



Growth Period of Porang (*Amorphophallus onchophyllus* P.) Through Tubber Cut and Inorganic Fertilizer Treatment

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Abstract: Porang (*Amorphophallus onchophyllus*) has many benefits for industry and health, because of the high content of glucomannan in its tubers. Porang needs to be developed, but the problem is getting a uniform source of tuber seeds. To get the uniform tuber seeds by dividing them. This study aims to get a uniform source of tuber seeds. This study was conducted in the field and laboratory. The experiment was arranged in a CRD. There are two factors, in seed tuber division: U1= Intact tuber, U2=Tuber cut in 2, U3=Tuber cut in 3 parts, and U4=Tubers cut into 4 parts. The second factor is fertilizer consisting of Urea, Za, and Phonska. The results of the combined treatment between tuber division and fertilizer treatment showed no significant interaction in all observed parameters. The seed tuber division treatment affects the bud break time, plant height, stem diameter, and canopy width, only at the beginning of growth. U1 gives the highest growth. The various fertilizer treatments only had a significant effect on plant height and stem diameter at 7 and 8 WAP. The treatment of splitting tuber seeds can replace intact tubers to be used as Porang tuber seeds.

Keywords: Inorganic fertilizer; Porang; Tuber cut

Introduction

Porang (*Amorphophallus onchophyllus*) is a type of files-iles plant that grows in the forest. Porang has plant benefits for industry and health, especially since the content of glucomannan in its tubers is quite high. Glucomannan is a source of soluble dietary fiber, which can be used as an ingredient in making edible films. Porang plants need to be developed and the problem is getting a uniform source of tuber seeds if you use small tuber seeds it will produce small tubers as well. Efforts to get uniform tuber seeds by dividing tuber seeds (Van Dijk et al., 2021).

In general, porang plants that have high economic value are the tubers. Porang tubers cannot be consumed directly, because they secrete very itchy sap. The content of porang is the substance glucomannan which is very useful for industrial raw materials and health (Patria et al., 2022). For the industry, glucomannan substances can be used as adhesive glue which is very strong while in the health sector, it is useful for reducing blood sugar

levels and lower cholesterol (Luo et al., 2022). Porang tubers have high economic value, so farmers want to expand porang cultivation. Most of the porang are directed at export needs and have not been met because production is still insufficient (Riptanti et al., 2022).

Porang bulbil morphology is unique with the presence of protrusions on the surface, namely tubercles. This part develops into a white bud candidate (Harijati & Ying, 2021). Splitting the porang seed tubers is one of the steps to suppress the procurement of seed tubers due to the limited number of small tubers used as a source of seeds because the porang character only produces 1 (one) tuber, whereas planting porang from a bulbil seed source requires more than two planting times to harvest. Year (Wahidah et al., 2021). Splitting seed tubers will not only suppress the supply of porang tubers.

Tubers, bulbs, tubers, seeds, and leaf cuttings are parts of porang that can be used as propagation material (Triharyanto et al., 2022). Propagation using bulbils and tubers as planting material is recommended because it can be planted immediately thereby saving time and

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costs (Hamaoka et al., 2023). However, studies on the provision of seeds from split tubers have not been carried out much. For this reason, it is necessary to study tuber division as a source of porang seeds, and whether the growth and yield are as good as those from whole porang tubers. However, because the availability of seeds from small porang tubers (<200gr) is very small, while the demand is high, it is, therefore, necessary to make efforts to provide split tuber seeds whose size and weight are relatively the same as the weight of small tubers (+200gr).

The aim is to get a uniform source of tuber seeds and the division of seed tubers can accelerate plant growth and the number of tillers and can encourage tuber growth.

