The effect of bulbil’s sizes on the growth of iles-iles
(*Amorphophalus muelleri*) Blume

C Tresniawati* and M S D Ibrahim
Genetic and Plant Breeding Division, Indonesian Industrial and Beverages Research Institute (IIBRI), Indonesian Agriculture Agency of Research and Development (IAARD), Jl. Raya Pakuwon KM.2 Parungkuda, Sukabumi, West Java, Indonesia

*E-mail: tresniawatic@gmail.com

Abstract. Iles iles (*Amorphophalus muelleri*) Blume is an industrial comodity. Indonesian Industrial and Beverage Crops Research Institute have been collected and studied *Amorphophalus muelleri* Blume germplasm. The aim of this study was to identify the influence bulbils sizes to plant growth. Plant material was originated from Bajawa, East Nusa Tenggara. The research was carried out at the green house, at an altitude of 450 m above sea level, with soil type is latosol, and climate type is B, according to Oldeman, from August 2019 to May 2020. The bulbils were categorized into three groups based on weight and diameter, i.e. small size (diameter 10.00-15.99 mm and 0.70-3.99 g); medium size (diameter 16.00-23.99 mm and 4.00-5.99 g); and large size (24.00-33.99 mm and 6.06-12.99 g). Experimental design were Randomized Block Design with three replications. The characters observed were plant height, pseudo stem diameter, number of branch, leaf length, and leaf width. The result showed as the size of the planted bulbils increased, parameters measured also increased and significantly different. In the development of Iles-iles or Porang from Bajawa, East Nusa Tenggara, planting material could be used in the form of bulbils with a diameter were 24.00-33.99 mm and weight were 6.06-12.99 g.

1. Introduction
Iles-iles or Porang (*Amorphophalus muelleri*) Blume) grows in Indonesia, especially on the island of Java [1]. Iles-iles plant grows scattered from the lowlands to the highlands. This plant grows anywhere, such as on the edge of teak forests, under bamboo groves, on river banks, in bushes and in places under the shade [2]. In this study, the plant material used came from the shade of the kemiri sunan plant in Bajawa, East Nusa Tenggara.

Iles-iles is an industrial plant. Porang is a type of plant that produces tubers. Iles-iles tubers contain glucomannan (polysaccharide from the Mannan family) which is very high, around 20 - 65%. Glucomannan is good for diet program [3], controlling type 2 diabetes [4] and maintaining blood sugar condition [5]. Another benefit of iles-iles tuber is as industrial raw material and medicine [6]. Iles-iles tubers must be processed properly so that they can be consumed. This is because the iles-iles tubers contain oxalic acid and CaOX (calcium oxalate) crystals which can be bad for health [6].

Propagation of iles-iles clones through bulbils, tubers, and seeds [7] [8]. Iles-iles is an apomixis plant, where the formation of seeds without going through pollination [9]. The characteristic that can distinguish iles-iles from other Amorphophallus types is the presence of bulbil. Bulbil (leaf tubers) can also be called air tubers or frog bulbs, appearing 1-1.5 months after the leaves are fully open. Bulbil size
varies and is influenced by leaf size and location on each leaf. The size of the bulbil that appeared in the middle of the rachis is the largest bulbil [7]. Balittri explored iles-iles in East Nusa Tenggara, namely Bajawa. The material obtained were in the form of bulbil. Iles-iles had variation or diversity in size and weight. Therefore, research was conducted to determine the best size of bulbil to use as plant propagation at first vegetative phase.

2. Material and Method

The research was carried out at the greenhouse, at an altitude of 450 m above sea level, Latosol soil type, and climate type B (Oldeman), from August 2019 to May 2020.

2.1. Plant material

Plant material was originated from Bajawa, East Nusa Tenggara, Indonesia. The bulbils were categorized into three groups based on weight and diameter, i.e. small size (diameter 10.00-15.99 mm and 0.70-3.99 g); medium size (diameter 16.00-23.99 mm and 4.00-5.99 g); and large size (24.00-33.99 mm and 6.06-12.99 g) (Figure 1). Bulbils were planted in polybags with a size of 20 x 20 cm, the media used was a mixture of soil and manure with a ratio of 1:1.

