% artificial fertilizers in food/horticultural crop farming and effectively increase crop productivity (Suwandi, Sopha, & Yudi, 2015).

In addition to the use of POH to increase shallot productivity, Growth Regulating Substances (ZPT) also can be used. Growth regulators are non-nutrient chemical compounds (nutrients) with certain concentrations that can affect the yield of cultivated plants (Salisbury and Ross, 1995). One of the widely available natural ZPT is corn ZPT which contains organic compounds (Asrijal, Syam'un, Musa, Riadi, 2018). These organic compounds include auxins and cytokinins. Auxins function in inducing cell elongation, influencing apical dominance, inhibition of axillary and adventitious shoots and initiation of roots while cytokinins function to stimulate cell division in tissues and stimulate shoot growth (Salisbury and Ross, 1995). Therefore, the application of growth regulators is expected to increase the growth and yield of shallots. Thus, this study was aimed to determine the effectiveness of of biological organic fertilizer and growth regulators use to increase the yiels of shallots (*Allium ascalanicum* L.).

B. Methodology

The research was conducted in Talotenreng Village, Wajo Regency from December 2019 to March 2020. The materials used were shallots of the Bima Brebes variety, NPK fertilizer, water, ZPT, and POH. The tools used were machetes, scales, meters, labels, sickles, hoes, sprinkles, and writing utensils. The study used a randomized block design analysis with 2 factors: Factor I of POH concentration (P), which consisted of 0 ml liter of water^{-1} (P0), 10 ml liter of water^{-1} (P1), 20 ml liter of water^{-1} (P2), and 30 ml liter of water^{-1} (P3). While, Factor II : ZPT concentration (Z) of 0 ml liter of water^{-1} (Z0), 1.0 ml liter of water^{-1} (Z1), 1.5 ml liter of water^{-1} (Z2), and 2.0 ml liter of water^{-1} (Z3). The experiment was performed in triplicates; thus, there were 48 experimental plots in total.

The land preparation included land clearing and tillage. The land was cleared from plant debris with a sickle to ensure the condition fir for cultivation. Soil tillage was performed by hoeing as deep as 30 cm and creating size of 1.5 m x 1.2 m plot with a trench depth of 30 cm and a trench width of 50 cm as a plot divider.

First, the shallot bulbs were cut into parts. Shallot bulbs were planted with a distancing of 15 cm x 15 cm and 1/3 of the bulb was planted on the side of the planting hole. Each planting hole was filled with vertically planting shallot bulb with its tip facing above the soil. At the beginning of growth, watering was carried out twice, namely in the morning and evening depending on environmental conditions. The morning watering was attempted as early as possible while shallot still looks wet, to reduce pest attacks. Afternoon watering was stopped when the percentage of plant growth had reached more than 90%.

Since fertilization was not used as a treatment; hence, the fertilizer was applied at similar dose to all plants according to the recommended dose for shallots. The type of fertilizer used was NPK. Fertilization was carried out twice, namely at 7 days after planting (DAP) and 21 DAP.

Weeding was started at 7 DAP by removing weeds or wild plants that interfered the shallots growth and development. Bloating was performed at 3, 4, and 5 DAP. The damaged or landslide plots were re-tidied by strengthening the edges of the spaces. Pest control was performed when pest attacks were found by mechanical means and/or with insecticides and fungicides.

Application of biofertilizer (POH) was conduted in 4 times with a span of a week at 20 DAP, 27 DAP, 34 DAP, and 41 DAP. POH was applied by spraying on all parts of the plant with certain concentration, namely the first treatment (P0/control) with a concentration of 0 ml liter of water^{-1}, the second (P1) 10 ml liter of water^{-1}, the third (P2) 20 ml liter of water^{-1}, and the fourth treatment (P3) 30 ml liter of water^{-1}. The application of growth regulators (ZPT) was performed 4 times with a span of a week at 20 DAP, 27 DAP, 34 DAP, and 41 DAP. PGR was applied by spraying on all parts of the plant with certain concentration, namely the first treatment (Z0/control) 0 ml liter of water^{-1}, the second (Z1) 1 ml liter of water^{-1}, the third (Z2) 1.5 ml liter of water^{-1}, and the fourth treatment (Z3) 2 ml liter of water^{-1}.

Shallots were harvested at 60-75 days after planting. Harvesting is characterized by a change in leaf color to pale yellow, the top foliage has dried up and emit a distinctive aroma. The best time to harvest shallot is when the soil is dry and sunny days. The harvest done by lifting the bulb clusters carefully. The parameters of the sample plants observed were the number of bulbs, bulbs weight per plot, and bulb weight per hectare. The data was analysed using Analysis of Variance (ANOVA), if there is significant effect found, it was then followed by Least Significant Difference Test Analysis with the confidence level of 5% (Gaspersz, 1991).

C. Result and Discussion

The results showed that the ZPT concentration was significantly different to the number of bulbs per plot and the POH concentration was significantly different to the fresh bulbs weight per plot and per hectare. While the interaction between POH and PGR was not significantly different on the number of bulbs per plot and the weight of fresh bulbs per plot and per hectare.

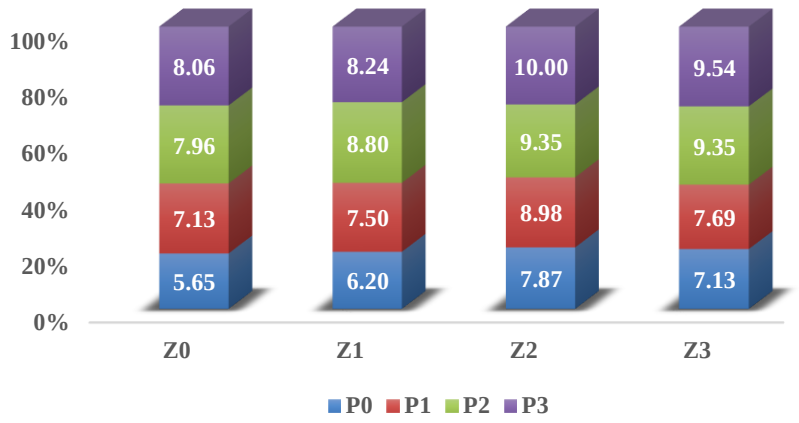

Figure 1. Diagram of the interaction between POH and ZPT on the Weight of Fresh Bulbs per Hectare

Table 1. Average Number of Shallot Bulbs at various ZPT concentrations

ZPT Concentration	Average	Different Value	LSD α = 0.05
Z0	18.7	b	1.02
Z1	19.4	b	
Z2	21.2	a	
Z3	19.5	b	

Note: Numbers followed by the same letter are not significantly different at LSD = 0.05.

Table 2. Average Weight of Shallot Fresh Bulbs at various POH concentrations

POH Concentration	Average	Different Value	BNT α = 0.05
P0	3.63	c	0.59
P1	4.23	b	
P2	4.79	ab	
P3	4.84	a	

Note:Numbers followed by the same letter not significantly different at LSD = 0.05.

Table 3. Average Weight of Shallot Fresh Bulbs per hectare at various POH concentrations

POH Concentration	Average	Different Value	LSD α = 0.05
P0	20.14	c	3.27
P1	23.47	b	
P2	26.60	ab	
P3	26.88	a	

Note:Numbers followed by the same letter are not significantly different at LSD = 0.05.

The results of LSD test (0.05) in Table 1 showed that the best and highest number of bulbs was produced by a ZPT concentration of 1.5 ml liter of water^{-1}, which was significantly different from other PGR concentrations. Growth regulators are non-nutritive organic compounds that in low concentrations can encourage, inhibit, or qualitatively change plant growth and development (Widyastuti and Tjokrokusumo in Asrijal, Syam'un, Musa, Riadi, 2018). PGR concentration significantly affected the number of bulbs per plot, it can be due to PGR contains elements that can assist in plant metabolism processes. This is in line with Asrijal (2020), sweetcorn extract produced the highest yield components, namely the number of bulbs per clump (7.02 bulbs), bulbs yield per clump (30.91 g), and bulbs yield per hectare (17.30 t ha^{-1}).

The results of LSD test (0.05) in Tables 2 and 3 showed that the best and highest fresh weight of bulbs was produced by a POH concentration of 30 ml liter of water^{-1}, which was significantly different from the POH concentration of 0 ml liter of water^{-1} and 10 ml liter of water^{-1}, per plot and per hectare, but not significantly different from POH concentration of 20 ml liter of water^{-1}. It is assumed that the microbes present in POH are able to support shallots growth and production. According to Ghoname & Shafeek (2005), the use of organic fertilizers and biofertilizers can increase plant growth, yield, and quality of crop yields. Based on Suwandi, Sopha, & Yudi (2015) the best doses to increase shallots yields were 2 tons/ha of organic fertilizer (compost), 300 kg/ha Urea + 300 kg/ha ZA, 300 kg/ha SP36, 200 kg/ha KCl. Rahmawati (2020) stated that NPK dose of 350 kg/ha and distancing of 25 x 25 cm was the best for plant height, number of leaves, leaf width, and fresh weight of lettuce.

The interaction between POH and PGR produced yields of 8.09 t ha^{-1}. It is higher than Olvie Grietjie Tandi and Faisal (2020), shallot as one of the local superior varieties has an average yield potential 7-8 t/ha at the farmer level in Minahasa District. However, this result was lower than Asrijal (2020) with yield of 17.30 t ha^{-1} bulbs per hectare.

D. Conclusion

POH concentration of 30 ml liter of water^{-1}, the highest was in fresh bulbs weight per hectare. ZPT concentration of 1.5 ml liter of water^{-1}, the highest was in the number of bulbs per plot. The interaction between POH concentration of 30 ml liter of water^{-1} and ZPT concentration of 1.5 ml liter of water^{-1}, the highest was in fresh bulbs weight per hectare of 8.09 t ha^{-1}.

