International Information and Engineering Technology Association
Advancing the World of Information and Engineering

International Journal of Design & Nature and Ecodynamics
Vol. 18, No. 4, August, 2023, pp. 957-962
Journal homepage: http://iieta.org/journals/ijdne

Vegetative Propagation of Bubil Seeds and Tuber Dormancy Reduction in Porang (*Amorphophallus muelleri* Blume) for Shorter Harvest Time

Gunardi D. Winarno*, Irwan S. Banuwa, Sugeng P. Harianto

Department of Forestry, Faculty of Agriculture, Lampung University, Lampung 35144, Indonesia

Corresponding Author Email: gunardi.djoko@fp.unila.ac.id

https://doi.org/10.18280/ijdne.180423

Received: 20 December 2022
Revised: 11 August 2023
Accepted: 18 August 2023
Available online: 31 August 2023

Keywords:
bubil, tuber, undormant, porang

ABSTRACT

The development of vegetative propagation techniques for porang (*Amorphophallus muelleri* Blume) is crucial for augmenting plant populations. However, a significant challenge encountered during this process pertains to the plant's six-month dormancy period during the dry season. Both the bulbil seeds and tubers enter this dormant state as a natural adaptation mechanism, thereby prolonging the harvest timeframe. If you can wake Bubils and bulbs when they are dormant, it will shorten the waiting time for harvest. The current study proposes a methodology to overcome this dormancy period, with the aim of reducing the time to harvest. Traditionally, there has been a lack of effective treatments to alleviate the dormancy of bulbils during the dry season, leading to an extended harvest period of approximately three years. The proposed method involves the application of growth regulators to bulbil seeds and tubers during the dry season, followed by planting to obtain small to medium-sized tubers. Results indicate that the application of growth regulators markedly accelerates the germination of bulbil seeds and growth of porang tubers. Notably, almost all treated bulbils (95%) demonstrated premature shoot emergence. Consequently, porang farmers are projected to achieve a significant reduction in time to harvest large tubers, from three years down to one year. This study provides novel insights and practical solutions for the porang farming industry, potentially revolutionizing current farming practices and significantly enhancing crop yield within a reduced timeframe.

1. INTRODUCTION

The importance of the porang plant is not only for world food and industry, but also as a supporting plant for conservation, so it is necessary to develop its population. According to Hettercheid [1], porang (*Amorphophallus muelleri* Blume) is one type of iles-iles plant that is often found in the forest. Porang is a family of Araceae which is a shrub (herb) plant with a height of 100-150 cm and has a stem tuber. The stem and leaves are green to dark green with stripes with prismatic white spots. Soemono et al. [2] stated that the growth cycle of porang plants goes through four phases: the dormant phase, the growth phase of stems and roots, the initiation and filling phase of the tubers, and the old phase. Early growth is noted when shoots appear above the soil surface, about 3 cm in height. Porang is an annual plant and prefers an environment with high shade and adequate humidity. According to Sari and Suhartati [3], porang growth requires shade so that it can be cultivated as an intercrop in community forests or in plantation forest areas. One of the characteristics of the porang plant is that it has a high tolerance for the shaded environment, so that this plant grows well in forest areas and can grow on all types of soil with loose and not flooded conditions [4].

At each meeting of the petiole, blackish brown bulbil will grow as a means of breeding for porang plants and as a distinguishing feature of this species compared to other types of Amorphophallus. According to Santosa and Sugiyama [5] reported shoots from whole tubers will appear earlier and will be larger in size than plants from split tubers, regardless of weight. Shoots from small intact tubers appear earlier than larger plants. For cultivation it is recommended to use whole tuber seeds measuring 100 or 200 g.

The porang's tubers are utilized in global food and various industries, including but not limited to rice, noodles, tofu, industrial adhesives, cosmetics, banknotes, and jelly production. Despite the extensive use and exportation of porang from Indonesia to countries such as China, Japan, Korea, America, and Australia, the supply from Indonesia currently only meets an estimated 10% of global demand. The tubers' glucomannan content extends their use beyond food to various industrial applications, chemical laboratories, and medicine. Additionally, porang flour can be transformed into a range of processed food items, such as meatballs, chips, cookies, noodles, and tofu, and utilized in cosmetics, textiles, and pharmaceuticals [6, 7].