2.2. Data Analysis

Experimental design was Randomized Block Design with three replications. Each unit consisted of five bulbils. The characters observed were plant height, pseudo stem diameter, number of branch, leaf length, and leaf width. Bulbil began to sprout after 12 weeks after planting (WAP) and quantitative observations were made at 28 WAP. The data obtained were analyzed statistically using Analysis of variance (ANOVA). If there was a significant difference between treatments, proceed with Duncan's at the 5% level [10].

3. Results and discussion

In general, the diversity in the observed characters was the result of differences in bulbil size (Table 1 and 2). The character of the number of branches shows no variation, because all bulbils produced three branches which were pseudo leaf stems and this is a natural characteristic of bulbil originating from Bajawa.

The characteristics of plant material in the form of bulbil were: bulbil weight between 1-23g depending on the parent plant and bulbil position on the leaves; bulbil diameter 1-5 cm depending on plant age and position on the leaves; plant height in one planting period between 20-50 cm; dormancy period is 4-5 months; and bulbil tissue is smooth [2]. Bulbils from Bajawa began to sprout after 12 weeks after planting (WAP).
The result showed that size of bulbil influenced plant height, stem diameter, number of branch, leaf length, and leaf width (Table 1 and 2). Bulbil size had a significant effect on the character of plant height. The larger bulbil gave better growth than small bulbil. According to Sumarwoto [11], large bulbil had more food reserves than small bulbils, so that early shoot growth was faster. This is confirmed by Hobir [12], that suitable bulbil for planting material is 2.5 – 5 g in size.

Table 1. The average value of plant height and pseudo stem diameter from three bulbil’s sizes

| Size                                | plant height (cm) | Pseudo stem diameter (mm) |
|-------------------------------------|-------------------|---------------------------|
| Small (diameter 10.00-15.99 mm and 0.70-3.99 g) | 17.87±2.92c       | 3.09±0.74c               |
| Medium (diameter 16.00-23.99 mm and 4.00-5.99 g) | 21.14±2.61b       | 5.90±0.47b               |
| Large (24.00-33.99 mm and 6.06-12.99 g) | 28.23±6.19a       | 6.71±1.04a               |
| CV (%)                              | 19.31             | 13.94                     |

Notes: Numbers followed by the same letters in the same column are not significantly different according to Duncan’s test at 5%

Table 2. The average value of leaf length and leaf width from three bulbil’s size

| Size                                | leaf length (cm) | leaf width (cm) |
|-------------------------------------|------------------|-----------------|
| Small (diameter 10.00-15.99 mm and 0.70-3.99 g) | 5.35±1.00c       | 2.82±0.48b      |
| Medium (diameter 16.00-23.99 mm and 4.00-5.99 g) | 8.45±0.83b       | 4.16±0.51a      |
| Large (24.00-33.99 mm and 6.06-12.99 g) | 10.05±0.29a      | 4.33±0.76a      |
| CV (%)                              | 19.23            | 14.15           |

Notes: Numbers followed by the same letters in the same column are not significantly different according to Duncan’s test at 5%

According to Sugiyama and Santosa [13] when the leaves reach their maximum size, primordia and leaf sheaths will furthermore bigger in size. The number of leaves will continue increase and develop during the vegetative phase. In the first year, *A. paeoniifolius* can produce 2-5 leaves with 2-3 leaves can live together. It is comparable to research results that *A. muelleri* has 3-4 leaves in its first year.

Pseudo stems withered 10 months after planting. Plants became dormant. To determine the development of plants in the first vegetative phase, the fresh weight of tuber and tuber diameter were observed. Observations were made on the sample plants. The data were not analyzed statistically. Data showed at Figure 2 and 3.

Figure 2. The average value of fresh tuber weight from three bulbil’s sizes
Figure 3. The average value of tuber diameter from three bulbil’s sizes

Results of the studies indicated that bulbil size as a planting material influenced vegetative growth and all other parameters measured. As the size of the planted bulbil increased, parameters measured also increased in proportion to the size of the planted bulbil. These results were similar to hyacinth and lily [14].

4. Conclusion
Size of Bulbil influenced vegetative characters. As the size of the planted bulbil increased, parameters measured also increased. In the development of Iles-iles from Bajawa, East Nusa Tenggara, planting material could be used in the form of bulbil with a diameter of 24.00-33.99 mm and 6.06-12.99 g in order to gain large tuber production.

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