E. References

Asrijal, Syam'un, E., Musa, Y., Riadi, M. (2018). Characterization, Identification, and Analysis of Plant Growth Regulator (PGR) Conditions to Four Types of Free Clean Maize. *International Journal of Current Research in Biosciences and Plant Biology*. 5(4):17-23. DOI: 10.20546/ijcrbp.

Berlian, N dan Rahayu, (2004). Bawang Merah Mengenal Varietas Unggul dan Cara Budidayanya secara Kontinyu. *Penebar Swadaya*, Jakarta.

Gaspersz, (1991). Metode Perancangan Percobaan. *Penerbit, CV. Armico*, Bandung Indonesia.

Ghoname, A & Shafeek, MR. (2005). Growth and Productivity of Sweet Pepper (Capsicum annuum L.) Grown in Plastic House as Affected by Organic, Mineral and Bio-N Fertilizers. *Journal of Agronomy*, 4(4):369-72.

Iriani Enndang, (2013). Prospek Pengenbangan Inovasi Teknologi Bawang Merah di Lahan Sub Optimal (Lahan Pasir) dalam Upaya Peningkatan Pendapatan Petani. *Balai Pengkajian Teknologi* (BPTP) Jawa Tengah.

Olvie Grietjie Tandi dan Faisal, (2020). Technology Innovation Support in Development of Local Superior Shallot in North Sulawesi. *Agrotech Journal* 5(1):10-21. DOI: https://doi.org/10.31327/atj.v5i1.1233.

Rahmawati, (2020). The Effect of NPK Doses and Plant Distancing on Lettuce (*Lactuca sativa* L.) Growth and Production. *Agrotech Journal* 5(2): DOI: https://doi.org/10.31327/atj.v5i2.1398.

Righi, S, Lucialli, P & Bruzzi, L. (2005). Health and Environmental Impacts of A Fertilizer Plants – Part 1. *Assesments of Radioactive Pollution.J. of. Env. Radioactive*, 8(2):167-82.

Salisbury, F.B dan C.W Ross, (1995). Fisiologi Tumbuhan (Jilid 2). *ITB*, Bandung.

Simanungkalit, RDM. (2007). Aplikasi Pupuk Hayati dan Pupuk Kimia: Suatu Pendekatan Terpadu. *Buletin Agro Bio*., 4(2):56-61.

Surajudin As'ad., R. Yusuf, dan H. Mas'ud, (2015). Respon Tanaman Bawang Merah (Allium ascalonicum L.) Varietas Lembah Palu Terhadap Pemberian Jenis Mulsa dan Pupuk Organik Cair.

Suwandi, Sopha, GA & Yudy, MP. (2015). Efektifitas Pengelolaan Pupuk Organik, NPK, dan Pupuk Hayati Terhadap Pertumbuhan dan Hasil Bawang Merah. *J. Hort.*, 25(3):208-211.

Zafari, A & Kianmehr, MH. (2012). Management and Reduction of Chemical Nitrogen Consumption in Agriculture. *American J. of. Plant. Sci.*, 3(18):27-34.

Agrotech Journal
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Organogenesis of Cavendish Banana (*Musa acuminata* L.) Plant in Various Concentration of ZPT IAA (*Indole Acitid Acid*) and BAP (*Benzyl Amino Purine*) in Invitro Culture

AUTHORS INFO

Rahman Hairuddin
Faculty of Agriculture, University of Cokroaminoto Palopo
rahmanhairuddin73@gmail.com

Mawariani
Faculty of Agriculture, University of Cokroaminoto Palopo
mawarianiagroc@gmail.com

ARTICLE INFO

e-ISSN: 2548-5148
p-ISSN: 2548-5121
Vol. 6 No. 1, June 2021
URL: http://dx.doi.org/10.31327/atj.v6i1.1563

Abstract

Bananas are a horticultural commodity that originates from Southeast Asia and the West Pacific, including Indonesia. Banana cultivation is carried out with the aim of increasing the economic value of the community by cultivating the Cavendish banana species. Cavendish banana (Musa acuminata L.) is one type of banana that is widely exported, and has high economic value. The constraints in the cultivation of this Cavendis banana plant are the small, high-quality tillers produced in large quantities and in a short time. Propagation of seeds with tissue culture technology is one solution in dealing with the problem of providing these seeds. This study aims to determine the effect of ZPT IAA and BAP concentrations on the growth of cavendish banana shoots in vitro. This research was conducted at the Tissue Culture Laboratory of the Faculty of Agriculture, Cokroaminoto University, Palopo, on Jalan Lamaranginang, Batu Pasi Village, Wara Utara District, Palopo City. Starting from January to May 2020. This research was arranged in a completely randomized design (CRD), which consisted of 5 treatments and 3 replications with a total of 15 experimental units. By giving treatment concentrations of P0: Control, P1 (IAA 0.5 mg L-1 and BAP 1 mg L-1), P2 (IAA 1 mg L-1 and BAP 2 mg L-1), P3 (IAA 1.5 mg L-1 and BAP 3 mg L-1), P4 (IAA 2 mg L-1 and BAP 4 mg L-1). With research parameters callus color, callus texture, root emergence time, shoot emergence time, number of shoots, and number of leaves. The results showed that at the concentration with treatment P3: IAA 1.5 mg L-1 and BAP 3 mg L-1 produced the highest number of leaves, namely 3 strands. The fastest root emergence time was 25.33 days and the highest number of shoots was 2.33. While for the time of emergence of treatment shoots P0: Control showed the best results, namely 7 DAS (days after planting). This is because a balanced amount of auxins and cytokinins can affect the growth of banana plants in vitro

Keywords: BAP, IAA, in vitro, cavendish banana (*Musa acuminata* L.)

A. Introduction

Banana is a tropical fruit commodity that is very popular in the world. The total consumption of bananas in 2013 reached 5.63 kg / capita / year (PUSDATINTA, 2014). Currently, it is very important to increase production output and quality to meet the needs of public consumption

which continues to increase every year. It is hoped that with improved cultivation and good techniques, Indonesia can increase the export value of bananas, which in 2007-2011 was only 0.06%.

Cavendish banana (*Musa acuminata* L.) is one type of banana that is widely exported, and has high economic value. The constraints in the cultivation of this Cavendis banana plant are the small, high-quality tillers produced in large quantities and in a short time.

Tissue culture technology is a method used to be able to produce healthy seeds in large quantities and in a relatively short time. The new individual pups that are produced will be genetically the same as their parent (Dwiyani R, Yuswanti H, Darmawati IAP, Suada K & Mayadewi NNA., 2015). In vitro propagation is carried out with the composition of the planting medium and the addition of appropriate growth regulators (ZPT) as a requirement for good plant growth and development, in fulfilling macro nutrients, micro nutrients, vitamins, carbon sources, and various growth regulators. synthetic and natural from the auxin and cytokinin group. (Eriansyah *et al*., 2014). The explants used come from the weevil, on the part of the weevil there are buds containing meristematic tissue that actively divides the plant roots into plantlets.

Ilham *et al.* (2017), conducted a study on red banana callus using a combination of auction hormone with a combination of 2 ppm 2,4-D + 3 ppm BAP which was effective in inducing, with a callus appearing time of 4 MST (weeks after planting); green callus color, compact callus texture; and the highest callus weight was 0.0203 grams.

Bella *et al*. (2016), conducted research on banana micro shoots on the provision of genes and cytokinin concentrations against shoot formation time and shoot height of yellow Kepok bananas showed that the use of 2 mg L-1 BAP was able to produce high multiplication heights based on changes in shoot explant percentage (%) and shoot (cm).

Based on the above background, the use of auxin ZPT and cytokinin types IAA and BAP in appropriate amounts can increase growth. Therefore, in this study, the researcher will give a combination of IAA and BAP with different concentrations to be able to see the effect on the growth of Cavendish bananas.

B. Methodology

This research is one of the requirements in completing the undergraduate study in the form of a thesis. This research was conducted at the Tissue Culture Laboratory of the University of Cokroaminoto Palopo and took place from January to April 2020. The explants used came from the cavendish banana hump (Musa acuminata L.). The materials used in this study were cavendish banana weevil, sterile distilled water, 70% alcohol, spirit, coconut water, MS media, 7 grams of agar, sugar, sterile distilled water, types of growth regulators (ZPT) (IAA and BAP).). The tools used in this study included scarpel blade, measuring cup 1000 ml, analytic naraza, organ curl bottle, autoclave, LAP (Laminar Air Flow) sprayer, 70% alcohol, tweezers, petri dish, refrigerator, culture rack, air conditioner. , lamps, paper towels, aluminum foil, warp plastic, labels, matches.

This study used a completely randomized design (CRD) P0 = (MS + 0 mg / L-1 IAA + 0 mg / L-1 BAP) P1 = (MS + 0.5 mg / L-1 IAA + 1 mg / L- 1 BAP) P2 = (MS + 1 mg / L-1 IAA + 2 mg / L-1 BAP) P3 = (MS + 1.5 mg / L-1 IAA + 3 mg / L-1 BAP) P4 = (MS + 2 mg / L-1 IAA + 4 mg / L-1 BAP). This experiment was analyzed using a completely randomized design (CRD), with 5 treatments and 3 replications in order to obtain 15 experimental units, then to determine the effect between treatments, Analysis of Variance (ANOVA) was carried out. If there is a real difference, it is followed by the BNJ test (Honestly Real Difference) at the level of 0.5%. The observation parameters used callus color, callus texture, root emergence time (days), shoot appearance time (days), number of shoots (fruit), number of leaves (strands).

