

Ecological role and potential extinction of *Amorphophallus variabilis* in Central Java, Indonesia

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Abstract. Wahidah BF, Afiati N, Jumari. 2022. Ecological role and potential extinction of *Amorphophallus variabilis* in Central Java, Indonesia. *Biodiversitas* 23: 1765-1773. *Amorphophallus variabilis* Blume is a member of the genus *Amorphophallus* which is known as a wild plant that lives in forests, including Central Java, Indonesia. This plant has a high diversity but its existence is neglected and is rarely used by the community. This study aims to introduce *A. variabilis* through the inherent biological characteristics of the species, local the community's knowledge, ecological functions and the threat of extinction. Data on biological characteristics covering morphological characters were obtained from field observations, while data on anatomy were obtained by making semi-permanent preparations using a modified Ruzin method. Data on community's knowledge were obtained by conducting semi-structural interviews. The results showed that its morphological and ecological characters were very similar to other members of *Amorphophallus*, but with a very wide variety of patterns on the petiole. The anatomical structure of the leaf blade has a dorsiventral type consisting of several layers, namely a thin cuticle layer, flat upper epidermis, palisade mesophyll, spongy mesophyll, vascular tissue and lower epidermis. The tissue that composes the petiole consists of the epidermis, hypodermis, collenchyma supporting tissue, vascular bundles and secretory cells, while the tuber consists of periderm, cortex, vascular bundles, and pith tissue. This species has almost the same potential as *Amorphophallus muelleri* Blume which was previously known to have economic and medicinal values. However, the community's knowledge about the *A. variabilis* is still poor, resulting in neglect of this species that possibly causes its extinction and may have an impact on the ecological balance.

Keywords: *Amorphophallus variabilis*, anatomy, community's knowledge, ecological role, extinction potential, morphology

INTRODUCTION

Amorphophallus is a genus of the family *Araceae*. This group of plants usually forms tubers and has perfect flowers that smell bad, so they are known by the public as corpse flowers. According to Yuzammi (2000), *Amorphophallus* is a species of wild plant that can grow and adapt to various types of habitats from highlands to lowlands and is found in primary forests to people's fields. It is also found on the banks of rivers and chalky lands. *Amorphophallus* is spread in Africa, Madagascar, India, Asia, and Australia (Boyce et al. 2012; Mayo et al. 1997; Sedayu et al. 2010). The center of diversity for the genus is in Southeast Asia. Many species are endemic, while few are widespread. Of them, edible *Amorphophallus* such as *A. konjac* and *A. paeoniifolius* is becoming widely known in several countries (Susanto 2020). *Amorphophallus* consists of approximately 200 species (van der Ham et al. 2005); of them, 25 species grow in Indonesia. Of the 25 species, the 18 species, or about 72% are endemic species in various areas such as Sumatra, Java, Kalimantan, and Sulawesi (Hettterscheid and Ittenbach 1996).

The island of Java, one of the islands in Indonesia, has a

relatively large potential for *Amorphophallus* diversity, but the very high anthropogenic pressure on the flora of Java has caused the degradation of plant diversity on this island largely due to decades of widespread land conversion. There are several endemic *Amorphophallus* species, which is a biological wealth, found in several locations on the island of Java, but local residents ignore their existence. The limited knowledge of the community about these endemic species may cause the species to become extinct (Yuzammi et al. 2014). Incorrect community understanding of a species will affect the sustainability of that species in nature. As explained by Adedayo and Surulere (2020) regarding the status of African turtles where fishing community knowledge is low about these turtles. It was explained that although these turtles are often caught accidentally, there is no awareness by the community to release them back into the sea but to be consumed or sold so that it affects the turtle population in the wild. The fishermen also mentioned that there are two species of turtle, namely *Lepidochelys olivacea* and *Dermochelys coriacea*. However, only *L. olivacea* turtles were found. The potential for extinction is also determined by the intensity of the use of the species by the community. The

lower the intensity of use, the higher threat of extinction. Especially if the plant is not cultivated (Jumari et al. 2012).

One of the *Amorphophallus* species that is relatively attractive is *A. variabilis*. The people of Central Java, Indonesia usually call this plant by the name Iles Iles, but in West Java, the name Iles Iles refers to the species *A. muelerri* Blume (Susanto 2020). Similar to other *Amorphophallus*, this plant is also commonly found in forests, plantations and people's land. From the results of observations in forests in Central Java, researchers found more than 100 variants of *Amorphophallus*. Although the exact species is not yet known, from the observed morphological characters, there are indications that these variants are mostly derived from the species *A. variabilis*. This is an indicator that, in fact, the Central Java region has the potential to store a relatively high diversity of *Amorphophallus*.

