Germination of porang (amorphophalus muelleri) from different bulbil to various planting media

by m umar harun

Submission date: 05-Jul-2024 09:36AM (UTC+0700)
Submission ID: 2412673225
File name: 48.pdf (356.47K)
Word count: 5466
Character count: 27695

BIOVALENTIA: BIOLOGICAL RESEARCH JOURNAL
e-ISSN: 2477-1392
Vol. 7 No. 2, Nov 2021

GERMINATION OF PORANG (*Amorphophalus muelleri*) FROM DIFFERENT BULBIL TO VARIOUS PLANTING MEDIA

Hegar Nurjannah[1], M. Umar Harun[2*], Erizal Sodikin[3]

[1]*Master Programe in Agriculture Science, Faculty of Agricultur, Sriwijaya University, Jalan Padang Selasa 524, Palembang, South Sumatra 30139, Indonesia.*
[2]*Department of Agriculture Cultivation, Agronomy Department, Faculty of Agricultur, Sriwijaya University, Jalan Raya Palembang-Prabumulih km 32, Indralaya, Indonesia.*
[3]*Agronomy Department, Faculty ofAgricultur, Sriwijaya University, Jalan Raya Palembang-Prabumulih km 32, Indralaya, Indonesia.*

*Corresponding author

E-mail address: mumarharun@unsri.ac.id (M. Umar Harun).
Peer review under responsibility of Biology Department Sriwijaya University

Abstract

Porang plant is atubers that havevarious benefits. Porang cultivation needs intensive management through cultivation efforts which of course must be supported by the availability of seeds. Therefore, it is necessary to procure porang seeds from vegetative (tubers) and generative (stem bulbil and branch bulbil). This study aims to obtain the best growing media for porang germination from various types of bulbil. The method used in this study was a factorial randomized block design. The way of working in this research is: Preparation of Seedling Media, Preparation of planting material (Bulbil), Seeding, Maintenance (including watering and weeding). The results showed that there was no significant interaction between the planting medium and the type of bulbil, the media had no significant effect on all observed variables, while the bulbil had a significant effect on the percentage of germination growth, stem height, and number of leaves. The best type of bulbil for breeding is stem bulbil which is superior to the variables of plumule emergence time, petiole length, stem height, and number of leaves compared to branch bulbil. Meanwhile, the best growing media in porang nurseries was a mixture of 50% husk charcoal + 50% sawdust on the variables when the plumule appeared, the percentage of germination, petiole length and stem height. The appearance of bulbil from stems on a mixture of 50% husk charcoal + 50% sawdust media, namely the time of emergence of plumules (5.61 days), percentage of sprouting (86.67%), petiole length (8.72 cm), height stems (31.11 cm) and number of leaves (7.72 strands).

Keywords: Porang, Germination, Bulbil, Planting Media

Received: October 19, 2021, Accepted: October 31, 2021

1. Introduction

Porang (*Amorphophalus muelleri*) is a plant tubers that havethe benefits are more diverse than other root crops. One of the local varieties of superior production porang patented in collaboration with the Agricultural Research and Development Agency (Balitbangtan) of the Ministry of Agriculture is Madiun 1. Porang tubers contain 15% - 64% glucomannan (dry basis), which can be used as raw materials for the food and health industry [1]. Porang cultivation is an effort to diversify food ingredients and provide industrial raw materials that can increase the value of export commodities in Indonesia [2].Therefore, it is necessary to intensify and expand the porang cultivation area and the adequacy of seed material to meet the porang, domestic and export industries [3].

Porang cultivation requires intensive management such as land management for seedlings and planting, plant maintenance and how to harvest tubers. For seeds or plant seeds derived from seeds, it is necessary to prepare a nursery for seedlings, and if they have germinated, they can be transferred from the nursery to the field [4]. According to [5], intensive cultivation efforts must of course be supported by the availability of seeds. Therefore, it is necessary to procure seeds from seed sources other than root tubers. One of them is with bulbil.