C. Result and Discussion

1. Callus Color

Callus color can be observed by looking at the changes that occur, there are several colors that appear in the observation, including white, green and brown. The difference in color that appears indicates the cell activity that occurs whether the cell remains alive or dead.

Treatments with IAA concentrations of 2 mg L -1 and 4 mg L-1 showed a different color change compared to treatments with other concentrations. Callus color of Cavendish banana (*Musa acuminata* L.) which showed different and varied callus colors (table 1) the variations that occurred in this study were caused by the presence of different cell metabolism in each part of the explants planted.

Table 1. Callus color of Cavendish banana (*Musa acuminate* L.) on MS medium with a combination of ZPT (growth regulator) IAA and BAP.

Treatment	Deuteronomy		
	1	2	3
P0	White	Green	White
P1	White	White	White
P2	White	White	White
P3	White	White	White
P4	Chocolate	White	White

a b c

Figure 1. Color change in callus (a: green, b: brown, c: white)

The callus color in several experiments was different, such as the media with a green IAA concentration of 0 mg L-1 and BAP 0 mg L-1 (Figure 4.1a). Furthermore, at concentrations of IAA 2 mg L-1 and BAP 4 mg L-1 there was a difference in the color of the callus to brown (Figure 1b), then at the IAA concentration of 1.5 mg L-1 and BAP 3 mg L-1 the color of the callus showed a white color. (Figure 1 c).

Indication of the difference in callus color can determine the level of development that is formed. According to Ali S.K., A.A. Elhassan, O.S. Ehiweris and E.H. Maki. (2007), there are several callus colors that are formed including yellow, greenish, and bright green. This color difference is due to the chloroplast content, when the callus is white there are starch grains, which will then become a membrane system when exposed to light the callus will turn green, indicating the callus is in good condition.

The change in the color of the callus from green to brown and then to death can indicate the presence of phonic compounds coming out of the explants. The browning event that occurs naturally is a process of change due to the occurrence of an injury when cutting the cavendish banana weevil, the change in callus color to brownish also indicates that no chlorophyll is formed so that the green color of the callus does not appear.

2. Callus Texture

Based on the observations from the research, it can be seen that the callus textures that are formed are crumb and The compact difference can identify that the different concentrations of IAA and BAP can affect the texture of the cavendish banana callus.

The results of the above research indicated that there were two types of callus texture that appeared, namely compact and crumb in the treatment with a combination of 2 mg L-1 IAA and BAP 4 mg L-1 in the treatment resulting in a crumb texture while in the other treatments it was compact.

Callus textures formed on cavendish banana weevil explants showed that each treatment with different IAA and BAP concentrations had a different texture, as seen in (Table 2). Formed a compact callus texture and a crumbly callus texture.

Callus textures in several experiments had differences, such as media with a concentration of 0 mg L of IAA^{-1} and BAP 0 mg L-1 had a crumb callus texture, then at a concentration of IAA 2 mg L-1 and BAP 4 mg L-1 there was a difference in one of the replications in the experiment with a crumb callus texture.

The results of the study with different callus textures could identify that the media contained nutrient composition, growth regulators and environmental conditions of the culture. A good callus to use is a callus with a compact texture because it can accumulate a lot of secondary metabolisme.

Table 2. Callus texture of Cavendish banana (Musa acuminata L.) on MS medium with a combination of ZPT IAA and BAP.

Treatment	Deuteronomy		
	1	2	3
P0	Crumb	Compact	Compact
P1	Compact	Compact	Compact
P2	Compact	Compact	Compact
P3	Compact	Compact	Compact
P4	Crumb	Compact	Compact

Based on the observations, it is known that a compact callus texture can be seen at the concentration of media with a combination of IAA 0.5 mg L-1 and BAP 1 mg L-1, with a low concentration that can form callus with a compact texture. The formation of textured callus is the effect of cytokinins and auxins that affect the water potential in cells. This causes the absorption of water from the medium into the cells to increase so that the cells become stiff so that the use of coconut water is very useful in the formation of callus textures (Dwi, 2012).

3. Time Emerged Roots

The mean time of root emergence in treatment P3 with a concentration of IAA 1.5 mg L^{-1} and BAP 3 mg L -1 showed the fastest time, namely 25.33 days after planting (HST) and the longest root emergence time was in P2 treatment with a concentration of IAA 1 mg L-1 and BAP 2 mg L^{1}. Indicators of success in tissue culture techniques are marked by the emergence of roots on explants planted on the media, the emergence of roots is indicated by the appearance of white lumps on the bananas hump close to the place where the media is placed.

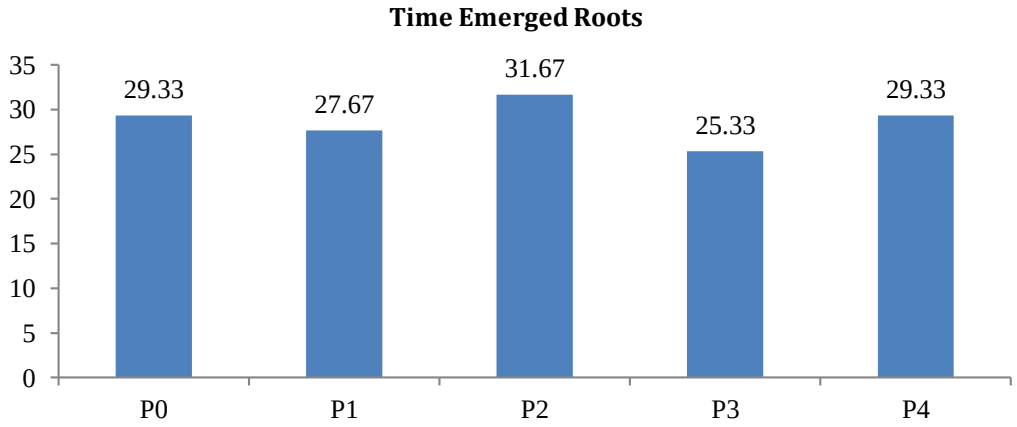

Figure 2. Effect of combination of IAA and BAP on root emergence time in Cavendish Banana (Musa acuminata) in vitro

The auxin hormone plays a role in the formation of undifferentiated lateral roots and callus. However, if the dedium is exposed to light, the explant response will decrease.

According to Yatim (2016), the number of roots is important for explant / plant growth in in vitrro tissue culture. The greater the number of roots is good for absorbing nutrients from the media. The fastest sprouting time was found in treatment P3 with a time of 25.33 HST with a combination of IAA 1.5 mg L -1 and BAP 3 mg L -1. Auxin group ZPT was able to initiate roots and accelerate root extension in tissue culture, whereas in the cytokinin group it was able to stimulate shoot growth in plantlets.

Figure 2. Explants on IAA 2 mg L-1 medium and 4 mg L-1 BAP medium

Figure 3. Explants on IAA medium 1.5 mg L-1 and BAP 3 mg L-1

4. Time Emerged Shoots

The observations from the time when shoots appeared showed that the treatment with the concentration of IAA 0 mg L-1 and BAP 0 mg L-1 showed the fastest time was 7 days after planting (HST) while in the treatment with a combination of IAA 2 mg L-1 and BAP 4 mg L-1 indicates the longest time, which is 20 days after planting (DAT).

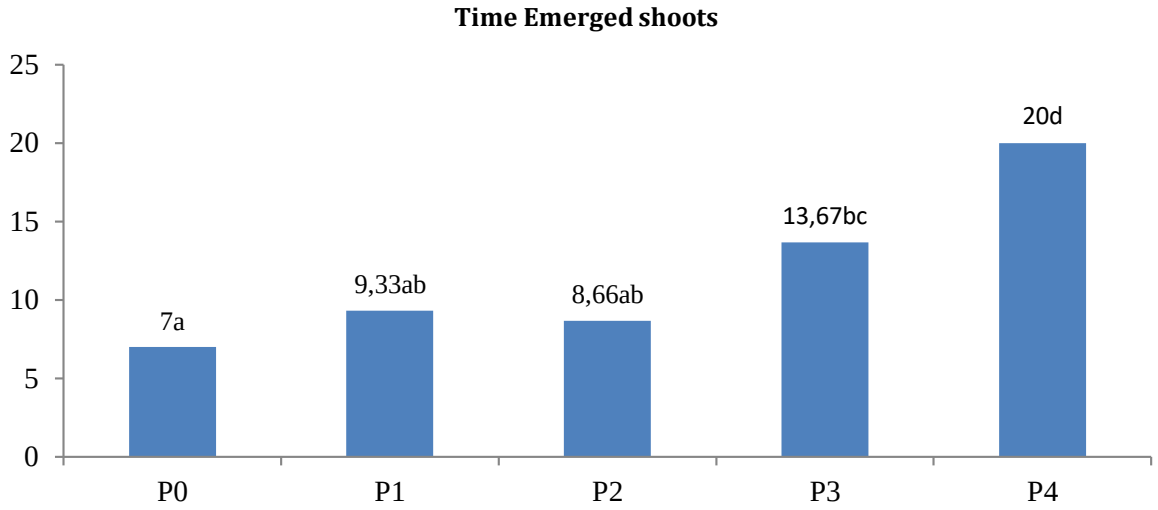

Figure 3. Effect of combination of IAA and BAP on Tuna Appearance Times Cavendish Banana (Musa acuminata) in vitro

The emergence time of cavendis banana shoots was not influenced by the combination of IAA and BAP concentrations in the P0 treatment (contral / without treatment) resulting in the fastest shoot emergence time of 7 days after planting (HST) and the longest time on P4 treatment (IAA 2 mg L-1 and BAP 4 mg L-1) that is 20 days. The administration of IAA and BAP had a significant effect on the delay in the emergence of shoots so that the BNJ (Honest Significant Difference) test was carried out at a level of 0.5%, after the BNJ result was 3.67%.