The existence of *Amorphophallus variabilis* Blume as a component of forest vegetation certainly has its own role in the ecosystem. Although its habitus is small, it has a significant role in forest ecosystems (Elliott et al. 2015; Gilliam 2007). People's perceptions and knowledge of these plants can indirectly to influence the sustainability of *Amorphophallus* in carrying out its functions in the forest ecosystem. The way in which the community utilizes and manages the biodiversity will determine the sustainability of these resources, their productivity and the sustainability of their ecological functions. This research aims to introduce *A. variabilis* through the biological characteristics.

MATERIALS AND METHODS

Study area

The research was conducted in several forests and plantations in Central Java, Indonesia namely Silayur Indah

Forest Tourism in Ngaliyan, Jati Forest in Mijen, Pagerwunung Nature Reserve in Darupono, Kendal, Selo Arjuno Nature Tourism in Limbangan, Kendal, Rubber Plantation in Gunung Pati, Cemara Sewu in Kalongan, East Ungaran, and Tlogo Plantation/Goa Rong PT CMJT, Tuntang from March to April 2021 (Figure 1).

Procedures

Biological characteristics of *Amorphophallus*, including morphological and ecological structures, were obtained by observing the morphological structure and habitat of *A. variabilis* in the field. While the anatomical structure was observed by making semi-permanent cross-sections of leaves, petioles, and tubers, made using modified semi-permanent preparations from the Ruzin method (1999). The process of making preparations begins with cutting the tuber organs, petioles, and leaves into small parts. The cut organs were then fixed with 70% alcohol for 3x24 hours. Next, the organs that have been fixed are incised using a microtome (clamp-on hand microtome) in a transverse direction with a thickness of $\pm 5-8 \mu\text{m}$. The results of the incision were accommodated in a Petri dish containing distilled water to expand the tissue. After that, the tissue was stained using 1% safranin for 1 minute for easy observation put back into a Petri dish containing aquadest to clean the excess 1% safranin residue prior to being washed twice in glycerin, so that the safranin did not fade. The slices were taken and placed on an object-glass, dripped with glycerin, covered with a cover glass and the edges of the cover glass were glued with nail polish. The preparations were observed with a binocular microscope, then documented using a digital camera.

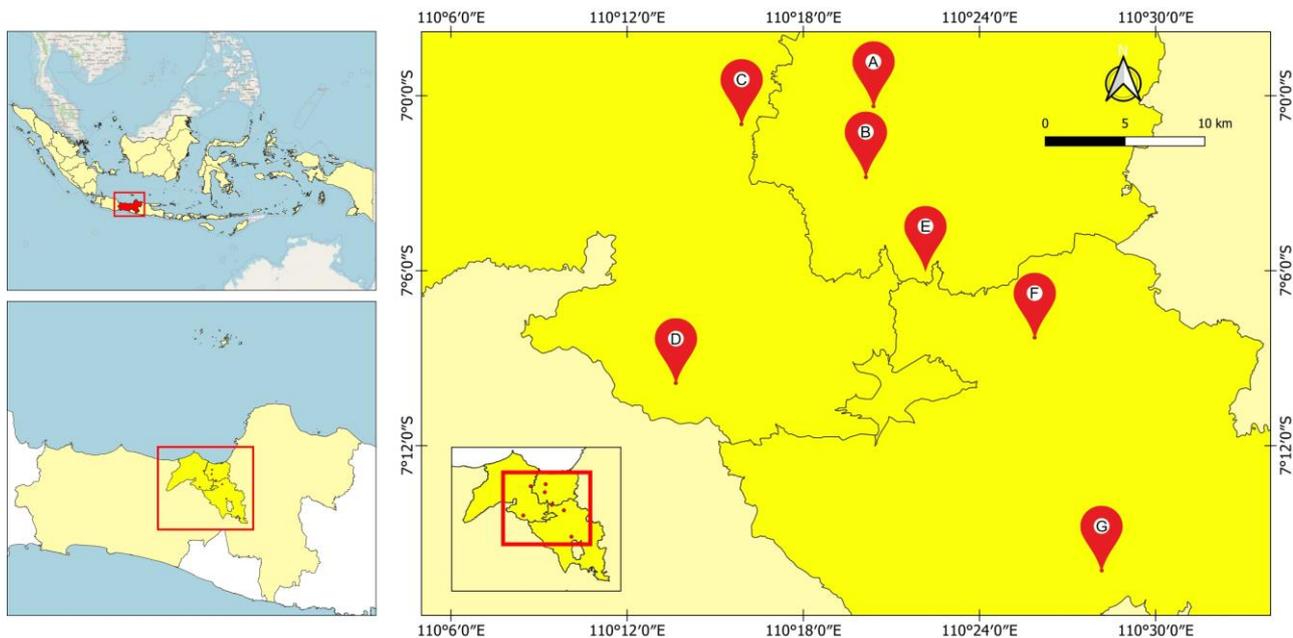


Figure 1. Map of research location including: A. Silayur Indah Forest Tourism in Ngaliyan, B. Jati Forest in Mijen, C. Pagerwunung Nature Reserve in Darupono, Kendal, D. Selo Arjuno Nature Tourism in Limbangan, Kendal, E. Rubber Plantation in Gunungpati, F. Cemara Sewu in Kalongan, East Ungaran, G. Tlogo Plantation/Goa Rong PT CMJT, Tuntang, March-April 2021