Bulbil are generative tubers that grow at the base and axils of the leaves. Porang plants whose seed sources come

from bulbs, induction and growth are not only in the terminal leaf branches (terminal *bulbil*), but also bulbil growing in the leaf branching (leaf axillary) as *axillary bulbil*[6]. Bulbil can be referred to as stem bulbil and branch bulbil. Based on observations made to farmers in the Musi Banyuasin area, stem bulbil have the characteristics of larger bulbil sizes and faster shoot growth, and fewer bulbil. Branch bulbil have characteristics, namely the number of bulbil is more and easy to obtain, but the size of the bulbil is small and the growth of shoots is slow.

To get the germination and growth of bulbil into seeds, of course, it depends on the origin of the bulbil and the available media [7]. The germination phase is an important phase to get productive plants later, therefore the selection of healthy and growing plants is absolutely necessary. Overall seedling conditions, both physical and physiological conditions were relatively better and more ready to be transferred to a new medium, so that the sprouts were better able to adapt and absorb the nutrients contained in the growing media. With these conditions, it is expected that the growth process will be optimal.

According to [8] that there are three factors that influence the success of sprout growth, namely environmental conditions in the form of water availability and media or environmental temperature and the internal conditions of the seedlings, namely in the form of physiological readiness of the seedlings in or to adapt at the time of weaning. Furthermore, it is also said that even though the physical or environmental conditions of the growing media (availability of water, temperature and light) are in optimum conditions. However, germination will only grow optimally if the seedlings are in optimum physiological conditions.

The growing medium used for sprout growth is one that is able to prepare sufficient nutrients. The use of organic materials such as sawdust and rice husk charcoal has the potential to be used as an alternative nursery media to reduce the use of top soil. The results showed that rice husk charcoal seedling media gave the same good growth of yellow cempaka seedlings as top soil seedling media. Wood sawdust is one of the wastes with abundant availability, easy to obtain, cheap and renewable. Wood sawdust is a biomass that has not been utilized optimally, especially as a nursery medium [9]. Husk charcoal has good characteristics as a planting medium, namely high air circulation, high water holding capacity, blackish color so that it can absorb sunlight effectively. Husk charcoal media is a practical planting medium because it does not need to be sterilized, this is because pathogenic microbes have died during the combustion process [10].

The results of the research by [11], the media for the growth of micro potato cuttings of the granola variety utilizes waste that is processed into organic fertilizer that can support plant growth and development. Organic materials that can be used come from manure, husk charcoal, compost and peat. Utilizing this organic material by mixing organic fertilizer with soil using volume so that the resulting media is balanced for growth, especially for plants [12]. Based on the results of research by [10],the composition of the media (sand, rice husk charcoal and sawdust) can affect plant growth better (height and stem diameter) than tomato plants. On media with the addition of rice husk charcoal or manure according to [13] that porang bulbil can grow well. Stem bulbil and branch bulbil respond to various existing growing media. To find out the response of the porang bulbil to the growing media, this research needs to be carried out.

This study aims to obtain the best growing media for porang nurseries from various types of bulbil.

2. Materials and Methods

2.1. Tools and Materials

Research was carried out in a shadow house with a roof covered with tarpaulin, and walls made of waring (25%) with dimensions of 12 m long, 6 m wide and 4 m high. The process time under the tarpaulin house is 1 month, then after 1 month the tarpaulin is opened and replaced by using waring as the next roof. The purposed is because the Porang nursery only lasts 2 months, after that tubers will form, so they must be moved immediately. The research was carried out from November 2020 to January 2021, in Sembawa Village, Banyuasin Regency. The tools used are: polybag (10 x 15 cm), hoe, tape measure, rope, ruler, camera, book, pen, marker and label. While the materials used are:stem bulbil, branch bulbil, top soil, sand, rice husk charcoal, sawdust, 50% rice husk charcoal + 50% sawdust, 50% sand + 50% rice husk charcoal, and 50% sand + 50% sawdust.

2.2. Research Methods

Design used is Factorial Randomized Block Design. Factor 1 is Bulbil Origin (K): K_1= Stem Bulbil, K_2= Branch Bulbil. Factor 2 is Planting Media (M): M_1= Sand, M_2= Rice Husk Charcoal, M_3= Sawdust, M_4 = Top Soil, M_5 = Rice Husk Charcoal 50% + Sawdust 50%, M_6 = 50% Sand + 50% Rice Husk Charcoal, M_7 = 50% Sand + 50% Sawdust. There were 14 Treatment Combinations and repeated 3 times so that the total sample was 42 units. For each treatment unit, 10 samples were prepared so that the total population of the experimental plants was 420 plants.