In addition, medicinal applications of the porang plant encompass treatment for conditions such as rheumatism, tumors, and pulmonary swelling. Other uses encompass drug delivery, bioadhesive properties enhancement, cellular therapy, materials for cell immobilization, encapsulation materials, films and membranes, coating materials, cosmetics, emulsifiers, and surfactants [8]. Given the vast array of uses, the demand for porang raw material remains high and continues to grow.

Despite the increasing demand, the cultivation of porang plants faces significant challenges, particularly regarding seed availability. Seeds, in the form of bubils, are typically available only during the dry season, when the porang plant wilts and the bubil seeds fall [9]. Thus, the dry season induces a dormancy period in the porang plants, which is only broken as the rainy season approaches, prompting farmers to plant bubils synchronously.

While waiting for porang to grow and grow around December to May, after that there is no more activity for planting development due to the dry season. Anticipating this, of course, requires engineering techniques to be able to reproduce plants and wake them up when they enter dormancy.

On the other hand, the long wait for the porang harvest, which takes 3 years, makes farmers feel it is too long compared to corn, cassava and rice. This long wait is because during the dry season (6 months) porang plants will be dormant, especially in bubils and their tubers. As an adaptation reaction to the environment when entering the dry season, due to lack of water for growth. For this reason, it is necessary to engineer bubil seeds and tubers so that they are not dormant during the dry season and can be temporarily planted in the nursery to produce small tubers.

This paper aims to address two main issues: (a) how to propagate plants through Bubils and bulbs, (b) how to grow bubils or try to make Bubils and tubers not dormant during the dry season. The aims of this research are: (a) attempts at vegetative propagation in bubils and tubers, (b) wake up bubils and tubers during dry season.

2. METHOD

The research was conducted for 4 months starting from July to October 2021. The research location is in Siliwangi village, Hanura Village, Pesawaran Regency, Lampung.

The materials used in this study were stem cuttings (length size 10 cm), bubils (diameter 2.5 cm) and tubers of porang plants (diameter 5 cm), weaning media and growth stimulants. The equipment used includes seedling houses (3 × 5 m) with paranet (height 3 m), polybags (10 × 15 cm), digital scales (max 10 kg), basins (diameter 22 cm), measuring cups (1 liter), 1 scissors, 1 watering pot (5 liter).

The stages of the method used are:

a. The working procedure includes the preparation of weaning media and bubils and tubers, providing treatment with PGR (Plant Growth Regulators) auxin and recording the growth process. Soaking using PGR Auxin on tubers is very good for accelerating the growth of roots and shoots in porang tubers. Based on research conducted by Budianto et al. [10] the duration of ZPT immersion carried out can increase the presentation of shoots and root presentations of a plant.

b. Sowing of Bubils and bulbs in a nursery shaded with paranet.

c. Inspection of buds that will grow.

d. Weekly data logging on growing Bubils and tubers.

Experimental design 1

Experiments were carried out to determine the effect of the concentration of Growth Stimulating Substances and cuttings from porang plants were arranged using a design consisting of 6 treatment groups of 20 samples each for a total of 120 samples. The treatment groups were arranged as follows:

a. Split Bubil seeds given PGR (Plant Growth Regulators) RootMore,

b. Split Bubil seeds without PGR,

c. Whole Bubil seeds were given PGR,

d. Whole Bubil seeds without PGR,

e. Split tubers are given PGR,

f. Split tubers without PGR.

The treatment used was 1 tea spoon (5 ml) added to 1 liter of water then stirred evenly. The material is soaked for 1 hour and drained overnight so that the PGR seeps into the sample. Materials that have been treated are put into polybags that have been filled with seedling media in the form of coffee skin compost. All samples were watered every day and observed every week in the nursery.