Data on the community's knowledge were obtained using a semi-structured interview method on informants selected by purposive sampling, namely the community around the research area as many as 20 people. Informants consisted of porang (*A. muelerri*) farmers and communities around the forests and plantations of the research sites.

RESULTS AND DISCUSSION

The morphology of *Amorphophallus variabilis*

Morphological characters in some members of the genus *Amorphophallus* are very similar to each other, so it is difficult to be distinguished by common people, especially if the age of the plant is still young. This plant with a height of 1-1.5 m shows a high morphological variation, especially in the petiole organ. Figure 2.D shows some of the variants of *A. variabilis* which are shown by various patterns on the petiole. Another morphological variation is related to the shape of the leaflets that make up the compound leaves of the species.

Amorphophallus is a perennial plant (Singh and Wadhwa 2014). Based on their habitus, iles-iles (*A. variabilis*) is a species of herbaceous plants that produce 1-2 leaves from the rootstock. The rootstock is modified into tuberous roots with a diameter of about 15 cm and has a white tuber tissue. Its leaves are compound with finger bones and have a length of up to 125 cm. There are variations in the shape of the leaf blades in several *A.*

variabilis found in the study area, namely lanceolate, elliptical, obovate, and oval with leaf tips generally acuminate and caudate (Figure 2.C-F). In several variants of *A. variabilis* found in the study area, several structural differences were found in the rachis. On the rachis attached wing-like structures of different sizes. Some have wide wings (Figure 2.D); medium-sized wings (Figure 2.E) and narrow wings (Figure 2.F).

This plant is quite unique because its body support structure is in the form of a pseudo-stem originating from the petiole (petiolus). Not all stems of *Araceae* are modified as strong pseudo-stems like *Amorphophallus*. This sturdy stem is thought to have formed to support the large leaf structure of this genus. The petiole of *A. variabilis* is usually small when compared to other *Amorphophallus* such as *A. muelerri* Blume and *A. phaeoniifolius*. This petiole has a very diverse pattern that causes many variants in the species. Phornvillay et al. (2015) stated that the petiole character of *Amorphophallus* members could also be distinguished from the size in addition to the pattern. The type of flowering of this plant is compound flowers, hump-shaped with a length of between 20-40 cm, with protective leaves at the base. The male flowers are yellow, while the female ones are green and yellow (Figure 2.H-I). This plant flowers at the height of an average of 15-80 cm in certain seasons/years, namely when entering the rainy season. It has Buni, round shape, red or orange type of fruit (Figure 2.J).



Figure 2. The Morphology of *Amorphophallus variabilis*. Habitus (A-B); leaf (C-F); Several patterns on petiola (G); Flower (H-I); Buni Fruit (J); Tuber (K).

The life cycle of *A. variabilis* is generally the same as other *Amorphophallus* which consists of 2 phases, namely the vegetative phase and the generative phase. The vegetative phase is characterized by the presence of vegetative organs in the form of leaves, while the generative phase is characterized by the appearance of flowers and the flowering phase. Between the two phases is interspersed by a dormant phase, where *A. variabilis* is in a resting state for approximately 2 or 3 months. One of the uniqueness of this species is that each phase never appears simultaneously in one individual. If the plant is entering the leafy phase, it will never have flowers. And vice versa, flowers seem to come out directly from the ground, without any leaves (The time required for each phase varies greatly and is largely determined by the size of the tubers (Forda et al. 2015). The tubers produced in this plant are small in shape, flattened in shape. On the surface of the tubers there are nodules, fine fibrous tubers and white in color (Figure 2.K).

Amorphophallus variabilis has a very high tolerance to shade so that the plant will grow optimally if it lives in a shady area. Similar to *Amorphophallus titanum*, which was reported to thrive below the forest canopy in the Sumatra rainforest (Arianto et al. 2018). *A. variabilis* does not need a lot of light. For optimal growth, this species only needs about 40% light. Likewise, with altitude, this plant can grow at an altitude of 0-900 m.a.s.l, but optimal growth and development will be at an altitude between 100-600 m.a.s.l., with a temperature range between 25-35°C, and an area with rainfall between 1000-1500 mm/year. As a member of the Araceae family, *A. variabilis* can grow in almost all types of soil, but optimal growth and development are achieved in loose soil, with a neutral pH and good drainage.

