THE SELECTION TECHNIQUE OF BULBIL PORANG
(*Amorphophallus muelleri* Blume) BASED ON GROWTH RESPONSE

Qurrota A’yun¹, Nunung Harijati², Retno Mastuti²

¹ Postgraduate of Biology Program, Faculty of Mathematics and Natural Sciences, University of Brawijaya
² Department of Biology, Faculty of Mathematics and Natural Sciences, University of Brawijaya

Jl. Veteran, Malang, East Java 65145, Indonesia
Email: qurrotaayun216@gmail.com

ABSTRACT

Bulbil is a vegetative reproductive organ which is located on center and site of branching of porang leaf. The purpose of this study was to determine the best growth response between the center bulbil, the 1st- and 2nd- branch bulbils. All bulbils were obtained from 2 years old porang which has petiole with height 119.8 – 120 cm. All porang previously were cultivated in Rejosari Village, Bantur District. The harvested Bulbils were grown in a polybag (15x15 cm) which contain mixture of soil, manure, cocopeat and husk charcoal (5:3:1:1). The unit experiment where each type of bulbil was grown with 3 replications. Each replicate consisted of 15 plants. The experiment was organized by completely random designed. The ANOVA test was applied to all data. The result showed that differences in source the bulbil in term position (center bulbil, 1st- and 2nd- branch bulbils) significantly affected the time for appearance 1st shoot, germination rate and germination uniformity (80%). The petiole height-diameter and the canopy width of porang plants were affected by source of bulbil as well. The best results for all parameter were given by seeded-bulbil derived from center bulbil. All the bulbils produced more than one shoots in one planted bulbil.

Keywords: position of bulbil, germination, growth

1. INTRODUCTION

*Porang* (*Amorphophallus muelleri* Blume) belongs to the genus *Amorphophallus*, family Araceae. Porang is a tuber type plant that has economic value and promising prospects to be developed in Indonesia as an export commodity. Jepang, China, Australia, Sri Lanka, Malaysia, Korea, and several other countries use porang plants as food and industrial materials (Sumarwoto, 2005). Opportunities porang exports are very large. However, porang production not meet the demand. Therefore, it needs extent cultivation field of porang and sufficiency of seeded-material to meet the porang industry both inside and outside the country.

Bulbil, tuber, and seeds can use as seeded-material. Seeds look beneficial as seeded material because can provide at least 300 seedlings. However, the seeds are available after the porang plant three years old. In contrast, bulbil and tuber are available in a shorter time. Bulbil is preferable as a seeded-material because in one plant can produce 10-12 bulbil, while tuber as a seeded-material only available one per plant. The bulbil located in the center and branch of the leaf stalks porang, and the color is brown (Fauziyah, 2004; Sumarwoto, 2004).

From empirical observations, the appearance of the center bulbil does not coincide with the branch bulbil. The center bulbil first appears, then the 1st- and 2nd- branchspah bulbils (Figure 1). The bulbil is released from the petiole of porang not at the same time. The 2nd- branch bulbil is first detached from the petiole of porang, then the 1st- branch bulbil and the center bulbil is the last time.

![Figure 1](image-url). Position of the center bulbil (blue), the 1st- branch bulbil (red), and the 2nd- branch bulbil (black).
Empirically, the shape and size of the bulbil are also different. The center bulbil is round (Figure 2A), while the branch bulbils is oval shaped (Figure 2B-C). The size of the center bulbil is bigger compared with the branch bulbil. However, the size of the center and branch bulbils between the porang one plant and the other plants also varies even though all of the originated in the same growing period.

Figure 2. The shape and size of bulbil on the porang plants: A. the center bulbil, B. the 1st. branch bulbil, and C. the 2nd. branch bulbil

Porang plants have polyembryony character that is the production of more than one shoot per seed, bulbil or tuber (Porang Research Center, 2013). In dorman bulbil seen the presence of tubercle that there is the skin of bulbil and brown color. When bulbil dormancy was end, some tubercle developed into shoot, and not all shoots successfully develop into shoots. The success of growing shoots into mature plants is initiated with a supply of food reserves in the bulbil and quite logically different bulbil sizes will provide different amounts of food reserves (Santosa & Wirnas, 2009). Based on this, it was suspected that there was a difference in the number of shoots produced between the center bulbil, the 1st. and 2nd. branch bulbils.