5. Number of Shoots

The mean number of shoots in treatment P3 with a concentration of IAA 1.5 mg L-1 and BAP 3 mg L-1 produced the highest number of shoots, namely 2.33 fruit while the least number of shoots was produced in treatment P0, P1, and P4 with each produce shoots of 1.33 pieces.

The addition of ZPT with a combination of IAA and BAP concentrations in each treatment showed different results, P3 treatment (1.5 mg L-1 and BAP 3 mg L-1) could produce the highest number of shoots, namely 2.33 shoots (Graph. 3). The treatment can produce the highest number of shoots, but the time needed to produce shoots is quite long, namely 13.67 days (Graph. 2). The organogenesis process that occurs is caused by the growth regulators given if the auxin is lower

than the cytokinin it will lead to shoots, if the auxin and cytokinin ratio is balanced, callus will be formed, and if the auxin ratio is higher it will affect root formation.

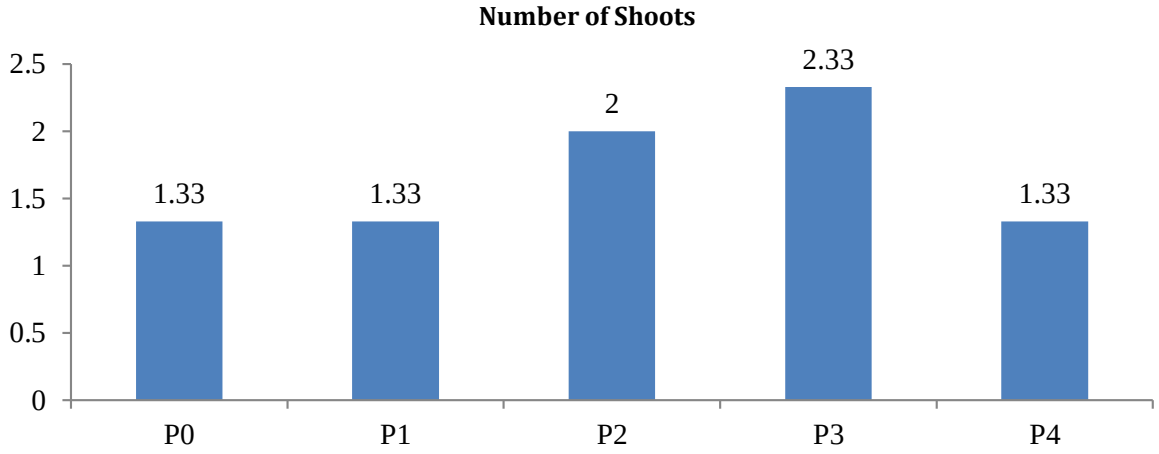

Figure 4. Effect of the combination of IAA and BAP on the Number of Cavendish Banana Shoots *(Musa acuminata)* in vitro

Treatment that produces the number of shoots 1, 33 shown in (P0, P1, and P4) this condition can be seen that the difference in the number of shoots is one of the factors indicating the success rate in the in vitro study of Cavendish banana.

Figure 5. Number of shoots on P2

Figure 6. Number of shoots at P3

6. *Number of Shoots*

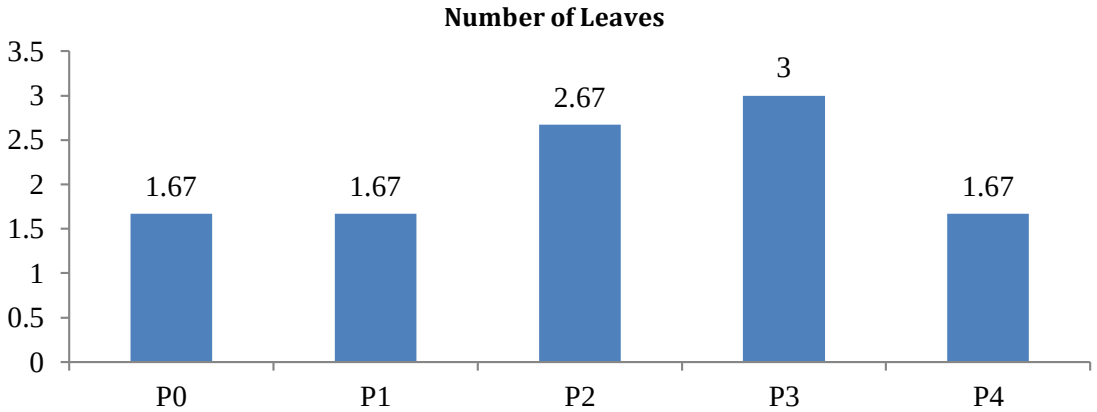

Figure 7. Effect of the combination of IAA and BAP on the number of Cavendish Banana Leaves in vitro

The results of the observation on the number of leaves showed that P3 treatment with a concentration of IAA 1.5 mg L-1 and BAP 3 mg L-1 produced the highest number of leaves, namely 3 strands. The treatments that produced relatively large numbers of leaves were 3 pieces of P3 (IAA 1.5 mg L-1 and BAP 3 mg L-1) (Pig 4), the concentrations of IAA and BAP had no significant effect on the number of leaves. The number of leaves is directly proportional to the number of shoots where the more shoots, the more leaves. As stated by Abidin (1993), Indole Acetiet Acid

(IAA), a growth hormone in the auxin group which plays a role in the process of cell enlargement and elongation. This is in accordance with the results of this study that IAA and BAP produced an average of 1.33 shoots/explant.

D. Conclusion

Based on the results of research, giving ZPT IAA and BAP with different concentrations showed an effect on the growth of cavendish banana shoots, with the highest number of shoots in the P3 treatment (IAA 1.5 mg L-1 and BAP 3 mg L-1) as many as 2.33 shoots. Other treatments showed that the interaction variety test results were not significantly different between ZPT IAA and BAP, from these results the P3 treatment (IAA 1.5 mg L-1 and BAP 3 mg L-1) gave the provision of root emergence time, namely 25.33 shoots were 2.33, and the number of leaves was 3 in the Cvendish Banana tissue culture. Whereas for the time when shoots appeared, the results obtained with P0 treatment (control / without treatment) showed significantly different results, namely 7 DAS (days after planting) so that the BNJ test at 5% level was carried out and showed 3.67% results.

E. References

Abidin, Z. (1993). Dasar-Dasar Pengetahuan Tentang Zat Pengtur Tumbuh. Bandung: Penerbit Angkasa.

Ali S.K., A.A. Elhassan, O.S. Ehiweris and E.H. Maki. (2007). *Embryogenesis and plantlet regeneration via immature male flower culture of banana (Musa sp.) cv. Grand Nain.* Journal of Forest Products & Industries 2(3): 48-52.

Bella *et al*. (2016). *Pengujian Evektivitas Berbagai Jenis dan Konsentr34si Sitokinin Terhadap Multiplikasi Tunas Mikro Pisang (Musa paradiciaca* L.) secara in vitro. Jurnal Kultivasi Vol.15(2) Agustus 2016.

Dwi, N.M. (2012). *Pengaruh Penambahan Air Kelapa dan Berbagai Konsentrasi Hormon 2,4-D pada Medium MS dalam Menginduksi Kalus Tanaman Anggur Hijau (Vitis vinivera* L.). Jurnal Natural Sciense vol.1 (1).

Dwiyani R, Yuswanti H, Darmawati IAP, Suada K & Mayadewi NNA. (2015). In vitro germination and its subsequent growth of an orchid of Vanda tricolor Lindl. var. suavis from Bali on complex additives enriched medium. Agrivita 37 (2) : 144-150.

Eriansyah. (2014). *Pengaruh Pemotongan Eksplan dan Pemberian Beberapa Konsentrasi Air Kelapa Terhadap Pertumbuhan dan Perkembangan Eksplan Pisang Ketan*. Universitas Sultan Agung Tirtayasa. Banten.

Ilham A. Latunra. (2017). *Induk Kalus Pisang Barangan Merah Musa acuminata Colla Dengan Kombinasi Hormon 2,4-D dan BAP Secara In Vitro*. Jurnal Ilmu Alam dan Lingkungan 8 (15) 53-61.

[PUSDATINTA] Pusat Data dan Sistem Informasi Pertanian. (2014). *Buletin Konsumsi Pangan*. Pusat Data dan Sistem Informasi Pertanian. 5(3):38.

Yatim, H. (2016). *Multiplikasi Pisang Raja Bulu (Musa paradisiaca L. AAB GROUP) pada Beberapa Konsentrasi Benzyl Aminopurine (BAP) Secara In Vitro*. Fakultas Pertanian Universitas Tompotika. Luwuk.