The anatomy of *Amorphophallus variabilis*

The anatomical structure of *A. variabilis* observed includes the anatomy of the leaf blade, petiole and tuber. In general, the anatomical structure of the leaf blade of *A. variabilis* from the upper surface (adaxial) to the lower surface (abaxial) is composed of several layers, namely a thin cuticle layer, upper epidermis, palisade mesophyll, spongy mesophyll, vascular tissue and lower epidermis (Figure 3.A-B). This species has a dorsiventral leaf type which is characterized by the presence of palisade mesophyll just below the adaxial epidermis. Among these tissues are also found vascular tissue, strengthening tissue in the form of collenchyma cells, secretory structures, and aerenchyma cells.

Epidermal tissue of *A. variabilis* consists of a single layer of cells composed of rows of flattened cells forming a compact, tight tissue. The epidermis is a tissue that covers and protects plant organs such as roots, stems, leaves, flowers, fruits, and parts of plant seeds. Various modified epidermal cells regulate transpiration, increase water absorption, and excrete substances. In addition, it is stated that the epidermis as a multifunctional tissue plays an important role in relation to water, defense, pollinators attraction, excessive light by radiation, heat loss at night,

the structure that bears most of the stress exerted by the growth of internal tissues. In the leaf organs of *A. variabilis*, there is an upper epidermis and a lower epidermis, the outside of which is covered by a thin waxy structure called the cuticle. The layer serves to help reduce the evaporation of water. The cooperation of the epidermis and cuticle will also provide protection against mechanical injury, water loss, and infection. In addition, this lipid-rich and hydrophobic layer are able to increase plant integrity against predators (Glover et al. 2016; Segado et al. 2016).

Beneath the upper epidermis (adaxial epidermis) is the mesophyll tissue. Mesophyll tissue is useful in the process of photosynthesis, so in this tissue, many chlorophyll grains are found (Esau 1977). From the observations, it can be seen that the anatomical structure of the leaves in this species is of the dorsiventral type, where the palisade mesophyll is only found on one side, namely the adaxial side. Beneath the palisade mesophyll is the spongy mesophyll cells. This tissue is composed of loosely arranged round or irregular cells that leave plenty of space between the cells to allow gas to pass (Fahn 1995; Sari and Putra 2019). Spongy mesophyll also contains chloroplasts but not as much as in palisade mesophyll. Its regulatory properties play an important role in photosynthesis. This is because it is loosely packed to enhance gas exchange during photosynthesis.

The petiole (petiolus) of *A. variabilis* differentiates into pseudo-stem that supports the plant body. There are several tissues that make up the petiole in this herbaceous plant, including the epidermis, hypodermis, collenchyma strengthening tissue, vascular bundles and secretory cells. The hypodermis in this species is composed of sclerenchyma tissue (Figure 3.C-D).

The epidermis of the petiole consists of a single layer of parenchyma cells that are neatly arranged without intercellular spaces (Esau 1977). Apart from being a protector, the epidermis in the petiole serves as a storage place for water reserves for plants, especially during the dry season. The water stored in the proplasm of the epidermal tissue will be transported to the photosynthetic organs. In the epidermal tissue, photosynthesis does not occur, because the cells that make up the tissue do not have chlorophyll. To reduce evaporation, the epidermis in the petiole produces a fairly thick cuticle. The cuticle also has an important role in increasing the reflection of sunlight, so that it can protect plants from the too-high intensity of sunlight (Torre 2003). Beneath the epidermis, there is a hypodermic tissue composed of small hypodermic cells and usually composed of a single layer of sclerenchyma cells. Sclerenchyma tissue is able to provide support so that the plant structure is stronger (Lopez and Barclay 2017). Beneath the hypodermis, there is parenchyma tissue which is the ground tissue of the organ. On some of the basic parenchyma cells in *A. variabilis*, it is found anti-nutritional substances in the form of Ca-oxalate, which were accumulated to form crystals with various shapes (Figure 3.G-J).