Method

The research materials used were garden soil, manure, polybags, porang tubers, ashes, Urea, Za, and Ponska. The tools used are knives, hoes, screws, labels, bamboo, watering can, caliper, and sprayer. This experiment was a factorial experiment with two factors, namely seed tuber division and fertilizer treatment. The experiment to be carried out was arranged in a Completely Randomized Design (CRD) and repeated three times. Factor I: U1=Intact Tubers (100 g), U2=Tuber cut in 2 (200 g), U3=Tuber cut in 3 (300 g), and U4=Tuber cut in 4 (400 g). Factor II: Inorganic Fertilizers, namely Urea=2 gr/plant, Za=2 gr/plant, and Phonska= 2 gr/plant. The research was carried out using the planting medium used in this study, which was a mixture of garden soil and compost, then put in a polybag with a size of 35x35 up to 4/5 of the parts filled. The seed tubers used in the study were porang tubers which had previously been sorted based on their weight according to the treatment.

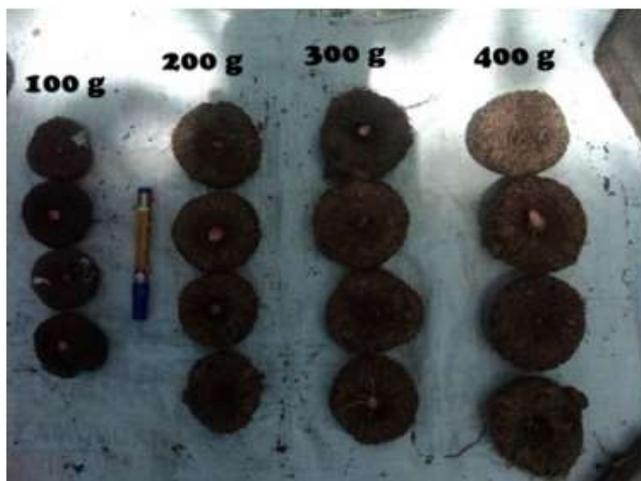


Figure 1. Seedling bulb size

The tuber seeds of the porang plant used to weigh 100 grams for whole tubers, then weigh 200 grams to be split evenly into 2 then planted and 300 grams to be split into 3 and planted and 400 grams to be split into 4 then planted. Before planting, the part of the tuber that is split is smeared with rubbing ash from wood-burning waste to protect the exposed parts from rot caused by soil microorganisms. The tuber planting is done by punching holes in the media by hand, for the position of the tuber planter, which is to keep the place where the shoots grow on the top, for both whole and split seed tubers. Parameters observed on the growth of porang plants, namely: the time of bud break (days) which is counted as days when the shoots have broken off, plant height (cm) which is measured from the soil surface to the branching point of the highest leaf, canopy width (cm) which is measured by the leaf canopy that is the width of the left and right sides after the leaves open completely, and the dry weight of the plant.

Result and Discussion

The growth of the porang plant starts from the time the bud bursts until the bulbil appears. The buds are porang buds located in the middle of the tubers. This bud grows from the base to the top. The grow buds allow the becoming of new porang stems.

Table 1. Average Time of Shoot Break (Days) Due to Root Splitting and Fertilizer Treatment (Urea, Za, and Phonska)

Treatments	WAP (Days)
P1 (Urea)	35.75
P2 (Za)	38.50
P3 (Phonska)	35.25
BNT 5%	ns
U1 (Intact tuber)	26.67 a
U2 (Tuber cut in 2)	38.44 b
U3 (Tuber cut in 3)	40.89 b
U4 (Tuber cut in 4)	40.00 b
BNT 5%	6.41

Note: The mean number followed by the same letter in the same treatment and column is not significantly different in the 5% BNT test. WAP: Week after Planting

Splitting seed tubers is one way of multiplying seed sources. Splitting seed tubers, apart from being able to multiply seed sources, dividing seed tubers can also increase plant growth and the number of tillers. Gastal et al. (2015) stated that cutting tubers aims to accelerate shoot growth and increase the number of tillers. The treatment of tuber division affected the bud break time, in which intact tubers experienced the fastest bud break time (26.67 days), this was influenced by metabolic processes in the plant which affected the rate of bud breakage.