2.3. Procedure

Seedling Media Preparation

Media used were sand, rice husk charcoal, sawdust, top soil, 50% rice husk charcoal + 50% sawdust, 50% sand + 50% rice husk charcoal and 50% sand + sawdust 50 %. Each seedling medium was prepared in such a way by following

the pre-defined treatment. The mixture of planting media is put into polybags (10 cm x 15 cm) by fulfilling 80% of the volume of the polybag.

Preparation of planting material (Bulbil)

The bulbil used were stem bulbil and branch bulbil from Sungai Lilin, Musi Banyuasin Regency. Before being used as planting material, the bulbil were selected in size so that they were relatively uniform and free from fungal infection.

Seeding

Seeding is done by making planting holes in polybags with a depth of ± 3.5 cm, the width of the holes is adjusted to the diameter of the bulbil and then put each bulbil into a polybag according to the treatment of the growing media.

Maintenance

Maintenance includes watering and weeding. Watering is done by watering the plants 2 times a day when the weather is not raining, if it rains then watering is done only 1 time. The volume of watering water is about 142 ml per plant. Weeding is carried out on weeds that grow in polybags and around polybags. Weeding is done manually and the rotation depends on the speed of weed growth. Maintenance was carried out for 2 months from the time of bulbil seeding.

2.4. Variables observed

Plumule Emergence Time (days)

Plumule emergencetime was observed every day for 2 weeks, the aim was to see how many days the plumule emergence.

Germination Percentage (%)

Germination percentage (%) was observed every day for 2 weeks, the aim was to see the normal number of sprouts. The criteria for normal germination are the appearance of plumules in bulbil sown in polybags.

Petiole Length (cm)

The petiole length (cm) was measured after 2 weeks of age, using a ruler by placing the ruler on the soil surface and then seeing and recording how many cm the petiole length of the porang plant was.

Stem Height (cm)

Stem height (cm) was measured after the plants were 2 weeks old in the nursery and carried out once every 1 week for 2 months. Plant height was measured using a ruler from the base of the stem above the soil surface to the tip of the plant stem.

Number of Leaves (strands)

Number of leaves (strands) of planting is calculated when the plant is 2 weeks old and is carried out once every 1 week for 2 months. Done when the main leaves appear.

3. Results and Discussion

Based on the results of the analysis of diversity showed that the treatment of bulbil significantly affected the percentage of germination growth, stem height and number of leaves. The treatment of growing media showed no significant difference to all variables. The interaction between the bulbil and the media showed no significant difference to all observed variables (Table 1).

Table 1. Analysis of Germination Diversity of Various Origins of Bulbil with Different Growing Media.

Variable	F Count			
	Bulbil	Media	Interaction	KK (%)
1. Plumula Emergence Time	0.08^{tn}	0.20^{tn}	0.90^{tn}	28.58
2. PercentageGermination	5.72^{*}	0.47^{tn}	1.02^{tn}	14.87
3. Petiole Length	0.91^{tn}	1.89^{tn}	1.24^{tn}	22.19
4. Stem Height	22.16^{**}	2.40^{tn}	0.23^{tn}	10.78
5. Number of Leaves	15.18^{**}	$1,08^{tn}$	1.01^{tn}	9.64
F Table (5%)	4.30	2.66	2.66	
F Table (1%)	7.72	3.59	3.59	

Description : ** : Very significant effect
* : Influential significant
tn : Not significantly different
KK : Coefficient of Diversity

Plumule Emergence Time (days)

Time between stem bulbil was not significantly different from that of branch bulbil, and also between planting media. The average time of emergence of bulbil plumules from stems is faster than branch bulbil. The time of emergence of plumules from 50% rice husk charcoal + 50% sawdust media was about 6.97 days (Table 2).

Table 2. Plumule Emergence Time (days) from Various Origins of Porang Bulbil on Different Growing Media.