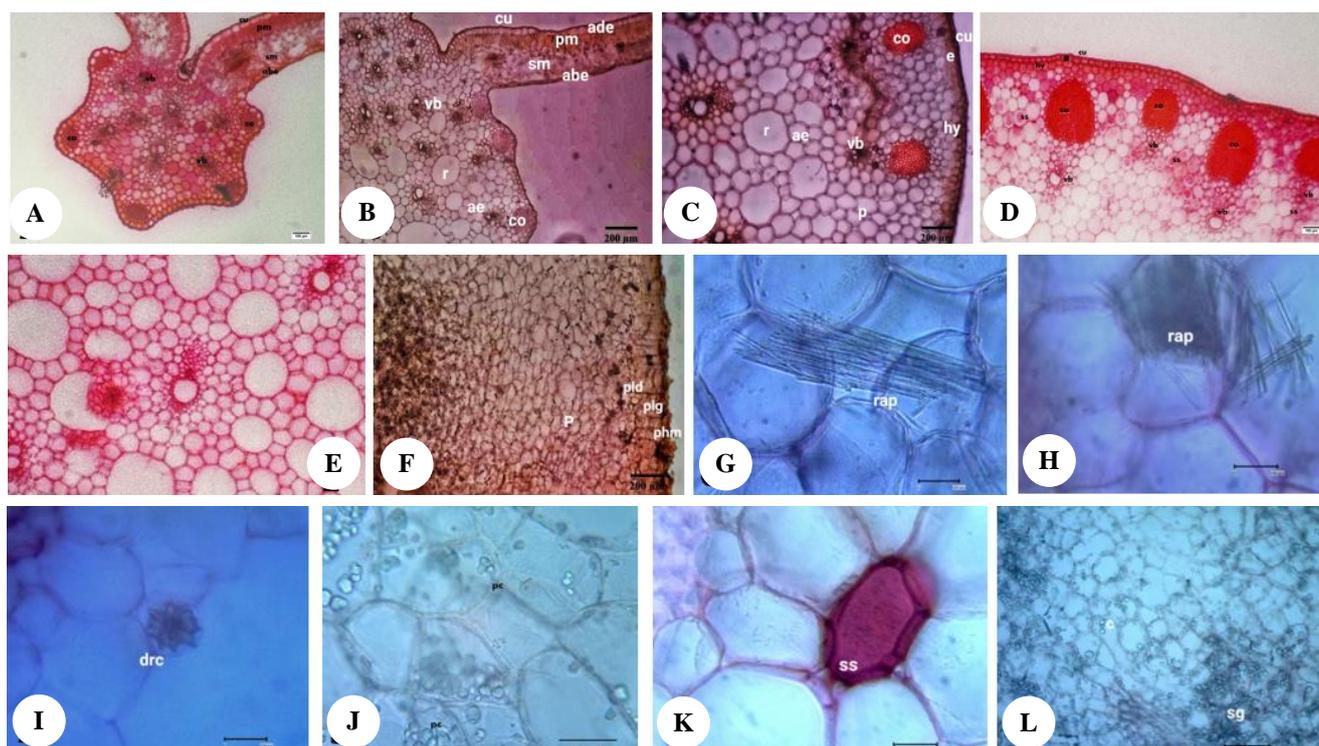


Figure 3. The anatomy of *Amorphophallus variabilis*. Cross section of leaf blade (A-B); Cross section of petiole/petiolus (C-E); Cross section of tubers (F); Cristal Ca-Oxalate (G-J); secretory structure containing secondary metabolites (K); starch grains and Ca-oxalate crystals in tubers (L); Aerenchyma tissue in the petiole (E) of the upper epidermis (ade); lower epidermis (abe); cuticle (cu); palisade mesophyll tissue (pm); spongy mesophyll tissue (sm); collenchyma (co); aerenchyma (ae); hypodermis (hy); vascular bundle (vb); parenchyma/ground tissue (p); rexygen cavity (r); phelem (plm); pelogen (plg); peloderm(pld); phloem (ph); xylem (xy); Ca-oxalate(c) crystals; Ca-oxalate crystals in the form of raphide (rap); drussen (drc) crystals of Ca-oxalate; Ca oxalate in the form of pris (pc); secretory structure (ss); starch grains (sg)

This structure causes the plant to itch when touched (Wahidah et al. 2021). Calcium oxalate can cause itching, irritation and other health problems when the tubers are consumed. Various shapes and sizes of Ca oxalate crystals can be found in all these plant organs. The forms of oxalate crystals include needles (rafida), prisms, rhombohedral, and drussen. According to Kuo-Huang et al. (2007), Ca oxalate crystals are also able to play a role in transmitting incoming sunlight to palisade mesophyll cells towards chloroplasts along the cell walls. It is known that as with other members of *Amorphophallus*, in general, *A. variabilis* plants will grow optimally if they are in the shade, so it is possible that an adaptation mechanism will occur with the formation of Ca-oxalate crystals to maximize the process of capturing and reflecting light by these plants to carry out the process of photosynthesis.