Agrotech Journal
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Growth and Production of Mustards on Various Compositions Growing Media and Types of Fertilization

AUTHORS INFO

Rahmawati
Faculty of Agriculture, Puangrimaggalatung University
rahmwatiunprima@gmail.com

ARTICLE INFO

e-ISSN: 2548-5148
p-ISSN: 2548-5121
Vol. 6 No. 1, June 2021
URL: http://dx.doi.org/10.31327/atj.v6i1.1564

Abstract

This study aimed to determine the effect of composition of growing media and types of fertilization on the growth and production of mustard plants. This study was carried out at the Experimental Garden of Uniprima-Sengkang from February to April 2020, using a randomized block design with two treatment factors, namely the growing media consisting of soil (control), manure + soil (1: 1), bokashi + soil (1: 1), and soil + manure + Bokashi (1:1:1) and fertilization, namely: without urea and *Azotobacter*, urea 50 kg ha^{-1} (0.2 g/plant), *Azotobacter*, urea 50 kg ha^{-1} (0.1 g/plant+ *Azotobacter*). The results showed that the composition of the growing medium Soil + Manure + Bokashi (1:1:1) and fertilization with ½ Urea 50 kg ha^{-1} (0.1 g/plant) + *Azotobacter* tended to show higher result in the parameters of plant height, number of leaves, leaf width and plant weight than other treatments, however, it statistically showed no interaction between the composition of the growing media and fertilization

Keywords: *Azotobacter,* growth media, mustard, urea

A. Introduction

Several periods ago, farming activities focused on increasing production with chemicals introduction in the form of inorganic fertilizers and synthetic pesticides. Urea is one type of inorganic fertilizers that is commonly used by farmers. The use of these fertilizers is due to their rapid and visible effect on crops and has been shown to contribute to increasing world food availability. This causes farmers to use this fertilizer a lot and tends to be applied excessively to soil and plants, causing further deterioration of the physical, chemical, and biological properties of the soil, decrease in land productivity, pollution on environment, ground water and surface water, as well as harmful to human and animal health.

The decline in land productivity, environmental pollution, and the high price of fertilizers are the right momentum to further increase efforts to conserve production resources and efficiency in the farming system. The use of synthetic nitrogen fertilizers in plant cultivation is the largest use of urea fertilizer among other food crop sub-sectors, this can be reduced by using natural nitrogen which is abundantly available in the atmosphere (78% of the volume of the atmosphere)

as a source of N for plants. Natural nitrogen fixing can be done by utilizing non-symbiotic N-fixing bacteria.

Azotobacter sp. is one of the bacteria that can be used as a biological agent (organic fertilizer) that is able to fix free nitrogen to be available into plants. The ability of *Azotobacter* in fixing N^2 was first known by Beijerinck in 1901 (Page, 1986). *Azotobacter* sp. in addition to being able to fix nitrogen, it also can produce a type of plant growth hormone and inhibit certain types of fungi.

Azotobacter is a non-symbiotic bacteria that is able to live freely in the root area of plants without having symbiosis with certain types of plants (Yuwono, 2006). The use of *Azotobacter* sp. as a biological fertilizer is more environmentally friendly because it can improve or maintain the physical, chemical and biological properties of the soil so as to create a conducive environment for plant growth. The important thing to note in the use of *Azotobacter* is the concentration and volume of the *Azotobacter* solution given during the application.

In addition to nitrogen, the material that plants need for their growth and development is other organic materials such as manure, bokashi, compost and so on. This use is expected to not only add nutrients to the soil but also improve soil texture. Moreover, the presence of organic matter in the soil can increase the development and population of soil microorganisms, including *Azotobacter*.

The use of nitrogen sources is often found during the cultivation of vegetables, especially leaf vegetables. One type of leaf vegetables that is much favored by the people of Indonesia from the lower class to the upper class is mustard.

Mustard is an annual plant that has oval leaves, smooth, hairless, and does not crop. This plant is very useful to overcome the problem of vitamin A deficiency or short-sightedness, can relieve itching in the throat in cough sufferers, heal headaches, as a blood purifier and really help improve kidney function and improve and facilitate digestion (Haryanto E, Tini Suhartini and Estu Rahayu, 2003). Various dishes that use mustard as raw materials are often found on the dining table.

The public's desire to consume mustard greens has recently shown an increase, in accordance with population growth, increasing purchasing power and increasing public nutrition knowledge. Seeing the prospect of mustard plants being feasible to be developed, efforts are needed in their cultivation, including the use of organic matter and *Azotobacter* as non-symbiotic N-fixing microbes.

Based on the description above, an experiment was carried out on "growth and production of mustard plants on various compositions of growing media and types of fertilization".

.

B. Methodology

This experiment was carried out in the form of a two-factor factorial experiment arranged in a randomized block design, namely growing media Soil (Control=M_0), Manure + soil (1: 1) (M_1), Bokashi + soil (1: 1) (M_2), Soil + Manure + Bokashi (1: 1: 1) (M_3). and Fertilization without Urea and *Azotobacter* (A_0), Urea 50 kg ha^{-1} (0.2 g/plant) (A_1), *Azotobacter* (A_2), Urea 50 kg ha^{-1} (0.1 g/plant) + *Azotobacter* (A_3). Based on these two factors, sixteen treatment combinations were obtained which were repeated three times as a group, so there were 48 treatment combinations. Each treatment combination consisted of 2 experimental units, then there were 96 experimental units.

Implementation of the experiment was done with sowing the seeds, namely the mustard seeds to be sown soaked in warm water for 30 minutes. After that, the seeds were sown in the nursery plots with a mixture of sand, soil, and manure in a ratio of 1:1:1. Seedling maintenance includes watering in the morning and evening by paying attention to the humidity of the seedling media. After the seedlings have 3-4 leaves, the mustard seeds are ready to be transferred to the growing media in polybags.

Furthermore, the preparation of growing media in polybags was carried out by preparing topsoil soil mixed with manure, bokashi with a comparison composition according to the treatment. After that, the media mixture was put into a 30 cm x 40 cm polybag and then saturated with water and left for one week.

Planting was done by sucking the seeds in the nursery, seedlings that have 3-4 leaves and the media around the roots are carefully transferred into polybags to avoid damage to the roots. The seeds in polybags were placed and labeled and then arranged according to the experimental plan.

Fertilization and microbial inoculation according to the treatment; i.e. urea is applied a week after planting in polybags with a dose of 50 kg/ha (0.2 g/plant) and Urea (0.1 g/plant). *Azotobacter* application had been done with making *Azotobacter* solution by dissolving 1 L

Azotobacter stock in 50 L of water. After that, *Azotobacter* was incubated in a bucket, then stirred evenly 3 times and allowed to stand for 5 hours. Followed by the application of *Azotobacter* solution to the mustard plant with a dose of 2 mL plant^{-1}.

Watering was carried out in the morning and evening by paying attention to the humidity conditions of the growing media. Weeding is done every week by pulling weeds around the plant.

Harvesting was done when the plant was 40 days after planting. With the characteristic that the leaves have started to turn yellow. This plant was harvested by cutting the stem of the plant just above the soil surface without including the roots.

Components of observation included plant height (cm); measured from the base of the stem to the tip of the highest leaf at the end of the experiment, the number of leaves (strands), the measurement was carried out at harvest and counting the leaves that had fully opened, width of leaves (cm), by measuring leaf diameter, the widest at harvest and fresh weight (g) was weighed at the end of the experimen

C. Result and Discussion

The results showed that fertilization had a significant effect on plant height, while the composition of the growing media and the interaction between the two has no significant effect.

Table 1. The average height of the mustard plant

Treatment	Average	Duncan test ά 0.05
A3	38.33a	5.31
A2	36.30a	5.58
A1	35.18ab	5.73
A0	30.13b	

Note : Numbers followed by the same letter indicate no significant difference based on Duncan test at ά 0.05.

Table 2. The average number of leaves of the mustard plant

Treatment	Average	Duncan Test ά 0.05
M3	9.42a	1.32
M2	8.50ab	1.39
M1	7.83b	1.43
M0	7.33b	

Note : Numbers followed by the same letter indicate no significant difference based on Duncan test with ά 0.05.

Table 3. The average widht of leaves of the mustard plant

Treatment	Average	Duncan Test ά 0.05
M3	41.07a	9.71
M2	38.61a	10.22
M1	39.39a	10.49
M0	32.49a	

Note : Numbers followed by the same letter indicate no significant difference based on Duncan test at ά 0.05.

Furthermore, the experimental results on the parameters of observing the number and width of mustard leaves shows that the composition of the growing medium had a significant effect on the number and width of the leaves of mustard plants, while fertilizer application and the interaction between the two has no significant effect.

Furthermore, observations of plant fresh weight at harvest shows that the composition of growing media and fertilization and the interaction between the two has no significant effect.

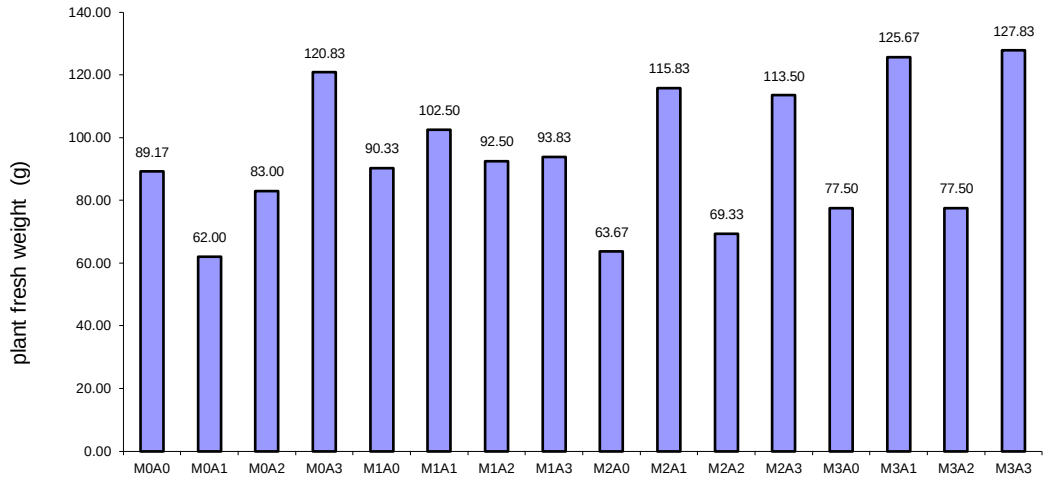

Figure 1. Diagram of lettuce plant height

The experimental results showed that the use of a growing media with composition of 1:1:1 (soil: manure: bokashi) with Urea 50 kg ha^{-1} (0.1 g/plant) + *Azotobacter* showed results tended to be better for plant height, number of leaves, leaf width and plant weight compared to other treatments.