It has been reported previously that the bulbil size affects the germination of bulbil and the growth of porang plants. But the size of the bulbil does not originate from the same growing period. The bulbil used comes from porang plants aged 1-3 years and is taken randomly from the pool bulbil. The bulbil size is determined by weighing and measuring diameter of the bulbil by regardless of the location bulbil on the porang plants (Santosa & Wirnas, 2009; Sumarwoto & Maryana, 2011). Therefore, to know the best growth response between the center bulbil, the 1st. and 2nd. branch bulbils from the same growing period, this research needs to be done.

2. MATERIALS AND METHODS

2.1. Preparation of Bulbil Porang

Two years old of porang plant, as bulbil sources, were selected as 45 plants which had a height of petiole of 119.8 - 120 cm. The weight, diameter and thickness of the center bulbil, the 1st. and 2nd. branch bulbils produced by these plants were 5.86 - 33.70 g, 23.49 - 47.10 mm, 16.26 - 30.24 mm (center bulbil); 2.66 - 9.19 g, 20.02 - 42.15 mm, 12.56 - 19.69 mm (1st branch bulbil); and 1.01 - 3.30 g, 11.40 - 22.45 mm, 8.30 - 16.35 mm (2nd branch bulbil)

2.2. Preparation of Media and Bulbil Planting

Planting media consist of soil, manure, cocopeat and husk charcoal with a ratio of each ingredient 5:3:1:1. Before used, soil, cocopeat, and huskcharcoal were steamed to kill disturbing organisms that can damage plant roots. All planting media were put in a polybag (15 x 15 cm), then the bulbil was planted at a depth of 1 cm from the surface of the planting media. The media was added NPK Phonska fertilizer (15:15:15) with dosage 0.05 g multiplied by the average bulbil weight in each treatment. Fertilizer was given when 80% of the canopies from 15 bulbils of porang that grew from each type of bulbil have opened perfectly. Fertilization is carried out for 2 weeks until the plants fall.

2.3. Parameters of Germination and Growth

Observation of germination was observed every day until all bulbil produce of shoots. Bulbil germination is characterized by the appearance of shoots as high as about 1 cm above the surface. Germination parameters were the time for appearance 1st shoot, germination rate and germination uniformity. The percentage of germination rate was calculated at 136 days after planting. Percentage of germination is calculated using the following formula (1):

\[
GR(\%) = \frac{NG}{NP} \times 100\%
\]

Explanation:

GR = Germination rate
NG = Number of bulbils germinated
NP = Number of bulbils planted
The time for appearance 1st shoot was the time (days) needed by the bulbil to give rise to the 1st shoot after planting, while the germination uniformity (in this experiment) was the time (days) needed by the bulbil to germinated 80%. The growth parameters included height and diameter of petiole, width of canopy, the percentage of monoeombryo and polyembryo, the height and diameter of petiol and the width of canopy of the shoot 1 to 8 and the percentage of plants that appearance of bulbil. All growth parameters are measured every 2 weeks.

2.4. Data Analysis

The experiment design used a Completely Randomized Design (CRD), which consisted of 3 treatments, each treatment had 3 replications, and each replication consisted 15 plants. Homogeneity and normality test were applied to obtained-data using the Levene and the Kolmogorov-Smirnov test respectively. If the data was homogeneous and normally distributed, then the data was analyzed using ANOVA (Analysis of Variance). If the results obtained are significant, then proceed using the Tukey test with a significance 5%.

3. RESULT AND DISCUSSION

3.1. Germination of Bulbil Porang

Bulbils planted in July 2018 germinate at October to December 2018. The Anova test results showed that the position of bulbil (center bulbil, 1st- and 2nd- branch bulbils) had a significant effect on the time for appearance 1st shoot, the rate of germination and the uniformity of germination (Table 1). Seed position in different organs on the mother plants can affect seed colour, size, morphology and germination (Gutterman, 2000).