Another structure in the appearance of the petiole cross-section of *A. variabilis* is the supporting tissue in the form of collenchyma tissue arranged in a large bundle (115-178 μm). This is thought to be related to the function of the petiole as a pseudo-stem which requires a strong structure to support the relatively large leaf blade organs of the species. Collenchyma tissue is composed of living cells that have thickened primary walls composed of

hemicellulose, cellulose, and pectin materials. This tissue provides support, structure, mechanical strength and flexibility to petioles, leaf veins, and stems of young plants; and allows easy bending without causing damage to these organs (Lopez and Barclay 2017).

In addition to collenchyma, in the petiole, transport tissue, sclerenchyma, Ca-oxalate crystals and secretory cells were also found. Some of the elements that can be observed in the vascular bundles of *A. variabilis* are xylem, phloem, and oxygen space. The type of vascular bundles in this plant is closed collateral where xylem and phloem are parenchyma cells only, no cambium is found. From the observations, some secretory cells (idioblasts) and Ca oxalate crystals around the vascular bundles are usually found even though their distribution is uneven.

Ca-Oxalate crystals were also found in the tubers of *A. variabilis*, which together with starch grains filled the parenchyma cells (Figure. 3L). Like other *Amorphophallus*, the number of Ca-Oxalate crystals in tubers is generally more than Ca-oxalate in other organs (Chairiyah et al. 2013). The number of these crystals is affected by the time of harvest from *Amorphophallus* tubers (Chairiyah et al. 2021). The tubers of *A. variabilis* are composed of the periderm, cortex, vascular bundle, and pith. The periderm is the outermost layer which becomes a protective tissue

replacing the role of the root epidermis as a result of the secondary thickening process. The periderm is composed of three structurally distinct tissues, namely phellem, phellogen, and phelloderm (Lulai 2002).

Community's knowledge about *Amorphophallus variabilis*

Plants, which are considered wild plants by the community, are found in several habitats such as forests, plantations, and people's yards. Based on the results of interviews with informants, this plant is not used by the community at all. Twenty informants interviewed stated that the plant was not used as well as walur (*A. paeoniifolius* (Dennst) Nicolson var. *sylvestris* Backer). Their thinking about this plant is not different from that of Javanese society in general. Some people said *A. variabilis* is snake diet, and is relatively dangerous for humans because it can cause itching if handled. When consumed, it can even cause a prickling, numb and burning sensation in the taste buds and throat. This causes this plant to be rarely used and is also considered an invasive plant that must be removed from plantation areas and yards.

The itching sensation caused by *A. variabilis* is due to the much content of Ca-oxalate crystals in almost all its organs, for example, in the tubers, stems and leaves. Figure 4 shows that the Ca oxalate crystals in general, including *A. variabilis*, are most widely distributed in tuber organs. Ca-oxalate crystals are very common in the Araceae family (Wahidah et al. 2021). However, many members of this family are edible. With a perfect way of processing, Ca-oxalate crystals can actually be removed from the plant. Therefore, special treatment is needed to reduce the Ca-oxalate level to be ready for consumption. People of Central Java have local wisdom to reduce Ca-oxalate levels in suweg (*A. paeoniifolius* (Dennst.) Nicolson var. *hortensis* Backer), another *Amorphophallus* tubers by covering the tubers with salt (Yanuriati et al. 2021). It is hoped that this method can be applied to *A. variabilis*, but unfortunately, the people of Central Java do not consume these plants.

The glucomannan content of *A. variabilis* is high when compared to other wild *Amorphophallus*. Besides being believed to be a low-calorie food ingredient that is useful for preventing obesity and diabetes, glucomannan also has the potential to inhibit the growth of *Escherichia coli* (Harijati et al. 2018; Harmayani et al. 2014). It is also mentioned by Shi et al. (2020) that members of the genus *Amorphophallus* are generally rich in soluble dietary fiber and are used as food and traditional medicine in several countries in Asia. So it is predicted that *A. variabilis* has the same potential as a food ingredient.

In addition to plantations and residential yards, *A. variabilis* is still commonly found in forest areas, especially natural forests. At least there are approximately 140 variants of *Amorphophallus* found at research sites in Central Jawa. Through the identification process, the morphological characters in these variants lead to the species *A. variabilis*.

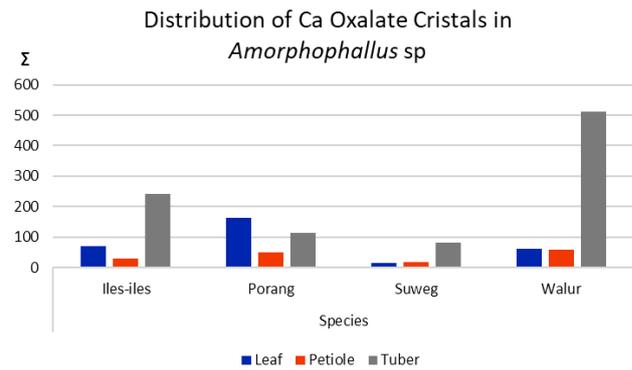


Figure 4. Distribution of Ca oxalate crystals in *Amorphophallus* sp.

