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Analyzing causes of the death of Ferns (Pteridophyta) in the Padang Savana, Taman Nasional Bromo Tengger Semeru (TN-BTS)

Eko Purnomo[1*], Nilana Izzati[1], Robbi Mauizzatul Hikmah[1], Diyana Sabila Rusydina[1], Lathifah Nurul Fauzi[1], Ibn Sina Rafiq Romawan[1]

[1]Department of Biology, Faculty of Science and Technology, Universitas Islam Negeri Walisongo Semarang, Indonesia

Corresponding author:
e.purnomo86@walisongo.ac.id
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Abstracts

The Padang Savana area of Bromo Tengger Semeru National Park (TN-BTS) is located at an altitude of 750-3676 m above sea level so that it has a high biodiversity with a distinctive vegetation character. Ferns (Pteridophyta) is one of the vegetation that dominates about 35% of the Bromo Conservation Area. The ferns in the location show a dry and dead physical condition. This study aims to analyze the causes of death of ferns (Pteridophyta) in the Padang Savana Bromo Tengger Semeru National Park. The research method used is a qualitative descriptive method and the data obtained from direct observation to the savanna of Bromo Tengger Semeru National Park (TN-BTS) and face-to-face interviews without guidance to resource persons. The sampling location is at an altitude of 2026 masl, temperature 24.4°C, air pressure 792.5 HPA, with the object of research in the form of a sprig of ferns (Pteridophyta) complete with dead leaf roots and is considered to represent all ferns (Pteridophyta) in the savanna. The data obtained from the resource persons were then analyzed using literature studies. The results showed that the death of ferns (Pteridophyta) was caused by several factors such as the presence of allelopathic substances produced from Imperata cylindrica, soil texture, and eruption disasters. Thus, the surrounding environment is very influential on the life of ferns (Pteridophyta) The results showed that the death of ferns (Pteridophyta) was caused by several factors such as the presence of allelopathic substances produced from Imperata cylindrica, soil texture, and eruption disasters. Thus, the surrounding environment is very influential on the life of ferns (Pteridophyta) The results showed that the death of ferns (Pteridophyta) was caused by several factors such as the presence of allelopathic substances produced from Imperata cylindrica, soil texture, and eruption disasters. Thus, the surrounding environment is very influential on the life of ferns (Pteridophyta).

Keywords: Pteridophyta; savanna; TN-BTS; ferns; Bromo

1. Introduction

Indonesia's biodiversity in tropical forests is very high. This happens because Indonesia has a tropical climate with two seasons, namely the dry season and the rainy season. Indonesia is ranked third after Brazil and Congo with an area of tropical forest which contains about 300,000 plant species [17].

Bromo Tengger Semeru National Park (TN-BTS) or the so-called Bromo Conservation Area which has an altitude between 750 - 3676 masl. The existence of the Bromo Conservation area at this altitude makes it quite high in biodiversity with special characteristics of vegetation [20]. The diversity is in the form of plants which are a group of living things consisting of cells and complex structures. Generally, plant morphology is divided into three parts, namely the root body, stem body, and leaf body. Plants can be grouped by age. One of the oldest plants on earth is the fern (Pteridophyta) which has about 10,000 species. Ferns belong to the Cormophyta spores with simple transport vessels [21]. Ferns based on their way of life are divided into hydrophytic, epiphytic and terrestrial ferns [9].

Ferns are one of the vegetation that in the highlands has more diversity than in the lowlands [10]. Ferns in the Bromo Conservation Area are included in terrestrial ferns because they can grow on soils that have high humidity and rainfall. The ferns that dominate the Bromo conservation area are the Genus Dryopteris. This group of plants contains flavonoid and steroid compounds that play an antiproliferative role in breast cancer cell types [2].

Rachmat [13] stated that the identification of ferns in Bromo Tengger Semeru National Park (TN-BTS) found 17 families with 17 species. The Shannon-Wienner Diversity Index shows a value of 1.68 with a dominance of 0.32 indicating that the diversity of ferns in TN-BTS is moderate [21], the development of ferns in the Bromo conservation area can be influenced by several factors, which are generally divided into 2, namely external factors and internal factors. Based on the factors that influence the growth of these ferns, the results of a study conducted by the IUCN in 2004 stated that ferns have a 52% risk of extinction [7]. Therefore, it is necessary to conduct further research on the factors that can cause damage or death of fern growth of Dryopteris erythrosora species in the Bromo Conservation Area.

2. Experiments Procedure

Types of research

The research method used is a descriptive qualitative method as well as a field method. Descriptive qualitative research method is a method that describes a condition or existing characteristics (LJ Maleong, 2013). While the field method is carried out by observing by coming directly to the savanna of Bromo Tengger Semeru National Park (TN-BTS) on June 23, 2021.at 10.00 WIB, precisely on Teletubbies Hill with an altitude of 2026 masl, temperature 24.4 °C, air pressure 792.5 HPA,in the form of documentation of observations to interviews with jeep drivers who are also local residents of the area. Documentation of observations was carried out using research tools in the form of cellphone cameras, books, and ballpoint pens.Then, interviews were conducted by direct question and answer with respondents in order to obtain information without using special guidelines [23].

Research object

The object in this study is a sprig sample offerns (Pteridophyta) complete with roots and stems that have died and are considered to represent all ferns (Pteridophyta) in the savanna. Nextlooking for scientific sources in order to obtain data in the form of reliable facts in accordance with the objectives and benefits of research (Sugiyono, 2014).