Nitrogen is one of the essential elements for living things that is needed in large quantities as the main component of amino acids, nucleic acids, nucleotides, chlorophyll and other cellular components in plants. In sufficient quantities, nitrogen promotes the division, elongation and enlargement of cells rapidly in the apical meristem so that plants grow taller. Nitrogen needs of plant can be fulfilled by application of urea fertilizer in accordance with the required amount. In addition, plant nitrogen needs can also be fulfilled through the use of non-symbiotic nitrogen-fixing bacteria such as *Azotobacter*. The significant difference in plant height (Table 1), number of leaves (Table 2), width of leaves (Table 3) and plant fresh weight (Figure 1) was due to the sufficient availability of nutrients.

Application 1/2 Urea with dose of 50 kg ha^{-1} (0.1 g/plant)+*Azotobacter* 2 mL plant^{-1} suggested the best results compared to other treatments. This is presumably even though the A3 treatment was only treated with 1/2 dose of the recommended dose of urea, but because the urea was combined with the treatment of 250 mL of *Azotobacter* solution per ha, the nitrogen needs of the plants are sufficient.

Meanwhile, the A2 treatment with *Azotobacter* without urea fertilizer showed lower yields, this may be because the availability of nitrogen has not reached an adequate amount. Likewise, treatment A1 which was treated only with urea fertilizer based on recommended dose showed lower yields than A3 treatment and was higher than treatments of A2 and A0. This is proofed that the use of only inorganic fertilizers (urea) is not efficient in supplying the nitrogen needs of plants.

The above conditions have explained that *Azotobacter* may able provide nitrogen elements in plants. This is in line with the opinion that *Azotobacter* has a complete mechanism as a potential microbe, namely providing nitrogen, phytohormones and antifungals. PGPR *Azotobacter* enhanced plant growth through nitrogen fixation, production of phytohormones and exopolysaccharides (Hindersah and Sudirja, 2004; Hindersah. R ., Marthin Kalay, Abraham Talahaturuson Yansen Lakburlawal., 2018).

Based on economic calculations, *Azotobacter chroococcum* inoculation has the potential to reduce the need for nitrogen fertilizers by 25-50%. Inoculation of *Azotobacter chroococcum* was effective in increasing crop yields of cultivated plants in soil fertilized with sufficient organic matter. Hendersah and Simarmata (2004), explained that in an integrated plant nutrition system, soil health related to nitrogen availability can be achieved by balancing the input of nitrogen sources from inorganic fertilizers and from nitrogen fixing organisms.

Furthermore, the composition of the growing media 1:1:1 (soil: manure: bokashi) also showed better results than other treatments. This is perhaps due to the composition of the growing media, which not only contain nutrients but also create a good soil physical condition thereby

stimulating plant growth. This composition causes water aeration and drainage to run smoothly and thus is good for plant growth. This in line with a statement by Pracaya (2002), that the desired or suitable environment for plant survival using growing media as a place for plant growth absolutely requires good air circulation, sunlight, and water. Harjadi (1991) continued, a good growing medium for plant growth and development is a medium that is able to provide water, nutrients, oxygen in sufficient quantities and can be uptaked by plants. Plant growth and development is an important process in the life and reproduction of a species, and is the result of the metabolic activity of cells that may be influenced by genetic and environmental factors. One of the environmental factors that influence plant growth is the soil factor with a role as a medium for plant growth, a source of nutrients and water for plants.

The interaction between the composition of the growing media and fertilization showed not significantly affect in whole observed parameters, but tended to obtain the best results on a 1:1:1 growing media (soil: manure: bokashi) with Urea 50 kg ha-1 (0.1 g/plant) + *Azotobacter*. This is because in these conditions the nutrient content is in sufficient and balanced condition for plant growth. According to Suseno (1988), for optimal growth, a balance of nutrients is needed.

D. Conclusion

Based on the results obtained, it can be concluded that the composition of the growing media 1:1:1 (soil: manure: bokashi) and fertilization ½ Urea 50 kg ha^{-1} (0.1 g/plant) + *Azotobacter* showed the best result on plant height, number of leaves, leaf width, and fresh weight of mustard plants compared to other treatments. There was no interaction between the composition of the growing media and fertilization on the growth and production of mustard plants, however, the combination of 1:1:1 composition of growing media (soil: manure: bokashi) with fertilization of Urea 50 kg ha^{-1} (0.1 g/plant) +*Azotobacter* tended to provide the best results.

E. References

Harjadi, S.S., (1991). *Pengantar Agronomi*. Gramedia, Jakarta.

Haryanto E, Tini Suhartini dan Estu Rahayu, (2003). *Sawi dan Selada*. Edisi Revisi, Penebar Swadaya, Jakarta.

Hindersah, R dan Simarmata, T., (2004). *Potensi Rizobakteri Azotobacter dalam Meningkatkan Kesehatan Tanah. Laboratorium Biologi Tanah*, Fakultas Pertanian, Universitas Padjadjaran, Bandung.

Hindersah. R ., Marthin Kalay, Abraham Talahaturuson Yansen Lakburlawal, (2018). *Bakteri Pemfiksasi Nitrogen Azotobacter Sebagai Pupuk Hayati Dan Pengendali Penyakit Pada Tanaman Kacang Panjang*. Jurnal Pertanian AGRIC Vol. 30, No. 1, Juli 2018: 25-32.

Page,W.G. (1986). *Sodium Dependent Growth OF Azotobacter Chrococcum.* Appl Environ.Microbial. 51:510-514.

Pracaya, (2002). *Bertanam Sayur Organik di Kebun dan Polybag*. Penebar Swadaya, Jakarta.

Suseno, (1988). *Fisiologi Tumbuhan, Metabolisme Dasar dan Beberapa Aspeknya.* Departemen Botani Fakultas Pertanian, Institut Pertanian Bogor.

Yuwono, (2006). *Bioteknologi Pertanian*, UGM Press,Yogyakarta.

Agrotech Journal
Url: http://usnsj.com/index.php/ATJ
Email: editor.atj@usnsj.com

Soil Characteristics on Sustainable Food Agriculture Land (LP2B) in Sawerigadi Sub-District, Muna Barat Regency

AUTHORS INFO

Wa Embe
Faculty of Agriculture, Muhammadiyah Kendari University
waembe@umkendari.ac.id

Asriani
Faculty of Agriculture, Muhammadiyah Kendari University
asriani@umkendari.ac.id

ARTICLE INFO

e-ISSN: 2548-5148
p-ISSN: 2548-5121
Vol. 6 No. 1, June 2021
URL: http://dx.doi.org/10.31327/atj.v6i1.1565

Abstract

The research was conducted in Sawerigadi Subdistrict on Sustainable Food Agricultural Land (LP2B) consisting of five profiles. The research objectives were to determine soil characteristics in physics, chemistry, biology, and to determine the level of soil fertility on it. The research method that is; 1) Land Survey, 2) Research implementation includes the both preparation stage and data collection stage (field implementation), 3) Soil analysis includes analysis of physics, chemistry and biology. Observation and carried out soil sampling were by making soil profiles at each point. The results of the physical observation properties from the five profiles were almost the same, which had a reddish yellow to brownish yellow color with the texture of loam, clay, clay loam to silty clay. Soil structure is angular blocky and rounded blocky and has a slightly sticky to very sticky consistency. The results of laboratory analysis of the five research profiles have slightly acidic to neutral pH, very low to low C-Organic and N-Total, very low to moderate CEC, very low to very high alkali saturation, P-available is low to very high, K-available is low to moderate, and very low to high base cations (Mg, Ca, Na, K). The value from the results of laboratory analysis of the five profiles at each layer tended to decrease with soil depth. The biological characteristics of the five research profiles are related to macro and micro activity of soil fauna, a little to a lot, the existence of macro and micro activity of soil fauna depending on vegetation conditions on the soil surface. The soil fertility level of the five research profile is in the low to medium category

Keywords: agriculture, soil, land, food, sustainable

A. Introduction

The characteristics and types of soil differ from one place to another, and these differences can affect the ability of the soil to support the growth and production of cultivated / cultivated crops. Food needs are increasing while agricultural land is decreasing. An important issue in current developments is sustainable agriculture, which is a process that maximizes agricultural resources to meet the needs and welfare of today's society without sacrificing future needs and welfare, so that agricultural resources become a priority for agricultural land, especially land, food agriculture in a sustainable manner.

The direction of planning for food agriculture areas in the Spatial Plan for Muna Barat Regency which is broader than that of the Central Government shows that the potential for developing sustainable food agriculture is still open. This development must be supported by academic studies so that the development of land area is directly proportional to the production of food. The study of soil characteristics in physical, chemical and biological soil can help in soil treatment during cultivation now and in the future.

The use of Sustainable Food Agriculture Land (LP2B) in Muna Barat, especially in Sawerigadi Sub-District, is still not optimal, this can be seen from the local food needs mostly sourced from other regions. In general, local farmers cultivate the land traditionally and without the addition of organic matter. The lack of food production is also caused by, among others, the low level of public knowledge about soil characteristics, so that the treatment of soil as a planting medium is not appropriate.

Research on soil characteristics, especially in Sawerigadi Subdistrict, has obviously no previous research as supporting data on soil fertility. In connection with this, the author will conduct research on Soil Characteristics on Sustainable Food Agricultural Land (LP2B), as a basis for consideration of the treatment of agricultural land which is expected by knowing the characteristics of the soil, the treatment of soil as a planting medium is carried out appropriately and proportionally, as well as agricultural production food increases.