According to Hernandez et al. (2021), the presence of a significant effect on the observation of bud break indicates that the division of seed tubers affects the growth of porang plants (Figure 2). Sosnowski et al. (2023) stated that plant height speed is influenced by genetic factors such as phytohormones which correlate with the environment. The time of growing shoots affects the height of the shoots, the bud prima had a faster shoot growth time. According to (Finch-Savage & Bassel, 2016), larger bulbs will produce better growth because they contain lots of food reserves.

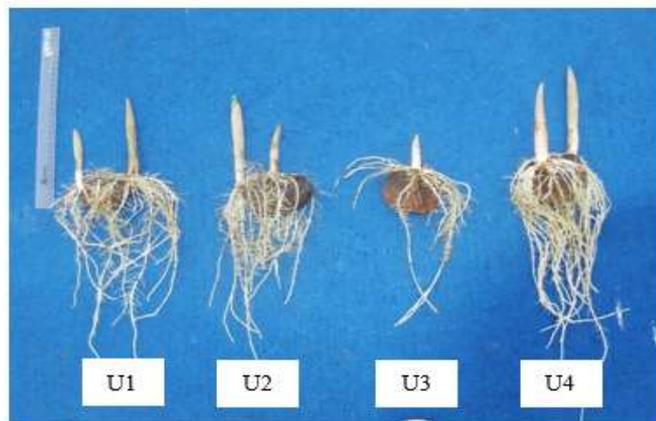


Figure 2. Growth of porang shoots



Figure 3. Observation of bud break in porang plants

The results of the research conducted showed that intact tubers (U1) in the parameters of bud break, plant height, and canopy width got the best average value compared to other treatments, it is suspected that intact tubers (U1) have food reserves that are more maintained because they are still in perfect dressing of the tuber skin, this is different from the condition of the split tuber where apart from focusing on providing nutrients for growth, the split tuber also focuses on wound healing as a result of the splitting treatment. There it requires more nutrient sources to repair damaged cells.

Table 2. Height Average of Porang Plants Due to Treatment of Types of Fertilizers and Root Splitting 7th to 18th

Treatments	Plant Height (cm) (WAP)											
	7	8	9	10	11	12	13	14	15	16	17	18
Urea (P1)	2.42 ab	3.53 ab	4.82	6.69	7.82	8.47	8.82	8.96	9.01	9.06	9.11	9.14
Za (P2)	1.57 a	2.53 a	3.76	5.02	6.60	7.66	8.36	8.43	8.79	8.83	8.93	8.96
Phonska (P3)	2.93 b	4.07 b	4.67	5.70	7.02	7.03	14.31	7.56	7.55	7.61	7.69	7.71
BNT 5 %	1.10	1.19	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
U1 (Intact tuber)	4.25 b	5.43 b	6.52 b	7.52 b	8.70	8.98	9.01	9.08	9.10	9.13	9.19	9.22
U2 (Tuber cut in 2)	2.12 a	3.06 ab	3.50 a	4.56 a	6.37	7.00	7.49	7.56	7.70	7.75	7.83	7.85
U3 (Tuber cut in 3)	1.36 a	2.37 a	3.84 a	5.69 ab	6.46	7.00	7.67	7.54	7.87	7.95	8.00	8.01
U4 (Tuber cut in 4)	1.49 a	2.64 a	3.80 a	5.43 a	7.05	7.89	17.82	9.10	9.14	9.18	9.30	9.33
BNT 5 %	1.34	1.44	1.80	1.87	ns	ns	ns	ns	ns	ns	ns	ns

Note: The mean number followed by the same letter in the same treatment and column is not significantly different in the 5% BNT test. WAP: Week after Planting.

The use of fertilizer (P) did not significantly affect all observations, except for plant height when entering the 7th and 8th Week after Planting (WAP), there was no significant effect on the parameters above because all fertilizer content (Urea, Za, and Phonska) contained sufficient N elements for plant growth. According to Sugiharti et al. (2022), Nitrogen plays an important role in plant growth. Nitrogen stimulates plant vegetative growth, such as leaves, stems, and roots (Razaq et al., 2017).