Experimental design 2

Bubil seeds as much as 20 kg were given isoprocarb ($C_{11}H_{15}NO_2$) 50% powder as much as 200 gr evenly. Bubils are placed on a board in a dark room but there is enough ventilation. The structure of the room to put bubbles in the form of a wall measuring 10 m × 10 m. Vents measuring 20 cm × 500 cm, placed at the top of the wall.

Then after 1 week sprayed with water using a sprayer every day (at 5 o'clock in the afternoon). Then after 1 month 100 grains were taken randomly to see the percentage of success in growing shoots. The specific process of work procedures is the use of materials that are easy to obtain and easy to apply but are not widely practiced by researchers.

Data collection

The data recorded every week is the growth of prospective shoots in all samples. Usually there will be spots that will sprout on the Bubil seeds or tubers that will grow. The growth elements noted are the small white shoots (usually 1, sometimes more) that appear on the surface of the tubers or tubers. Bubbles or tubers that fail to grow usually do not appear small shoots and eventually rot. Small shoots can be seen clearly just by observing without using a lop.

Data processing and data presentation

Data processing using Microsoft Excel to find out the bubil bud growth percentage. Each sample was observed to see if there were bud spots that were an indication of the success of PGR. Data is presented in the form of tables, graphs, pictures and described.

3. RESULTS AND DISCUSSION

3.1 Bubil seeds

Bubil seeds do not appear to be budding at first and they can last up to 5 months stored in the open (Figure 1). Sugiyama and Santosa [11] reported that the initial growth of porang plants uses nutrient reserves in the seed buds (bubil) and is used for the growth of plant stems and leaves. About 60 days after planting, the seed bulbs rot and are replaced by new bulbs. These new bulbs will enlarge using the results of photosynthesis.

Bulbil is a leaf tuber or tuber that is hatched between the branching bones of the leaf blade. In general, porang plants that are still experiencing one growth period produce 1 bulbil, two growth periods produce 4-7 bulbils, and three growth periods produce 10-20 bulbils. The size of the bulbil varies depending on its location on the branching of the leaf bones and the age of the plant [12].

Figure 1. Bubil seeds can last up to 6 months without rot

The condition for it to last a long time is that the bubil seeds are harvested when the plants have fallen and the bubil seeds come off on their own. Storage in the open and not in plastic bags.

Bubil seeds until at the time of the rainy season sometimes begin to appear buds of growth. Usually the 9th month has started to appear so that the farmers will generally plant bubil in the 9th to the 10th month.

The growth of the old shoots is an opportunity for research to accelerate the emergence of shoots. In this study, it turned out that the buds can be stimulated by the growth of shoots by using PGR. The time it takes for the buds to emerge is 3 weeks or 21 days. As a comparison, propagation using leaf cuttings is relatively faster and cutting materials are easy to obtain. Propagation using leaf cuttings needs to be soaked in PGR. Research conducted by Sumarwoto [13] states that leaf cuttings soaked in PGR, the growth power reached 73.71%, while without immersion PGR was 55%. However, leaf cuttings in their implementation in the field are not as easy as bubil.

This faster growth of shoots than usual will benefit porang farmers. Saving 5 months of time will certainly have an impact on harvest time, especially the harvest of bubil again. So that in 1 year you can harvest bubil seeds 2 times (previously the bubil harvest was only once a year).

3.2 Tubers

Porang tubers that are split into 2 parts will appear to appear new shoots in the middle of the tubers (Figure 2). The same thing happened to tubers that were not split or whole. This study showed that tubers that were given PGR and those that were not given PGR, both grew new shoots after 1 month.

Figure 2. New shoots appear on the split tuber

Porang tubers can be split into 4 or 6 depending on the size. The bigger the size, the more it can be split. So that the opportunity for the development of plant populations is getting bigger. Based on observations in the field, plant growth from tubers is faster and larger than bulb seeds. Mondal and Sen [14] stated that seeds obtained from the upper half of the tuber had a high percentage of seed germination (98%), whereas it would produce lower germination if it came from the bottom half of the tuber. The bottom of the tuber is generally not very good when used as a seed.