Medium	Plumule Emergence Time (days)		Average
	Stem Bulbil	Branch Bulbil	
Sand	7.33	7.5	7.42
Rice Husk Charcoal	8.61	7.27	7.94
Sawdust	6.16	8.39	7.28
Top Soil	7 ,72	7.28	7.50
Rice Husk Charcoal 50% + Sawdust 50%	5.61	8.33	6.97
Sand 50% + Rice Husk Charcoal 50%	8.38	7.44	7.91
Sand 50% + Sawdust 50%	7,55	6,44	7,00
Average	7,34	7,52	

Percentage of Germination (%)

Germination percentage (%) of germination between stem bulbil was significantly different from that of branch bulbil. Stem bulbil have a higher growth percentage than branch bulbil. The percentage of germination growth on 50% rice husk charcoal + 50% sawdust growing media was higher than other growing media (Table 3).

Table 3. Percentage of Germination (%) from Various Origins of Porang Bulbil on Different Growing Media.

Media	Percentage of Germination (%)		Average
	Stem Bulbil	Branch Bulbil	
Sand	63.33	83.33	73.33
Rice Husk Charcoal	70.00	86.67	78.33
Sawdust	76.67	83.33	80.00
Top Soil	73.33	80.00	76.67
50% Rice Husk Charcoal + 50% Sawdust	86.67	80.00	83.33
50% Sand + 50% Rice Husk Charcoal	73.33	76.67	75.00
50% Sand + Sawdust50%	70.00	86.67	78.33
Average	73.33	82.38	

Petiole Length (cm)

Length between stem bulbil was not significantly different from that of branch bulbil. The average petiole length of the longest bulbil origin treatment was 6.80 cm in stem bulbil. The petiole length of the stem against the highest media treatment was 8.72 cm on 50% rice husk charcoal + 50% sawdust (Table 4).

The treatment of the bulbil significantly affected the percentage of germination growth, stem height and number of leaves. It is suspected that the bulbil has a higher amount of food reserves as an energy source for the germination process, so that the growth speed is greater, can be earlier in the photosynthesis process and faster in the formation of plant vegetative organs such as stem height and number of leaves. The main function of food reserves in seeds is to feed embryos and young plants before the plant is able to produce nutrients, hormones, and proteins [14]. Thus, when food reserves are available in small quantities, plant growth tends to be weaker.

According to [15], porang plants during their vegetative growth experience three periods. In the first period the plant height ranged from 20-50 cm, the leaf canopy diameter ranged from 25-50 cm, and the plant stem diameter (pseudo-stem) ranged from 0.5-1.0 cm. Based on the above provisions, the height of the porang plants planted was in accordance with the growth criteria for the first period with a high yield of 22.16 cm.

Table 4. Petiole Length (cm) from Various Origins of Porang Bulbil on Different Growing Media.

Media	Petiole Length (cm)		Average
	Stem Bulbil	Branch Bulbil	
Sand	6.05	6.66	6.36
Rice Husk Charcoal	7.66	5.61	6.64
Sawdust	7.05	5.61	6.33
Top Soil	6, 39	8.39	8.19
50% Rice Husk Charcoal + 50% Sawdust	8.72	6.55	7.64
50% Sand + 50% Rice Husk Charcoal	6.39	7.22	6.8
50% Sand + Sawdust50%	5.33	6.05	5.69
Average	6.80	6.58	

Stem Height (cm)

Stem height between stem bulbil has a very significant effect on branch bulbil. The highest average stem height was found in stem bulbil with a value of 28.11 cm. The average stem height in the best media was 28.52 cm on 50% rice husk charcoal + 50% sawdust (Table 5).

Table 5. Stem Height (cm) from Various Origins of Porang Bulbil on Different Growing Media.

Medium	Stem Height (cm)		Average
	Stem Bulbil	Branch Bulbil	
Sand	25.28	21.66	23.47
Rice Husk Charcoal	28.5	23.39	25.94
Sawdust	27.77	23	25.39
Top Soil	28.11	25 ,5	26.8
50% Rice Husk Charcoal + 50% Sawdust	31.11	25.94	28.52
50% Sand + 50% Rice Husk Charcoal	29.22	26.61	27.91
50% Sand + 50% Sawdust	26.77	22.66	24.72
Average	28.11	24.11	

Number of Leaves (strands)

Number of leaves between stem bulbil had a very significant effect on branch bulbil. The highest average number of leaves was found in stem bulbil with a value of 7.6 leaves, while the lowest number of leaves was found in branch bulbil with a value of 6.76 leaves (Table 6).