The crucial role of *Amorphophallus variabilis* in forest ecosystem

Forest ecosystems are complex ecosystems enriched with various species of plants and animals. Plants in these ecosystems are closely correlated with each other with their environment. Plants are the main source of production for ecosystems. It controls gas exchange with the atmosphere and plays an important role in the biocycles of water and nutrients in ecosystems (Buriánek et al. 2013).

Soerianegara and Indrawan (2005) state that forest does not only act as a habitat for plants and animals but animal and plant populations in the forest also form a community that is interrelated and dependent on each other and with the environment. The forest becomes an ecological system and is an ecosystem that provides many benefits for the components of the ecosystem, including benefits for human life.

Both natural and artificial forests generally have relatively high species biodiversity. Backer, 1973 stated that the components of a forest ecosystem that are full of plant diversity are not only limited to the habitus of towering trees but also are overgrown with various kinds of habitus, including the group of undergrowth (ground cover). This understory group also has a high species diversity. The understory is defined as a group of species that occupy the basic vegetation under forest stands except for saplings. Soerianegara and Indrawan (2005) also limit the scope of understory vegetation includes all plants that are not trees and cannot grow into trees. Some of the habitus in the understory group includes grasses, herbs, shrubs and ferns (Torre 2003; Yuniawati 2013). The understory plants in the forest vegetation stratification arrangement are in stratum D, which is a group of plants with a height of less than 4.5 meters and a stem diameter of approximately 3 centimeters (Windusari 2012).

Based on the results of field observations, *A. variabilis* was found in almost all forests in the Semarang and surrounding areas. This plant is a group of herbaceous plants that occupy the D stratum (understorey strata). Herbaceous plants are cosmopolitan in nature because their distribution is very simple and can adapt to almost all areas or habitats. This has an impact on the increase in understory plants in nature.

The diversity of *A. variabilis* in nature is determined by biotic and abiotic factors. Biotic factors include human and animal activities as well as microorganisms in the ecosystem. While abiotic factors include soil conditions, the abundance of water, air, light intensity, temperature, soil pH, and nutrients. Both factors will affect the growth and development of plants so that interactions are established with each other. The interaction between the components of the forest ecosystem with various environmental factors resulted in vegetation that grows naturally. A vegetation structure is an organization of individuals in space that produces a stand (Mueller and Ellenberg 1974).

The existence of undergrowth on the forest floor can function as a rainwater barrier and upstream flow that can minimize the danger of erosion. In addition, understorey vegetation plays a crucial role in forest ecosystems and determines the microclimate (Hilwan et al. 2013). Environmental factors that affect the existence of growth are the height of the area above sea level. The altitude of the area will affect species diversity, structure and composition of understorey vegetation, soil conditions, temperature, light and water intensity. The altitude of the area will indirectly play a role in the photosynthesis process and will be a limiting factor that will inhibit the growth of understorey plants.

The important role of herbaceous plants in stratum D is to maintain soil quality. The existence of herbaceous plants as part of the understorey community can prevent the soil from erosion and can maintain soil fertility. But its existence is often claimed to be a competitor for cultivated plants (Wardhani et al. 2020). Maisyaroh (2010) revealed that undergrowth could function in infiltration and help delay the fall of water directly and reduce the velocity of surface runoff so that it can inhibit or prevent rapid erosion. Other functions are part of biological diversity, protect soil and soil organisms, and help shape the microclimate on the forest floor (Kunarso and Azwar, 2013). Buriánek et al. (2013) also stated that in some undergrowth in the forests of the European region where there are understorey plants such as *Geranium robertianum* and *Urtica dioica*, the nitrogen concentration in the soil was significantly higher than in the same areas without the existence of this species. In addition to these ecological functions, several understorey species have been identified as plants that can be used as food, medicinal plants, and as alternative energy sources (Hilwan et al. 2013).