According to Gusmalawati [15], the flowering phase starts at the end of the dry season to the beginning of the rainy season and lasts about 2 months. The fertilization phase in porang lasts around 6-7 months. Furthermore, during the dry season, the bubbles will be dormant for 6 months. In the following rainy season these dormant bulbs grow into new plants.

For population development in the field, the use of split tubers is more profitable than bulb seeds. Split tubers will produce more bulbs than bulb seeds, because the growth of stems and leaves is greater.

However, if the bulbs are obtained from a remote location and it takes up to 3 days to travel, the tubers will be exposed to mold and easily rotted or damaged so that they will fail. Therefore, tuber development is only recommended for locations near or in the same area.

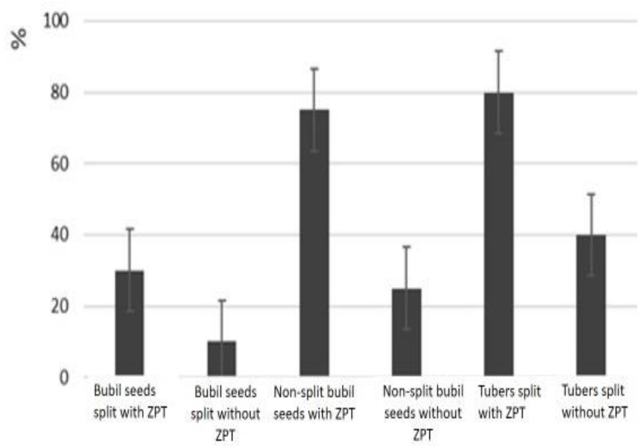

Figure 3. Percentage of shoot growth on bulbs and tubers with various treatments

The results of the research by Ambarwati and Murti [16] showed that the weight of harvested tubers was influenced by plant height and petiole diameter. While the weight of harvested tubers was positively correlated with tuber glucomannan content, and glucomannan content was positively correlated with starch content in tubers.

The percentage of successful emergence of shoots in different treatments after 1 month is presented in Figure 3.

3.3 First trial results

Giving PGR to intact bulbs gave 75% success in the emergence of shoots. This treatment certainly provides opportunities for farmers who will develop porang plants more quickly. The difference in growth speed can reach 5 months so it is hoped that harvesting that begins with bubil will be faster. If there is no treatment with PGR, it should not be applied to split tuber seeds or split tubers. This is because it avoids the risk of failure of the emergence of shoots and decay.

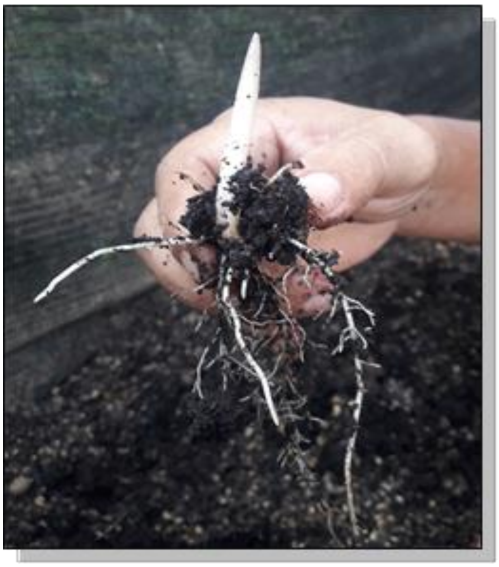

Figure 4. Growth of shoots and roots

Figure 5. Stem and leaf growth

Giving PGR to split tubers increased the success of the emergence of buds 2 times compared to not given treatment. According to Nisrina et al. [17] stated the interaction between PGR concentration and the duration of immersion will affect growth, namely shoot diameter. In the study, it was stated that the concentration of natural PGR and soaking time for 8 hours increased the shoot diameter by 3.18 cm or equivalent to 57.8% of the control. According to Gultom [18] the interaction between PGR auxin concentration of 300 mg/liter of water and 3 hours of immersion (Z_2L_2) resulted in a larger shoot diameter 71% higher than the control (Z_0L_0). Propagation in this way becomes more profitable for farmers, because the porang population will grow faster.