Table 6. Number of Leaves (strands) from Various Origins of Porang Bulbil on Different Growing Media.

Media	Number of Leaves (strands)		Average
	Stem Bulbil	Branch Bulbil	
Sand	7.83	7.11	7.47
Rice Husk Charcoal	8.33	6.66	7.5
Sawdust	7.05	6.94	7
Top Soil	7.66	6 ,11	6.88
Rice Husk Charcoal 50% + Sawdust 50%	7.72	7.05	7.39
Sand 50% + Rice Husk Charcoal 50%	7.61	6.94	7.27
Sand 50% + Sawdust50%	7	6.55	6.77
Average	7.6	6.76	

The treatment of growing media showed no significant difference to all variables. This is because the characteristics of the growing media are not a limiting factor for plant growth. The limiting factors are disturbed plant growth [16] some limiting factors are KTK, base saturation and soil pH. All combinations of planting media

did not affect the growth of porang seedlings.

The variables of stem height and number of leaves were not significantly different from each other. The highest stem height was in stem bulbil at 28.11 cm, this result was higher than in branch bulbil. The highest number of leaves was on stem bulbil as many as 7.6 strands. This is because stem bulbil have an older age than branch bulbil, so the more food reserves are stored, the faster their growth. This is in line with research [3], branch bulbil have a younger age and have fewer shoots than stem bulbil.

This is also in accordance with the research of [17] and [18], in stem bulbil there are more food reserves so that the photosynthesis process occurs earlier and vegetative organs are formed faster than branch bulbil. The growth of porang from the middle part of the bulbilstems can produce higher plants compared to the porang from the branched bulbil.

The planting media treatment had a significant effect on the stem height parameters, the planting medium that produced the highest stem height, which was 28.52 cm, was a planting medium with a mixture of 50% rice husk charcoal and 50% sawdust. The nature of the planting media that must be owned to support the development of porang tubers is a crumb medium. Deficiencies in the planting media can be regulated by adding organic matter in the form of husk charcoal [7]. Sawdust also has a porous nature, so when combined with husk charcoal it will produce a suitable planting medium for plant growth. Sawdust has a high water-holding ability so it does not dry out quickly. This material has balanced macro and micro pores so that air circulation is quite good. The mixture of soil with sawdust makes the growing media not lumpy and the water content is sufficient for growth and also facilitates root penetration into the media. Sawdust also contains 0.24 N, 0.2% P2O5 and 0.24% K2O.

But on the parameter of the number of leaves the best growing media is husk charcoal (M2) planting medium. Husk charcoal is one component of a mixture of planting media that can bind water from natural materials and is a soil enhancer that can improve soil properties. Rice husk charcoal is 'porous' so that drainage and aeration in the soil are good [19].

The interaction between the bulbil and the media showed no significant effect on all observed variables. This is presumably because the treatment of branch bulbil and stem bulbil taken from seedlings gave the same response to all planting media so that there was no effect on the observed planting variables.

The interaction on the time variable for the appearance of the plumule, all treatments had no significant effect on each other. The best treatment is found in stem bulbil. This means that stem bulbil have a faster growth rate than branch bulbil. This could be due to the fact that the amount of food reserves in stem bulbil is higher than that of branch bulbil. This is in accordance with [3] Stem bulbil grow earlier than branch bulbil so that in germination, stem bulbil produce shoots faster. The interaction between the time variables for the appearance of the best plumules was found in the planting medium of a mixture of 50% rice husk charcoal and 50% sawdust. This is presumably because the husk charcoal and sawdust media is a very porous medium, with good aeration and drainage, thus facilitating the growth and emergence of plumules. [20] suggested that the germination media is one of the factors that affect the process of seed germination. From the results of observations on the time variable for plumules, sand and sawdust media are media that can be used for the initial germination process of porang plants.