Some people consider some understorey species as a nuisance and dangerous plants (weeds). People often clear the land of undergrowth because it is considered disturbing the plants to be cultivated. Associated with *A. variabilis* found in all study sites were also treated as such. The results of interviews with informants who work as farmers and porang entrepreneurs (*A. muelerri*) explain the threat of the existence of *A. variabilis* can also occur in the process of procuring porang seeds. Procurement of porang seeds (*A. muelerri*) by porang farmers in Central Java is carried out in several ways, namely by breeding themselves, buying seeds from seed farmers and buying seeds from *pembolang*. The term *pembolang* is intended for people

who deliberately look for porang seeds in the forests of Central Java. In this burrowing process, there is often accidental destruction of the ecosystem by the burrowers. Although the goal is only to find *A. muelerri*, but in the process, they also often remove *A. variabilis* due to very similar morphological characters. Such activities are not beneficial for the existence of *A. variabilis* in nature. Moreover, the community still only considers this plant not a useful plant and has economic value. If left unchecked, this will certainly disrupt the stability of the ecosystem in the area, given the importance of undergrowth as a component of the forest ecosystem. Gilliam (2007) states that the study of forests as ecological communities emphasizes the composition of species supporting these ecosystems. Each has an important role. Herbaceous plants such as *A. variabilis*, which are small in stature have functions related to carbon dynamics and energy flow and vital nutrient cycles, including N, P, K, and Mg. In addition, the negative impact of the loss of understorey is that it can increase the potential for erosion and will indirectly remove organic matter that is in the top layer of soil so that soil fertility will continue to decline. Thrippleton et al. (2016) stated that strata D which consists of dense herbaceous plants could affect the speed of tree regeneration so that it can affect forest succession. Arif (2001) even mentions that the presence of understorey, including *A. variabilis* has a very crucial role in soil permeability in the process of absorption of water that falls from the canopy of trees in the vegetation strata above it and will prevent the flow of surface water so that it is absorbed by the soil.

Mackinnon (2000) adds, on the other hand, the striking or silvery coloration of the understorey in the forest will reflect red light onto the photosynthetic tissues of the plant. This is a form of adaptation to increasing the quantity of light, which is important in the assimilation process in a dark forest that lacks light. Understorey plants, in addition to providing benefits to the ecosystem, also provide ecological services for humans, for example, as a source of traditional medicinal ingredients, as a source of food, especially vegetables. Some species are used as fence material and ornamental plants, and as a source of craft materials. *A. variabilis* species have the potential to provide ecological services as plants with medicinal and food potential, considering that the phytochemical content of *A. variabilis* is no less important than that of other *Amorphophallus* such as porang (*A. muelerri*) and suweg (*A. paeoniifolius* (Dennst.) Nicolson var *hortensis* Backer). The bottom has many benefits and needs to be preserved (Dey et al. 2016; Yuzammi and Handayani 2019).

Potential of extinction of *Amorphophallus variabilis*

Iles-iles (*A. variabilis*) with many variants are still found in the forests of Central Java. Although no in-depth identification has been carried out, with the discovery of 140 variants of the species at the research site, there is a lot of hope for this plant. Apart from being a source of germplasm, it is also expected to have the same potential as *Amorphophallus* which has other economic values. Unfortunately, people's perception and treatment of this

species can threaten the existence of this plant in nature. There are several factors that cause plants that were once common to be rare or rarely found today. The rarity of a species is the initial stage of species extinction, Charles Darwin stated in 1859. Meanwhile, according to Ladle and Whittaker (2011), rarity is a low density of species, living in narrow environmental conditions or geographical areas. Changes in the vegetation of the low-density species are affected by anthropogenic impacts to a much greater degree than by natural processes.

The problem of species scarcity can be caused by natural habitat loss, low regeneration capacity and human activities. The existence of understorey communities which are components of biodiversity in forests is very important to be preserved. Some species can provide a lot of value to their own ecosystems and to humans. This value is in the form of the value of the existence of plants, ethics, aesthetics/beauty and psychological benefits, the value of ecological services, the value of inheritance, the value of choice, the consumptive value and the productive value (Djarwaningsih 2010). These values are related to the potential to provide benefits, especially for the future. The extinction of species will cause harm to human welfare.

The use of plants by humans is categorized based on the intensity of use which may be high, moderate and low intensity. Species with high harvesting intensity are species that are widely used to support the needs of daily human life either on a regular, daily, seasonal, or periodic basis, for example, plants as food sources and sources of medicine. Species with the category of moderate use intensity are species of plants that are used regularly but only for a certain period of time (seasonal). Meanwhile, species in the category of low utilization intensity include species that are rarely used. In general, species with high utilization intensity will be cultivated by the community, while species with low or medium intensity of use are not widely cultivated by the community, which will be vulnerable to extinction (Jumari et al. 2012). The concern about the potential loss of plant species of *A. variabilis* is precise because its existence is neglected. Although it is still considered a wild plant, *A. variabilis* as one of the understorey plants has potential as a source of food, medicine, a collection of germplasm as a source of plant breeding, and vital ecological functions. Lack of public knowledge about this plant will result in this plant potentially becoming extinct. Plants that are neglected and not utilized have the potential to quickly lose their existence in nature.

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