After the buds grow, fibrous roots appear at the base of the shoots (Figure 4). Shoots grow relatively quickly (1 month) and develop into young stems and leaves (Figure 5).

3.4 Second trial results

Figure 6. Bubil without PGR

Figure 7. Bubil given PGR

The results showed that the buds that were not treated had no visible buds (Figure 6). The treated bulbs were 95% germinated simultaneously, as in (Figure 7). This condition is very beneficial for farmers, and can cut the dormant cycle that lasts up to 6 months. If the buds that have been treated have succeeded in sprouting, then land preparation is very important.

Usually, the farmers plant bubils in October in the form that is still intact and has not sprouted. Bubbles are left for almost 6 months, as a result the harvest range is long.

When compared to planting bubil with tuber planting, it will grow bigger in the form of tubers. However, today's farmers generally still plant bubil. Planting is carried out in October in the form of still intact and has not sprouted simultaneously.

This treatment is very easy and inexpensive but still uses 50% isoprocarb chemicals. Therefore, to keep the environment natural, it is necessary to find a substitute for chemicals into herbal ingredients.

Gultom [18] stated that the use of a ZPT auxin concentration of 300 mg/liter of water and 3-hour soaking to produce a larger shoot diameter was 71% higher than the control. But for implementation in the field, it is less practical. Farmers will find it difficult to measure the size and process. Besides that, the price of auxin is also more expensive than isoprocarb chemicals.

Providing concentration levels low growth regulators will stimulate growth in tubers and if the concentration level is high enough then what will happen is inhibiting growth, poisoning and can even kill plants. Therefore, to obtain optimum results, it is necessary to control the administration of ZPT with certain concentrations [19, 20].

4. CONCLUSION

Provision of Growth Regulatory Substances (PGR) root more can stimulate the appearance of buds on intact bubil porang seeds up to 75% without having to wait for the dormancy period. So that time efficiency in the development of the porang population can be increased. The administration of PGR to the split bulb seeds did not show significantly different results. The implication is that the division of bubil seeds for porang propagation should not be carried out. Meanwhile, tubers that were split and given PGR showed a two-fold difference with bulbs split without PGR. The implication is that tuber propagation can be done by splitting and giving PGR.

Bubil treatment using isoprocarb chemical will produce more bubil sprouts and simultaneously. So it will cut dormant time and save time waiting for harvest. However, farmers need to provide a place for the growth of bulbs to become small tubers.

Suggestion

Further research is needed to obtain organic PGR so that it does not have a negative impact on the environment. Farmers should plant porang in the form of tubers even though they are still small because they grow faster than bulbs.

For bulbs that have been active after being given PGR during the dry season, they should be sown before planting. This condition is so that the bulbs can become small tubers and are planted at the beginning of the rainy season.

REFERENCES

[1] Hettercheid, W. (1996). Generic diagnosis of *Amorphopallus* Blume. https://www.aroid.org/genera/amorphophallus/diagno.html, accessed on May 16, 2020.

[2] Soemono, S., Baharsjah, Sjarifuddin, J., Wiroatmodjo, J., Tjitrosoedirdjo, S. (1987). Effect of seedling weight on growth, yield, and quality of tuber suweg (*Amorphophallus campanulatus* Bl.) at various ages. Postgraduate thesis. Faculty of Postgraduate, IPB University, Indonesia.

[3] Sari, R., Suhartati, S. (2015). Porang plants: Prospects of cultivation as one of the agroforestry systems. Ebony Bulletin, 12(2): 97-110.

[4] Saradan, K.P.H. (2005). Cultivation of porang in forest areas. Perum Perhutani Unit I, East Java. https://www.researchgate.net/publication/343448968_Agroforestri_Porang_Masa_Depan_Hutan_Jawa.