The results of this study showed that the highest growth percentage was found in stem bulbil. This can be caused by stem bulbil producing more shoots per tuber, which is called polyembryonic. This result is also in accordance with research [3], that stem bulbil have the highest average growth percentage compared to branch bulbil. Based on research by [21], polyembryonic plants have the best growth components because they have more than 1 shoot in one tuber planted. This fact shows that porang plants have polyembryonic characters (can produce more than one shoot) [22]. The interaction of the best growth percentage variables was found in the treatment of rice husk charcoal and sawdust media, this was presumably because the nutrients contained in rice husk charcoal and sawdust media were still able to meet plant needs. Husk charcoal media has good drainage and aeration, coarse texture, light weight, and high air circulation because it has many pores so it cannot hold water. According to [23], rice husk charcoal easily binds water, does not rot quickly, does not clot quickly and is not easily overgrown with fungi and bacteria. In addition, husk charcoal can absorb toxic or poison and release it back at the time of watering. In this medium, plant roots can grow perfectly because they are guaranteed to be clean and free from micro-organisms that can interfere with plant growth. In addition to all these advantages, husk charcoal still has other advantages, namely being able to act as a source of potassium for plants. Husk charcoal contains nutrients N 0.3%, P2O5 15%, K2O 31%, and several other nutrients with a pH of 6.8. In addition to this, husk charcoal also has the ability to hold high water, crumb texture, air cycle and high CEC, and can absorb sunlight effectively [24]. In addition, in the sawdust media there were nutrients N 1.33%, P 0.007%, K 0.6%, Ca 1.44%, Mg 0.2%, Fe 999 mg kg^{-1}, Cu 3 mg kg^{-1}, Zn 41 mg kgkg^{-1}, Mn 259 mg^{1}[25].

The treatment of planting material showed that the treatment of stem bulbil and branch bulbil was not significantly different on the petiole length variable. In the petiole length variable, the best planting material was found in stem bulbil. This means that the petiole length of the porang plant is also influenced by the source of the bulbil. This result is in line with research [3] which has the highest petiole length compared to other treatments. The best results for all variables were also given by porang tubers from stem

bulbil. All tubers produce more than one shoot in one tuber planted.

The interaction of the best growth percentage variables was found in the top soil media treatment, this is presumably because top soil media contains a lot of organic matter, humus and makes it the most fertile medium so it is very suitable for porang plant growth. According to [26], in the top soil there is a total nutrient content of N 0.24%, P 11.4 ppm, K 1.56 me, C-Organic 2.90% and pH 7.5.

The variables of plant stem height and number of leaves were caused by differences between the types of bulbil used. Stem bulbil have a better growth response than branch bulbil. This can be caused, stem bulbil are produced from the main stem which still has a higher nutrient content than other parts. This difference causes the effect of planting material to be significantly different on the two parameters. According to [27], vegetative organs directly or indirectly play an important role in plant growth.

The interaction of the highest plant stem height variables was found in the planting media treatment of a mixture of 50% rice husk charcoal and 50% sawdust with a height of 28.52 cm, while the lowest stem height was found in sand media, this is presumably because the sand planting media has high porosity. Too high to be able to hold water for plant needs. [24] Stated that most of the nutrients needed by plants are supplied through plant media and then absorbed by the roots and used for plant physiological processes.

The interaction of the highest number of leaf variables was found in the rice husk charcoal media treatment, with the number of leaves being 7.5 strands. It is suspected that rice husk charcoal media supports the formation of new plant parts including the increase in the number of leaves, leaf area, leaf length.

The addition of roasted husks in the growing media plays an important role in improving physical, chemical properties and protecting plants, because rice husk charcoal has a large cavity, so it is good for planting media. Burnt husk contains SiO2 (52%), C (31%), K (0.3%), N (0.18%), F (0.08%), and calcium (0.14%). It also contains other elements such as Fe2O3, K2O, MgO, CaO, MnO and Cu in small amounts as well as several types of organic matter [28].

From the results of this study, in the K1M5 treatment, namely a combination of stem bulbil with 50% rice husk charcoal planting media mixed with 50% sawdust, found the fastest time to emerge for plumules (5.61 days), the highest percentage of sprouts growing (86.67 %), the highest petiole length (8.72 cm), and the highest stem height (31.11 cm).