B. Literature Review

1. Soil Defenition

Soil is a natural body which is formed and developed from natural materials on the surface of the earth. This natural body differentiates to form mineral and organic horizons with varying depths and different in nature from the parent material that lies beneath it in terms of morphology, physical, chemical and biological properties (Notohadiprawiro, T., san S.H. Suparnowo. 1994).

2. *Physical Characteristics of Soil*

a. Soil Texture

Texture is the ratio of the relative size of soil particles in the form of sand, dust, and clay fractions. Where for the sand fraction (2 mm-50μ), dust (50 - 2μ) and clay (<2μ) in the soil. Soil texture is commonly known as a texture triangle consisting of 12 soil texture classes, namely: sand, loamy sand, sandy loam, loam, dusty loam, dust, clayey clay, sandy clay, dusty clay, sandy clay, dusty clay, clay (Hardjowigeno , 1993).

b. Soil Structure

Soil structure is a small lump of soil grains, occurs because grains of sand, dust and clay are bonded to one another by a soil adhesive such as organic matter, iron oxides and others. These little lumps come in different shapes, sizes, and stability.

c. Soil Consistency

Soil consistency refers to the cohesion between soil particles and the adhesion between soil particles and other objects, the resistance of the soil to deformation. If the soil structure is related to the composition and shape of the lump (ped), then consistency deals with the strength and nature of the forces acting between the particles. Consistency is determined by three levels of soil moisture, namely wet, moist, and dry (Siradz, 2003).

d. Soil Color

Soil color reflects the integration and transformation and chemical, physical, and biological translocation that occurs in the soil. In general, the color of the surface horizon reflects a strong picture of biological processes, especially those related to the origin of organic matter. Organic material gives a dark brown to black color. Usually the higher the organic matter, the darker the soil color. The bright light color corresponds to the eluvization horizon where sesquoxide, carbonate and clay minerals have leached out (Tan, 1991).

3. *Soil Chemical Characteristics*

a. Soil Reaction (Soil pH)

The soil reaction shows the acidity or alkalinity of the soil which is expressed by the pH value. The pH value shows the number of hydrogen ion (H +) concentrations in the soil. The higher the H + ion content, the more acidic the soil will be (Susanto, and Sirappa, 2005).

b. Cation Exchange Capacity (CEC)

CEC is defined as the total amount of exchangeable cation adsorption. CEC is expressed in chemical units, namely milliequivalents per 100 g (me / 100 g). One equivalent is an amount chemically equivalent to 1 g of Hydrogen. The number of atoms in each equivalent is 6.02 x 1023 = (avogadro's number). Thus 1 me is equivalent to 1 mg of hydrogen and consists of 6.02 x 1020 hydrogen atoms. Soil CEC varies depending on (1) the grade and type of clay; (2) levels of organic matter and organic compounds composing organic matter (Hardjowigeno, 2003).

c. *Base Saturation (KB)*

Base saturation shows the ratio between the number of base cations with the number of all cations (alkaline and acidic cations present in the soil seepage complex). The maximum number of cations that can be absorbed by the soil indicates the magnitude of the CEC value of the soil. Basic cations are generally nutrients needed by plants (Ca ++, Mg ++, K +, and Na +). While the acid cations (H + and Al +++). Besides alkalis, it is easy to wash, so that the soil with high KB indicates that the land has not been washed much and is fertile soil. KB is closely related to soil pH, where soils with low pH generally have low KB, and vice versa.

Base Saturation = (Number of Base Cations)/CEC x 100%

4. *Soil Biological Characteristics*

Relation to macro and micro activity of soil fauna. In this case, soil fauna, both macro and micro, plays a very important role in improving soil structure, improving soil aeration and as a source of soil organic matter. Large animals (macro fauna) which are land dwellers in the form of large ground-breaking animals, earthworms, arthropods and mollusks (Hardjowigeno, 1993).

5. Sustainable Food Agriculture

Sustainable Food Agricultural Land is a field of agricultural land designated to be protected and developed consistently in order to produce staple food for self-sufficiency and national food sovereignty security. The protection of sustainable food agricultural land is carried out based on sustainable food agriculture land planning which includes: (1) Sustainable Food Agriculture Areas, (2) Sustainable Food Agriculture Land, and (3) Sustainable Food Agriculture Reserves (Susanto, and Sirappa, 2005).

C. Methodology

This research was conducted in Sawerigadi District, West Muna Regency in August 2020. Soil analysis was carried out at the Bogor Soil Research Institute. The research method that is; 1) Soil Survey, 2) Research implementation includes the preparation stage and data collection stage (field implementation stage), 3) Soil analysis includes analysis of physics, chemistry and biology. Observation and soil sampling were carried out by making a soil profile on the Sustainable Food Agriculture Land (LP2B) which became the sample area.

1. Research Design
   The research method that is; 1) Soil Survey, 2) Research implementation includes the preparation stage and data collection stage (field implementation stage), 3) Soil analysis includes analysis of physics, chemistry and biology.
2. Sample
   This research consists of five profiles. Each profiles taken three of soil sample based on layer of profile. So that the number of soil samples taken is 15
3. Technique of Data Collection
   Observation and soil sampling were carried out by making a soil profile on the Sustainable Food Agriculture Land (LP2B) which became the sample area.
4. Instruments

a. Soil profile observations involving external and internal data using a manual for observing soil profiles in the field.
b. Soil samples analysis was carried out at the Bogor Soil Research Institute laboratory.

5. Technique of Data Analysis
   c. Physical Soil Analysis. (Texture by filtering and pipetting methods (ISRIC, 1993), Soil Color (refers to the Munsell Soil Color Chart book, Structure and consistency (Soil Conservation Service, 1972)
   d. Chemical Soil Analysis
      Soil samples analysis was carried out at the Bogor Soil Research Institute laboratory.

e. Biological Soil Analysis
Biological observations can be made in the field directly on the existing soil profile, by observing macro and micro biological activity in the soil.

D. Result

1. Result

a. Physical Characteristics of Soil from Five Profiles in Sawerigadi Sub-District
The results of observations of the morphological properties of the physical properties at the research location which consist of five (5) soil profiles can be seen in Table 1:

Table 1. Soil Physics Morphology of the Five profiles in Sawerigadi Sub-District

Profiles/ Points	Layers	Code	Horizon	Depth (cm)	Color	Color Notation	Texture	Structure	Consistency
I	I	P1L1	O	0-15	10YR 3/3	Brownish Yellow	Loam	Angular Blocky	Slightly Sticky
	II	P1L2	B	15-40	10YR 5/6	Reddish Yellow	Clay Loam	Rounded Blocky	Slightly Sticky
	III	P1L3	C	40-80	10YR 7/8	Yellow Gray	Clay	Rounded Blocky	Sticky
II	I	P2L1	O	0-15	10YR 4/6	Brownish Yellow	Loam	Angular Blocky	Slightly Sticky
	II	P2L2	A	15-53	10YR 5/8	Reddish Yellow	Silty Clay	Angular Blocky	Sticky
	III	P2L3	C	53-74	7,5YR 5/8	Brownish Yellow	Clay	Angular Blocky	Sticky
III	I	P3L1	O	0-23	7,5 YR 4/6	Brownish Black	Silty Clay	Rounded Blocky	Sticky
	II	P3L2	B	23-52	7.5YR 4/6	Brownish Black	Clay	Angular Blocky	Verry Sticky
	III	P3L3	C	52-88	7,5YR 5/8	Brownish Yellow	Clay	Angular Blocky	Verry Sticky
IV	I	P4L1	O	0-15	10YR 4/6	Brownish Yellow	Clay Loam	Rounded Blocky	Sticky
	II	P4L2	A	15-53	10YR 5/8	Reddish Yellow	Clay	Angular Blocky	Sticky
	III	P4L3	C	53-74	10YR 5/8	Reddish Yellow	Clay	Angular Blocky	Sticky
V	I	P5L1	O	0-19	10YR 4/2	Brownish Yellow an	Loam	Rounded Blocky	Sticky
	II	P5L2	B	19-25	10YR 4/2	Brownish Yellow	Loam	Rounded Blocky	Sticky
	III	P5L3	C	25-50	10YR 6/1	Yellow Gray	Silty Clay	Angular Blocky	Verry Sticky

b. Soil Chemical Characteristics
The results of the chemical properties analysis on the five soil profiles in Sawerigadi Sub-District, Muna Barat Regency, are presented in Table 2.

Table 2: Results of Analysis of Soil Chemical Properties of Five Profiles in Sawerigadi District, West Muna Regency.