Bulbil originating from a different position has different times to produce shoots. The bulbil originating from the center germinated earlier than the 1st- and 2nd- branch bulbils. The center bulbil, the 1st- and 2nd- branch bulbils gave rise the 1st- shoot at 106 ± 0.00 days after planting, 124 ± 0.00 days after planting and 132 ± 2.89 days after planting respectively (Table 1). This is due to bulbil maturation in the different plant of porang. The center bulbil grows earlier than the branch bulbils so that in germination, the center bulbil is faster to produce shoots.

### Table 1. The time for appearance 1st shoot (SF), germination rate (GR) and the uniformity of germination (80%) (UG) on germination of bulbil porang

<table>
<thead>
<tr>
<th>Position of bulbil</th>
<th>SF (DAP)</th>
<th>GR (%)</th>
<th>UG (DAP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center</td>
<td>106±0.00</td>
<td>100±0.00</td>
<td>113±1.77</td>
</tr>
<tr>
<td>1st- branch</td>
<td>124±0.00</td>
<td>66.67±17.95</td>
<td>121±0.97</td>
</tr>
<tr>
<td>2nd- branch</td>
<td>132±2.89</td>
<td>33.67±11.55</td>
<td>137±0.67</td>
</tr>
</tbody>
</table>

Explanation: DAP (days after planting). The numbers followed by the same letters show no significant difference in the Tukey test α = 0.05.

At the age of 136 day after planting, the germination rate was observed. The highest rate of germination was found in the center bulbil which was 100%, while the lowest was found in the 2nd- branch bulbil (33.67%). The center bulbil has the ability to germinate faster than the 1st- and 2nd- branch bulbils. The more toward perifer, the bulbils germination is getting lower. This result was also supported by germination uniformity (80%). The average time to produced 80% of germination from each tuber group was 113 ± 1.77 days after planting (center bulbil), 131 ± 0.97 days after planting (1st- branch bulbil) and 137 ± 0.67 days after planting (2nd- branch bulbil) (Table 1). Thus, the higher the uniformity of bulbil germination, the faster the time (days) was needed to produce shoots and vice versa.

3.2. Plant Growth from The Bulbil Porang

The petiole height and diameter, and canopy width of plant from center bulbil was the highest compared to plants originating from the 1st- and 2nd- branch bulbils (Figure 3). The height and diameter of petiole porang from each type of bulbil showed significant differences age 168 to 210 days after planting (Figure 4). During the observation every 2 weeks, plants originating from the center bulbil have the height and diameter of petiole highest compared to the 1st- and 2nd- branch bulbils. The height and diameter of petiole and the width of canopy have a pattern of growth between center bulbil, 1st- and 2nd- branch bulbils. The height and diameter of petiole and the width of canopy on the growth of porang from each type of the bulbil age 182 to 210 days after planting.
indicates plant growth is not significantly different (plants start to stabilize or fixed).

Figure 3. Plant growth of originating porang from the center bulbil (CB), the 1<sup>st</sup>-branch bulbil (1<sup>st</sup>-) and the 2<sup>nd</sup>-branch bulbil (2<sup>nd</sup>-) age 210 days after planting

The growth of originating porang from the center bulbil showed a relatively better growth response compared to the 1<sup>st</sup>- and 2<sup>nd</sup>-branch bulbils based on the height and diameter of petiole and the width of canopy. According to Sumarwoto & Maryana (2011) and Mastuti et al. (2018), the center bulbil contained more food reserves so that the photosynthesis process occurs earlier and the vegetative organs form faster than the branch bulbil, so that the growth of originating porang from the center bulbil can produced plants that were higher than the originating porang from the 1<sup>st</sup>- and 2<sup>nd</sup>-branch bulbils.