The interaction between stem bulbil and planting media of 50% rice husk charcoal mixed with 50% sawdust is suitable for the growth of porang plant seeds. So that this treatment can be an alternative in porang plant breeding in the nursery.

4. Conclusion

1. Stem bulbil were better and superior for the variables of plumule emergence time, petiole length, stem height, and number of leaves in porang plant nurseries, compared to porang branch bulbil.
2. Growing media of 50% husk charcoal mixed with 50% sawdust in the nursery is the best growing medium for porang seedlings.

References

[1] Faridah, A., SB Widjanarko, A. Sutrisno, and B. Susilo. 2012. Optimization of Porang Flour Production from Porang Chips Mechanically with the Response Surface Method. Journal of Industrial Engineering, 13 (2) : 158-166.

[2] Sari, R., and S. Suhartati. 2015. Porang Plants: Prospects of Cultivation as One of the Agroforestry Systems. *Ebony Bulletin*, *12*(2), 97-110.

[3] A'yun, Q. 2019. The selection technique of bulbil porang (*Amorphophallus muelleri* Blume) based on growth response. Journal of Environmental Engineering and Sustainable Technology, 6(1), 30-35.

[4] Sari, R., dan Suhartati, S. 2015. Tumbuhan Porang: Prospek Budidaya Sebagai Salah Satu Sistem Agroforestry. *Buletin Eboni*, *12*(2), 97-110.

[5] Hidayat, R., FD Dewanti, and G. Guniarti. 2019. Study of Cytokinin Concentration and Dosage of Npk Fertilizer on Growth and Yield of Porang (*Amorphophallus onchophyllus bulbil plant*). *Agrotechnology-Plumula Scientific Periodic*, *7*(1), 33-44.

[6] Hidayat R, FD Dewanti., and Hartojo. 2012. Know the Characteristics, Benefits, and Cultivation of Porang Plants UPN "Veteran" JATIM Press. Surabaya. pp51

[7] Wardani, IB, N. Harijati., & R. Mastuti., 2019. The Study of Growth and Its Polyembryonic Properties of Porang Seeds (Amorphophallus muelleri Blume) from Various Fruit Colors in Different Planting Media.*The Journal of Experimental Life Science*,*9*(2), 122-127.

[8] Prihastanti, E. 2011. Perkecambahan Biji dan Pertumbuhan Semai Kakao (*Theobroma cacao* L.) Asal Sulawesi Tengah yang Dibudidayakan di Kabupaten Banyumas Jawa Tengah. *Anatomi Fisologi*, *19*(1), 8-15.