[5] Santosa, E., Sugiyama, N. (2007). Growth and production of *Amorphophallus paeoniifolius* Dennst. Nicolson from different corm weights. Jurnal Agronomi Indonesia, 35(2): 81-87. https://doi.org/10.24831/jai.v35i2.1315

[6] Budiman, Arisoesilaningsih, E. (2012). Predictive model of Amorphophallus muelleri growth in some agroforestry in East Java by multiple regression analysis. Biodiversitas, 13(1): 18-22. https://doi.org/10.13057/biodiv/d130104

[7] Ambico ambition on porang processing. (2008). https://www.byufitrah.militanunair.com.

[8] Zhang, Y.Q., Xie, B.J., Gan, X. (2005). Advance in the applications of konjac glucomannan and its derivatives. Carbohydrate Polymers, 60(1): 27-31. https://doi.org/10.1016/j.carbpol. 2004.11.003

[9] Porang dissemination modules. (2013). https://porang.ub.ac.id/media.php?module=detailjurnal&judul=porang-dissemination-module.

[10] Budianto, E.A., Badami, K., dan Arsyadmunir, A. (2013). Effects of ZPT combinations and long-term infiltration on the success of Red Betelnut breeding (Piper crocatum Ruiz dan Pav) secara stek. Agrovigor: Jurnal Agroekoteknologi, 6(2): 103-111. https://doi.org/10.21107/agrovigor.v6i2.1485

[11] Sugiyama, N., Santosa, E. (2008). Edible Amorphophallus in Indonesia-Potential Crops in Agroforestry. Gajah Mada University Press, Yogyakarta.

[12] Sumarwoto, S. (2005). Iles-iles (*Amorphophallus muelleri* Blume); description and other characteristics. Biodiversitas Journal of Biological Diversity, 6(3): 185-190. https://doi.org/10.13057/biodiv/d060310

[13] Sumarwoto, M. (2015). Propagation of seedlings through cleavage and closure of Iles.Iles (*Amorphophallus muelleri* Blume) stem tubers. AgroUPY, 6(2): 71-79.

[14] Mondal, S., Sen, H. (2004). Seed corm production of elephant foot yam through agronomical manipulation. Journal of Root Crops, 30(2): 115-119. https://eurekamag.com/research/004/312/004312658.php.

[15] Gusmalawati, D. (2013). Hereditary organ development structure and Pream grain growth ability (Amorphophalus muellerus blume). Magister thesis, Universitas Brawijaya.

[16] Ambarwati, E., Murti, R.H. (2001). Cross-correlation analysis of chemical composition between leaf corm and rock mass (Amorphophallus variabilis). Ilmu Pertanian (Agricultural Science), 8(2): 55-61. https://doi.org/10.22146/ipas.59974

[17] Nisrina, S., Hayati, R., Hayati, M. (2020). Effects of some types of ZPT and long-term infiltration on the

growth of Psidium guajava (Syzygium malaccense L. Merr & Perry). Jurnal Ilmiah Mahasiswa Pertanian, 5(2): 71-80. https://doi.org/10.17969/jimfp.v5i2.14886
[18] Gultom, R.D.K. (2021). Effects of concentration and long-term infiltration of Zptauksin on double bud division and bud growth (*Amorphophallus Muelleri* Blume). Jurnal Ilmiah Mahasiswa Pertanian, 1(3): 1-15. https://jurnalmahasiswa.umsu.ac.id/index.php/jimtani/article/view/597.
[19] Agustina, L.D. (2015). Effect of regulator concentration on the growth of NAA plants and effect of treatment time on the growth and yield of mung bean (Vigna radiata L.). Agroswagati. Jurnal Agronomi, 3(2): 364-374. http://dx.doi.org/10.33603/agroswagati.v3i2.802
[20] Tefa, A. (2017). Test of the viability and vigor of rice seed (Oryza Sativa L.) during storage at different moisture levels. Savana Cendana, 2(3): 48-50. https://doi.org/10.32938/sc.v2i03.210