The results of the research that has been carried out show that the use of fertilizer (P) on the variables of bud break, plant height, and canopy width produces the highest and best average values for the use of Phonska

fertilizer (P3). This is because Phonska fertilizer can help accelerate growth and dissolve easily in the soil so that it is quickly absorbed by plants. Phonska contains Nitrogen, Phosphor and Kalium. Hilo et al. (2017) state that plant height is influenced by the presence of balanced nutrients in the soil, including N, P, and K, these elements encourage cell division, especially meristem cells so increase plants' height.

Phonska is an inorganic fertilizer that can add nutrients to the soil and is available more quickly so that it can be absorbed by plants immediately after dissolving in (Maghfoer et al., 2022). Phonska also accelerates plant growth, strengthens plant stems, increases the durability of crops against pests, disease,

and drought, supports crop yields, and increases the size of fruit, tubers, and seeds (Hasanuzzaman et al., 2018).

The results of the study based on analysis of variance showed that the combined treatment of P1 and U1 resulted in a higher average value for almost every observation parameter. This is presumably because the treatment of intact tubers has food reserves that are still well maintained for the growth period. This is different from split tubers where in addition to tubers having to supply nutrients for the tuber, they also will heal scars from splitting which are also in recovery also need division regeneration of new cells to close the wound. Nutrition is a source of energy and material to produce various cell components. Plants need 9 macro elements

(mineral elements) or organic matter, namely: carbon, oxygen, hydrogen, nitrogen, sulfur, phosphorus, calcium, potassium, and magnesium (Ali Al Meselmani, 2023). If plants do not get these elements as needed, plant growth can be disrupted and even plants can die (Nunes Da Silva et al., 2022). The use of Urea (P1) fertilizer contains very high N elements so that it can affect the growth of porang plants, according to (Skorupka & Nosalewicz, 2021), the advantage of using urea fertilizer is the high nitrogen content. It is also suspected that the interaction between the observations in each observation parameter produces the highest and best values (Petropoulos et al., 2022).

Table 3. Average Leaf Canopy Width of Porang Plants as a Result of Treatments with Various Fertilizers and Root Splitting 8 to 18 (WAP).

Urea (P1)	Canopy (cm)										
Za (P2)	8	9	10	11	12	13	14	15	16	17	18
Phonska (P3)	2.55	2.93	5.96	6.73	7.74	8.43	8.18	8.63	8.61	8.52	8.53
BNT 5 %	1.77	1.40	3.81	5.38	6.43	8.05	8.29	8.54	8.53	8.58	8.52
U1 (Intact tuber)	0.71	3.32	5.05	6.08	6.60	7.25	6.98	7.40	7.38	7.40	7.38
U2 (Tuber cut in 2)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
U3 (Tuber cut in 3)	2.33	5.88 b	7.6. b	9.03 b	9.25	9.36	8.58	9.15	9.14	9.04	8.94
U4 (Tuber cut in 4)	2.96	1.36 a	3.06 a	4.92 a	6.16	6.98	7.00	7.39	7.37	7.47	7.52
BNT 5 %	0.71	1.68 a	4.85 ab	4.94 a	5.70	7.20	7.20	7.56	7.52	7.52	7.41

Note: The mean number followed by the same letter in the same treatment and column is not significantly different in the 5% BNT test. WAP: Week after Planting.

The growth of vegetative organs in tuber plants at the beginning of their growth uses energy from the food reserves contained in the tubers so the plants are not able to carry out photosynthesis (Garrido et al., 2023). Seedling growth is no longer dependent on food reserves, if the plant does photosynthesis, that is, when the vegetative organs are well developed, which is marked by the growth of roots and full blooming of leaves.

Table 4 shows that the type of fertilizer treatment only affected root weight at 19 weeks WAP, after that it no longer affected root weight, stem weight, leaf weight, and even total plant weight. This means that the type of fertilizer treatment did not affect the growth of porang plants until the age of 21 MST. The table above also shows that tuber division treatment affects stem weight, leaf weight, and root weight but has no effect on total plant weight. Subsequent observations (21 WAP) tuber division treatment no longer affected stem weight, leaf weight, root weight, and total plant weight.