Profiles/ Points	Layers	pH		C-Org	KB (%)	KTK	P-Available (ppm)	K-Available (ppm)	K (%)	Ca (%)	Mg (%)	Na (%)	N-Total
		H_2O	KCl										
I	I	6,1	4,7	1,00	85	17,97	71	27	0,05	12,81	2,33	0,14	0,10
	II	6,3	4,8	0,54	88	16,83	49	29	0,05	13,13	1,45	0,10	0,05
	III	6,5	4,9	0,21	91	16,03	3	23	0,04	12,94	1,47	0,08	0,03
II	I	5,1	3,7	0,49	54	4,39	8,2	11	0,01	2,28	0,22	0,91	0,06
	II	5,4	3,9	0,30	74	4,20	6,6	12	0,01	2,85	0,20	0,05	0,04
	III	5,7	4,1	0,20	77	5,41	3	18	0,02	3,74	0,40	0,03	0,03
III	I	5,2	3,9	0,66	27	5,24	10,2	11	0,18	0,70	0,50	0,03	0,07
	II	4,9	3,7	0,36	19	3,80	1,4	33	0,04	0,48	0,19	0,02	0,05
	III	4,9	3,7	0,28	14	4,93	7,9	20	0,02	0,45	0,15	0,05	0,04
IV	I	5,5	4,4	0,88	73	5,05	28,7	31	0,05	2,77	0,85	0,04	0,10
	II	5,8	4,5	0,35	77	5,77	2	24	0,04	3,44	0,80	0,14	0,05
	III	6,3	5,0	0,29	84	5,98	14	19	0,03	4,13	0,85	0,02	0,04
V	I	7,2	6,2	1,08	>100	7,61	62	14	0,01	7,64	1,02	0,08	0,12
	II	7,7	6,8	1,21	>100	8,16	20	15	0,01	10,83	1,16	0,02	0,12
	III	7,2	6,3	0,38	>100	8,51	8	18	0,01	7,98	1,20	0,05	0,05

E. Discussion

1. Physical Characteristics

a. Soil Color

The results of field observations on the five soil profiles, the colors obtained were generally light to dark dominant, namely brownish yellow to brownish black, this shows that most of the research points of low soil organic matter. The four profiles, each profile in each layer, the lighter the soil color is. This shows that the deeper the soil layer, the less organic matter available in the soil.

b. Texture

The soil texture in the five profiles has a texture in layers ranging from loam, clay, dusty loam to clay dusty. This profile shows the dominant has a slightly smooth texture. In general, clay-textured soils, because the texture is slightly smooth to smooth, each weight unit has a large surface area so that the ability to hold water and provide high nutrients. Soil texture in the five profiles shows that the lower the layer, the smoother the texture. Shows that the ability to bind water and nutrients in the soil is still high.

c. Structure

Profiles I, II, III, IV, and V at the study location have a rounded blocky and angular blocky structure in each layer. The rounded blocky structure is caused by previous tillage and the dominance of the sand fraction, while the angular blocky structure due to the increasingly compressed soil aggregate.

d. Consistency

The results of the observations on the five profiles can be seen at, dominated by slightly sticky, sticky, and very sticky at each layer. This is due to the low organic matter content and soil cultivation factors which are continuously without adding soil organic matter.

2. Chemical Analysis

a. Soil Reaction (Soil pH)

The results of the soil chemical analysis of the five soil profiles having soil pH ranging from the low (slightly acidic) to moderate (neutral) category indicate that the research location is a soil that is developing and has a little further weathering, this is also indicated by the presence of a B horizon, namely there is an increasing illusion (accumulation) of clay content from the top layer to the bottom layer. The low soil pH is due to the fact that there is still a little leaching of base cations and other soil materials at each layer. The neutral pH of the soil in one of the profiles (profile V) is due to the use of land at this location in the form of rice fields so that the application of chemical fertilizers is the cause of increasing soil pH.

b. C-Organic, N-total

Based on the results of laboratory analysis of C-Organic, the five soil profiles ranged from very low to low. Decreasing levels of C-organic in the soil along with decreasing soil depth (the deeper the soil, the smaller the value of C-organic content in the soil), the presence of C-organic content in each first layer is caused by decomposition of plant debris and animal waste which then mixed with soil minerals. The low levels of C-organic in the soil at the study location were due to the presence of vegetation on the surface which was dominated by grass vegetation, so that the decomposition of plant litter was slightly decomposed as a source of organic matter in the soil.

Amount of N-Total in the soil in the five profiles (I, II, III, IV, and V) in Sawerigadi Sub-District ranged from very low to low in each layer, this was due to the lack of plants containing source of N in the soil, where the research location is dominated by low-level plants (shrubs to mixed gardens) so that the process for the entry of N in the soil mostly comes from the residue / waste of the surrounding vegetation.

c. Cation Exchange Capacity (CEC) and Base Saturation (KB)

The results of the CEC Laboratory analysis on the profiles of the five profiles ranged from very low to moderate categories. The low CEC is caused by flat topographical conditions with land use types from the four profiles in the form of mixed gardens and rice fields so that the process of leaching or hoarding organic matter and soil cations will occur. An increase or decrease in CEC in each soil layer is in line with the increase or decrease in C-organic content in the soil.

The results laboratory analysis of the basal saturation (KB) of the research locations in the five profiles were in the low to very high category. The low base saturation was due to the fact that the study site had undergone further weathering which reacted with acid and a little leaching of alkaline cations. The high level of alkaline saturation at the research location was due to the fact that the research location had undergone further weathering and leaching of alkaline cations. This can also be seen in the table of the results of soil chemical analysis, namely the Ca cation is higher than the Mg, Na and K cations. These base cations are generally nutrients that are much needed by plants.

d. P-availability and K- availability

Based on the results of laboratory analysis, the P- availability research location in the soil varies, namely the very low to very high category. The low P- availability is caused by the use of land in the form of mixed gardens and shrubs so that the weathering process of vegetation that falls on the soil surface will be decomposed into the soil which will later become a source of phosphorus in the soil. High P-Availability is due to flat land conditions so the possibility of leaching of soil elements / soil material is small, as well as the dominant clay content factor when viewed from the soil texture.

The results of laboratory analysis of K- availability at the research location of the five profiles (I, II, III, IV, and V) are in the low to moderate category, namely 11-33 ppm, this indicates that the availability of K in the soil is sufficiently available. The availability of K in the soil is related to the pH and saturation of the soil base, low pH and base saturation causes the availability of K in the soil is low. The availability of K in the soil is due to the addition of potassium fertilizer, but at the research location there was no application of potassium fertilizer so it was in the low dominant category.

e. Base Cations (Mg, Ca, Na, and K)

The results of laboratory analysis of Mg cations for the five profiles were in the very low to moderate category. The low levels of Mg are caused at this location apart from being on a flat topography, as well as the use of abandoned shrublands and mixed gardens (without land cultivation) and no application of fertilizers causing the value of Mg cations to be very low, this is also in line with the pH value soil. On the other hand, the level of Mg in the medium category is caused by the condition of the land which is still made into mixed gardens and rice fields so that the presence of Mg cations is still sufficient in the soil, apart from that the factor of fertilizer use on the land causes the value of the Mg cation to be moderate.

The results of Ca cation analysis for profiles I and V are in the medium to high category, namely 7.64-13.13%. This is also because these two locations are on land that is being processed in the form of mixed gardens and rice fields so that the availability of alkaline cations Ca is high enough to be absorbed by plants, besides the high value of Ca content in the soil is due to the use of fertilizers in the land.

Laboratory analysis results of the five soil profiles (I, II, III, IV, and V) for basic cations (K, and Na), where the K and Na cations are in the very low-low category. the value of cation along with soil depth as well as soil pH. The low level of K and Na cations at the research location is because there has been no application / use of fertilizers containing K and Na elements as a source of these base cations.

The results of the basal saturation (KB) laboratory analysis of the research locations in the five profiles were in the low to very high category. The low base saturation was due to the fact that the study site had undergone further weathering which reacted with acid and a little leaching of alkaline cations. The high level of alkaline saturation at the research location was due to the fact that the research location had undergone further weathering and leaching of alkaline cations. This can also be seen in the table of the results of soil chemical analysis, namely the Ca cation is higher than the Mg, Na and K cations. These base cations are generally nutrients that are much needed by plants.

3. Biological Characteristics

The biological characteristics of the five research profiles, the number of macro and micro-soil fauna are in the range / number of a little to a lot, this is due to varying land use conditions, namely mixed gardens, former gardens (shrubs), former rice fields and rice fields so that the vegetation that falls on Soil surface makes less activity for macro and micro-soil fauna.

F. Conclusion

The physical characteristics of the soil formed in the five profiles of the study area (I, II, III, IV, and V), namely the color of the soil ranges from reddish yellow to brownish yellow, the soil structure ranges from angular blocky and rounded blocky, the texture is in the Loam, clay, silty clay to clay loam, while the consistency of the soil ranges from slightly sticky to very sticky. The chemical characteristics of the soil formed in the five soil profiles (I, II, III, IV, and V), namely the soil pH is slightly acidic to neutral, C-organic and N-Total are very low to low, CEC is very low to moderate, KB is very low to very high, low to very high available P-available, low to moderate available K, very low to low base cations (Mg, Ca, Na, K). The biological characteristics of the five research observation profiles for macro and micro activity of soil fauna range from a little to a lot. Based on the physical, chemical and biological characteristics of the soil, the soil fertility level in profiles I and V has a moderate level of fertility, while those in profiles II, III, and IV have low soil fertility.

G. references

Hardjowigeno, S., (1993). Soil Classification and Pedogenesis. Akademika Presindo. Jakarta.

Haedjowigeno, S., (2003). Soil Science. Akademika pressindo. Jakarta.

ISRIC. (1993). Procedures for Soil Analysis. In van Reewijk, L.P. (Ed.) Techical Paper, International Soil Reference and Information Centre. Wageningen, The Netherlands. 4th ed. p. 100.

Notohadiprawiro, T., san S.H. Suparnowo. (1994). Principles of Pedology. Soil Science Department, Faculty of Agriculture. UGM. Yogyakarta.

Siradz, Syamsul A., (2003). Genesis, Morphology and Soil Classification. Department of Soil, Faculty of Agriculture, Gadjah Mada University. Yogyakarta.

Soil Conservation Service. (1972). Section 4: Hydrology in National Engineering Handbook. USA: SCS.

Susanto, N.A., and Sirappa, M.P. (2005). Prospects and Strategies for Corn Development to Support Food Security in Maluku. Journal of Agricultural Research and Development. Maluku.

Tan, K. H., (1991). Basics of Soil Chemistry. Gadjah Mada University Press. Yogyakarta.