Data analysis

Data analysis using literature study. Literature study is carried out by reading library

sources to obtain the necessary data [18]. In this study, the analysis is in the form of how many ferns (Pterydophyta) experience death in the midst of other plants that can survive.After gettingfurther empirical data researchers can draw conclusions [15].

3. Results and Discussion

Research result

The results of field observations showed that the fern species Dryopteris erythrosora which dominates the savanna of TN-BTS experienced drought and death. The sample was taken as a sprig complete with dead leaf stem roots and was considered to be representative of all ferns (Pteridophyta) and the plant height was 63 cm, leaf length was 36 cm, and taproot length was 11 cm. More details are presented in the Figure 1 and Figure 2.

Figure1. expanse of ferns experiencing drought to death (Personal Documentation)

Based on direct observations and studies of literature from various research sources, it can be seen that several causes of the death of ferns in the savanna of Bromo Tengger Semeru National Park (TN-BTS) can be found, including:

1. *Allelopathic Substance from Imperata (Imperata cylindrica).*

Imperata cylindrica (Imperata cylindrica) is a pioneer plant species of grass that lives in places with high light intensity. The plant has a characteristic body with sharp leaves and rhizome roots. This plant is considered as a weed plant or a nuisance in agricultural land. But the potential of weeds that are processed properly can be used as compost. However, due to its rapid growth in various soil conditions, and the large number found in the savanna area of Mount Bromo, as well as the lack of effort to use it, it has a negative impact on the surrounding environment [8]. One of them is causing disruption of plants that live around the weeds, for example ferns that become dry and die.

Figure 2. Cross-sectional morphology of fern leaves (Personal Documentation)

As it is known that the reeds can produce chemicals that can affect the growth of plants in the vicinity. These substances are often referred to as allelopathy or allelochemistry. Chemical substances that are allelopathic from a plant species can be divided into two types, namely Autotoxic (inhibiting the growth of plants of the same sex) and Antitoxic (inhibiting the growth of plants of different species). Imperata is included in the Antitoxic type, so the chemical substances released can inhibit the growth of other plants such as nails that live in the vicinity.

Allelochemical substances contained in reeds include terpenoids, alkaloids, organic acids, amino acids, phenolic substances, pectate substances, gibberellic acid, and sugar. Phenolic substances include chemicals that can inhibit the growth of other plants depending on the level of concentration. The accumulation of high phenolic substances produced by reeds in the

Bromo conservation area causes the death of ferns [22].

Chemical substances that are toxic can cause disruption of plant life systems such as the process of protein preparation, photosynthesis and the ability to open leaf stomata [22]. The response of ferns to phenolic substances from reeds is in the form of dry and brittle leaves, shriveled stems, and rotting roots and no root fibers.

2. Eruption Disaster

According to Maulana [11], Mount Bromo is included in the category of an active volcano that has experienced several eruptions. The impact of the eruption reached a radius of 2.5 Km. occurred at the end of September 2016. Other sources state that the eruption cycle of Mount Bromo can occur every two to five years. The eruption of Mount Bromo occurred in April 2011 then returned to the alert status in 2012 to 2013. However, from 2014 to 2017 Mount Bromo was on alert status [12]. From the estimated time of the eruption, it is suspected that it could be one of the factors causing the death of ferns in the savanna of Bromo Tengger Semeru National Park (TN-BTS). Rahayu et al. [14] states that there are various ways in which ecosystems respond to volcanic eruptions depending on the type, scale, frequency, impacts, natural vegetation, and so on. In general, forest ecosystems are more resistant to eruptions than grassland ecosystems. Land affected by the eruption can be reused as land for cultivation, except for areas that still have the impact of being a place for lava flows [1]. Eruptions resulting from volcanic eruptions can cause plants to wither to death in different places (Department of Agriculture, 2014 in [16].

3. Soil Structure

In general, soil functions as a medium for plant growth and supports the continuity of plant life [3]. Soil has physical properties, chemical properties and biological properties as a result of the integration of climate and living organisms into the parent rock and is influenced by the shape of the region and the time in the formation process [5]. Soil is composed of four parts that make up the soil, including inorganic materials in the form of minerals, organic materials from the remains of dead plants and animals, water and air [4].

Based on observations in the field, Bromo Tengger Semeru National Park (TN-BTS) has a sandy texture and is rough when twisted, easily detached, and has no cohesion. The texture of a soil is a comparison between the sand, dust and clay particles contained in the soil mass [4]. The amount of wilting to death of ferns in the savanna area of Bromo Tengger Semeru National Park (TN-BTS) can occur because the water holding capacity of the soil is low. Hardjowigeno [6] stated that soil with a sandy texture has many macro pores so it is difficult to hold water. In addition, the ability in terms of providing nutrients for plants is also low, so there are difficulties faced by these ferns to keep growing and developing (Preparing Team, 2016).

4. Conclusion

Based on the research, it can be concluded that the death of ferns (Pteridophyta) in the savanna area of Bromo Tengger Semeru National Park (TN-BTS) is caused by several factors, including the presence of allelopathic substances from Alang-alang (Imperata cylindrica), due to the eruption of Mount Bromo, and the soil structure in the savanna area of Bromo Tengger Semeru National Park (TN-BTS) which has a sandy texture. However, further research is needed to strengthen and further explore the results of existing research.

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