On the age of 182 – 210 days after planting, it is also seen the plants of the appearance of bulbil originating from the center bulbil and 1<sup>st</sup>-branch bulbil. At first, the bulbil is small and green, then from week to week the bulbil will grow bigger and brown. At the age of 210 days after planting, the number of plants that grew from the center bulbil and 1<sup>st</sup>-branch that appearance of bulbil was 64.44% and 75.56% respectively (Figure 5). Plants that grew from the 2<sup>nd</sup>-branch bulbil have not yet appearance of bulbil. This is because the location of the bulbil in the plant of porang determines the age of the bulbil, so the 2<sup>nd</sup>-branch bulbil is younger than the center bulbil and the 1<sup>st</sup>-branch bulbil.

Figure 5. Growth of bulbil from plants age 210 days after planting. (A) The center bulbil, (B) The 1<sup>st</sup>-branch bulbil

3.3. Plant Growth from The Bulbil Polyembryo

The center, 1<sup>st</sup>- and 2<sup>nd</sup>-branch bulbils were able to bring out more than one shoot (polyembryo bulbils) and some only one shoot (monoembryo bulbil) (Table 2). It can be seen on the growth of shoots of different types of bulbil indicating that in a bulbil that is planted
can produce 1-3 shoots. The bulbil has *tuber*cle which were spread evenly on the surface of the bulbil skin. The farther the branching from the center of the branch, the less *tuber*cle on the surface of the bulbil skin. *Tuber*cle will not grow all into shoots depending on the availability of food in the bulbil (Santosa & Wirnas, 2009). Some bulbil whether derived from center or branching may produce more than one shoot. This fact showed that the porang plants have polyembryonic character (can produce more than one shoots) (Porang Research Center, 2013).

**Table 2.** Variations of the number of shoots produced from each type of bulbils age 182-210 days after planting

<table>
<thead>
<tr>
<th>Bulbil</th>
<th>Bulbil with variations in number of shoots (%)</th>
<th>Monoembryo</th>
<th>Polyembryo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center</td>
<td>1</td>
<td>67</td>
<td>26</td>
</tr>
<tr>
<td>1st. branch</td>
<td>1</td>
<td>18</td>
<td>69</td>
</tr>
<tr>
<td>2nd. branch</td>
<td>2</td>
<td>20</td>
<td>69</td>
</tr>
</tbody>
</table>

The 1st. shoot grew earlier then followed by the 2nd. and 3rd. shoots, so the 1st. shoot was higher than the 2nd. and 3rd. shoots (Figure 6). The above is supported by the Anova test results showed that the 1st-, 2nd- and 3rd. shoots have real effect on the growth and diameter of the petiole as well as the height of the plant’s heading age 182-210 days after planting. The 1st. shoots derived from the center bulbil have the height and diameter of petiole and the width of canopy followed by the 2nd. shoots, while the 3rd. shoots are not significantly different from the 2nd. shoots. The 1st. shoots derived from the 1st. branch bulbil had the highest of petiole height followed by the 2nd. and 3rd. shoots, while the measurements of the diameter of petiole and the width of canopy on the 1st. shoots were not significantly different with the 2nd. shoots, but differed significant with the 3rd. shoots. The 1st. shoots derived from the 2nd. branch bulbil were not significantly different from the 2nd. but significantly different shoots with the 3rd. shoots based on the height and diameter of petiole and the width of canopy (Figure 7).
According to Gusmalawati (2013), polyembryo plants have a better growth component because they have two to three shoots in one seed planted so that the number of vegetative organs (roots, stems and leaves) is more. The more shoots produced on a plant, the higher the energy produced in these plants. The high energy possessed by a plant causes plant growth and development to be better, so in this case polyembryo plants have a better growth component compared to monoembryo plants (produce one shoot). According to Tjitrosoepomo (2009), vegetative organs directly or indirectly play an important role in plant growth.

4. CONCLUSION

The center bulbil, the 1st and 2nd branch bulbils of the porang plant had a significant effect in germination and growth of porang plants. The center bulbil had the highest rate germination while the 2nd branch bulbil had the lowest rate germination.

The center bulbil had a height of petiole, the diameter of petiole and the width of canopy highest compared to plants originating from the 1st and 2nd branch bulbils. Some of the bulbils that were planted both from the center and branches had polyembryo character, which gave rise to more than one shoots.

5. REFERENCE