[9] Agustin, AD, & M, Riniarti. 2014. Utilization of sawdust waste and rice husk charcoal as weaning media for yellow cempaka (*Michelia champaca*). Sylva Lestari Journal, 2(3), 49-58.
[10] Bachtiar, S., M. Rijal., & D. Safitri. (2017). Effect of Hydroponic Media Composition on Tomato Plant Growth. *Biocells: Biology Science and Education*,*6*(1), 52-60.
[11] Aji, R. P. 2019. Pengaruh Macam Media Tanam Terhadap Pertumbuhan dan Hasil Umbi Bibit Kentang G0 Varietas Granola.Doctoral dissertation. Universitas Mercu Buana. Yogyakarta.
[12] Jon, E. 2018. The Effect of Planting Media on the Growth of Potato Micro Cuttings of Granola Variety (*Solanum tuberosum* L). Edubiotics. Vol. 3, No.1: 26-33, February 2018.
[13] Sari, M., E. Santosa., AP Lontoh., & A. Kurniawati. 2019. Seed Quality and Seedling Growth of Iles-Iles (Amorphophallus muelleri Blume) Plants from Different Growing Media. *Indonesian Journal of Agricultural Science*, 24(2), 144-150.
[14] Panggabean, E. L. 2012. Diktat Teknologi Benih. Fakultas Pertanian. Universitas Medan Area. Medan.
[15] Sumarwoto, 2012. Peluang Bisnis beberapa Macam Produk Hasil Tanaman Iles Kuning di DIY Melalui Kemitraan dan Teknik Budaya. Business Conference, Yogyakarta.
[16] Armanto, M.E., M.A. Adzemi, E. Wildayana and M.S. Imanudin. 2013. Land Evaluation for Paddy Cultivation in the Reclaimed Tidal Lowland in Delta Saleh, South Sumatra Indonesia. *Journal of Sustainability and Management*, 8(1): 32-42.
[17] Sumarwoto dan Maryana. 2011. Pertumbuhan Bulbil Iles-iles (*Amorphophallus muelleri* Blume) Berbagai Ukuran pada Beberapa Jenis Media Tanam. *Jurnal Ilmu Kehutanan*. 5(2): 94-96
[18] Mastuti, R., N. Harijati., EL Arumingtyas., and W. Widoretno. 2018. Effect of Bulbils Position on Leaf Branches to Plant Growth Responses and Corms Quality of Amorphophallus muelleri Blume. *J.Exp*. Life Science. 8(1): 3-4.
[19] Onggo, TM, K. Kusumiyati., & A. Nurfitriana. 2017. The Effect of Addition of Husk Charcoal and Polybag Size on the Growth and Yield of Tomato Cultivars 'Valouro' from stem grafting.*Cultivation*,*16*(1).
[20] Girsang, R. 2019. Peningkatan Perkecambahan Benih Bawang Merah (*Allium ascalonicum* L.) Akibat Interval Perendaman H_2SO_4 Dan Beberapa Media Tanam. Jasa Padi, 4(1), 24-28.
[21] Gusmalawati, D. 2013. Structure of the Development of Generative Organs and Growing Power of Porang Seeds (*Amorphophallus muelleri* Blume). Department of Biology, Faculty of Mathematics and Natural Sciences. Brawijaya University. Poor. Thesis.
[22] Indonesian Porang Research and Development Center. 2013. Cultivation and Development of Porang (*Amorphophallus muelleri* Blume) as One of the Potential Local Raw Materials. [Module].BrawijayaUniversity.Poor.
[23] Firdaus, M., Sofyan, A., dan Jumar, J. 2021. Pemanfaatan Arang Sekam Padi dan Pupuk Organik Cair (POC) Bonggol Pisang Terhadap Pertumbuhan Vegetatif Tomat (*Lycopersicum esculantum* Miil). Agroekotek View, 4(2), 79-83.
[24] Fahmi, ZI. 2013. Planting Media As External Factors Affecting Plant Growth. Center for Plant Seedling and Plant Protection Surabaya. Surabaya.
[25] Ansori, A., dan Asngad, A. 2017. Pemanfaatan Serbuk Gergaji Kayu Sengon (*Albizia falcataria*) dan Kotoran Kambing Sebagai Bahan Baku Pupuk Organik Cair Dengan Penambahan Effective Microorganism-4 (EM4). Doctoral dissertation. Universitas Muhammadiyah Surakarta. Surakarta.
[26] Saputra, E., Subiantoro, R., & Gusta, A. R. 2019. Pengaruh Kombinasi Media Lapisan Tanah dan Takaran Cocopeat pada Pertumbuhan Bibit Kakao (*Theobroma cacao* L.). Jurnal Agro Industri Perkebunan, 31-39.
[27] Tjitrosoepomo, G. 2020. Morfologi Tumbuhan. Gadjah Mada University Press. Yogyakarta
[28] Djafar. F., Moses, N., dan Jamin. FS. 2012. Study on Growth and Yield of Mustard (Plants *Brassica juncea* L.)Based on Soil And Husk Planting Media With Different Doses. Gorontalo State University. Gorontalo.

Germination of porang (amorphophalus muelleri) from different bulbil to various planting media

ORIGINALITY REPORT

4%	4%	1%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	jurnal.pancabudi.ac.id Internet Source	1%
2	text-id.123dok.com Internet Source	1%
3	Submitted to Sriwijaya University Student Paper	1%
4	eprints.umm.ac.id Internet Source	1%
5	biovalentia.ejournal.unsri.ac.id Internet Source	1%
6	pdfs.semanticscholar.org Internet Source	1%

Exclude quotes	Off	Exclude assignment template	On
Exclude bibliography	On	Exclude matches	< 1%