Plant growth is an irreversible increase in the size and dry weight of the plant (Hilty et al., 2021). Plant dry weight reflects the accumulation of organic compounds that plants successfully synthesize from inorganic compounds, especially water and carbon dioxide. Plant dry weight is strongly influenced by the amount of nutrients absorbed by plant roots (Padafani, 2022). Plant dry weight depends on the results of the difference between relative photosynthesis and respiration, and growth is a function of plants in producing dry weight (Huang et al., 2019). Plant dry weight reflects the nutritional status obtained by plants and is an indicator that determines growth optimization and plant development, it is tightly related to nutrient availability (Gallegos-Cedillo et al., 2021).



Figure 4. Leaf and stem of porang

Table 4. Average Partition Wet Weight of Porang Plants at the age of 16, 19, and 21 (WAP)

Treatments	Partition of Plant Wet Weight (g) at the top and bottom at the age of observation											
	16				19				21			
	WAP				WAP				WAP			
	Stem	Leave	Roots	Total	Stem	Leave	Roots	Total	Stem	Leave	Roots	Total
Urea (P1)	7.52	4.75	1.67	13.94	7.16	4.87	1.78 a	13.81	6.34	4.18	1.47	11.99
Za (P2)	6.66	4.51	1.56	12.73	9.11	5.94	2.76 b	17.81	4.74	2.67	1.38	8.79
Phonska (P3)	6.75	4.73	1.17	12.65	7.07	4.57	1.95 ab	13.59	5.48	3.21	1.71	10.4
BNT 5%	ns	ns	ns	ns	ns	ns	0,65	0	ns	ns	ns	ns
U1 (Intact tuber)	8.06 ab	5.19 ab	1.36	14.61	9.60 b	6.47 b	2.64	18.71	5.41	3.35	1.67	10.43
U2 (Tuber cut in 2)				11.55								
	6.02 ab	4.29 ab	1.24		5.93 a	4.04 a	1.86	11.83	5.01	3.18	1.34	9.53
U3 (Tuber cut in 3)	4.65 a	3.37 a	1.52	4.89	7.05 ab	4.64 ab	2.10	13.79	6.74	3.91	1.72	12.37
U4 (Tuber cut in 4)								15.96				
	9.18 b	5.80 b	1.76	16.74	8.54 ab	5.36 ab	2.06		4.91	2.98	1.34	9.23
BNT 5% N/ha	3.95	2.40	ns	ns	3.59	2.10	0.53	ns	ns	ns	ns	ns

Note: The mean number followed by the same letter in the same treatment and column is not significantly different in the 5% BNT test. WAP: Week after Planting.



Figure 5. Roots of porang

Porang generative phase begins in the fourth growing period marked by the emergence of flowers from tubers that have been dormant for the third time. Fruit and seeds are formed on the fruit cob. The generative phase in people from Flowering to ripe fruit lasts 8-9 months (Samad et al., 2021). Porang tubers ready to be harvested are marked by dry roots on the surface of the tubers (Finatsiyatull Rosida et al., 2022).

Conclusion

Based on the experimental results, it can be concluded as follows. The combined treatment of tuber fission and fertilizer treatment had no significant interaction on all parameters of porang plant growth observations. The seed tuber division treatment affects the bud break time, plant height, stem diameter, and canopy width only at the beginning of growth, whereas the intact tuber treatment produced the highest.

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Author Contributions

Investigation, F. D. D, R. H, P. L. T.; formal analysis, F. D. D.; investigation, R. H and P. L. T.; resources, F. D. D. and R. H.; data curation, P. L. T.: writing—original draft preparation, F. D. D and R. H.; writing-review and editing, P. L. T. visualization, F. D. D. and R. H.; supervision, P. L. T.; project administration, F. D. D.; funding acquisition, R. H. and P. L. T. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

There is no conflict of interest in conducting the research and publishing the manuscript. Copyright on behalf of the author.

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