Composition of Spermatophyta (Seed Plants) in the Biological Greenhouse Area of Univet Bantara Sukoharjo

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Abstract

Spermatophyta is a seed plant with a very high diversity and is easily found in the surrounding environment. The purpose of this study was to determine the composition of Spermatophyta in the biological greenhouse of the Univet Bantara Sukoharjo. Research This research is exploratory description research with the cruising method (survey). The research was conducted in the biology greenhouse of the Univet Bantara Sukoharjo campus which has an area of about 350 m2. The research procedure consisted of several stages, namely the preparation of tools and materials, observation and documentation of Spermatophyta in the greenhouse, recording of plant characteristics, identification and determination of plants, and data analysis. determination result. The plants data collected were analyzed descriptively and qualitatively. The results showed that the composition of Spermatophyta in the biological greenhouse was 58 species and all of them were angiosperms group which included dicotyledonous and monocotyledonous plants. The number of families found was 40 families. These results indicate that the biological greenhouse is not dominated by a few families but many families that live in the area. Families with more than one species are the Araceae family (talas taro tribe) with 6 species, the Euphorbiaceae family with 4 species, Papilionaceae and Asparagaceae each with 3 species, Mimosaceae, Amaranthaceae, Myrtaceae, Rutaceae, Oxalidaceae, and Orchidaceae were found 2 species. The diversity in the composition of spermatophytes in terms of their families is quite diverse, but the number of species from each family is not large enough so that further development is needed to enrich the diversity of Spermatophyta compositions in the biological greenhouse.

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INTRODUCTION

Spermatophyta (Seed plants) are a group of plants that have the highest level of phylogenetic development. The term Spermatophyta is taken from the greek words sperm which means seeds and phyta from the word python which means plant. Spermatophyta has the main characteristic of producing seeds as a means of reproduction. Seeds in Spermatophyta are a means of generative reproduction because seed formation begins with sexual events. The seed embryos that are formed have bipolar or bipolar nature, not only the stem poles that grow and develop to form stems, branches, and leaves, but the root poles can also grow and develop to form a root system (Ulfa, 2019). This process can occur because spermatophytes have flowers so they are often called anthophytes (flowering plants). The flower is formed from sporophyll seeds then a series of sporophylls arranged in one unit to form flower organs (Hasanuddin, 2006).

Spermatophyta is also known as phanerogamae which have visible reproductive organs. In addition, it is also often referred to as embryophytes siphonogama which means it has an embryo and reproduces through a vessel (Hartono *et al*., 2020; Tjitrosoepomo, 2013).. Spermatophyta is composed of roots, stems, true leaves (cormophyta) and is equipped with xylem and phloem tissues. Spermatophyta reproduces sexually by pollination or vegetatively. Sexual reproduction in Spermatophyta cannot be separated from the role of flowers. Flowers play a role in generative (sexual) reproduction which is characterized by pollination (pollination), namely the fall of microspores (male sex cells) onto the stigma, causing fusion between male and female gametes (Hasanuddin, 2006).

Spermatophyta consists of two subdivisions, namely gymnosperms and angiosperms (Tjitrosoepomo, 2013). Gymnosperms (open seed plants) have ovules with an open integument so the seeds are not protected by fruit leaves. In contrast, angiosperms (covered seed plants) are plants whose ovules are surrounded by ovules. In reproduction, these two sub-divisions have differences, namely in gymnosperms only one fertilization occurs, namely fertilization that produces seeds, while in angiosperms fertilization occurs twice. The first fertilization will produce seeds then followed by the second fertilization that produces fruit (Mulya, 2005; N. Sinaga, 1993). The subdivisions in the Spermatophyta are further classified into orders and families that are adapted to their respective characteristics (Sastria & N., 2018).

Spermatophyta that have been identified on earth currently consists of about 170,000 plant species from a total of 300,000 plant species, so that the number of Spermatophyta species is more than half of the total number of plants (Tjitrosoepomo, 2013). The distribution of these spermatophytes is influenced by bioecological factors, namely biotic and abiotic factors. Biotic factors are related to the living conditions of plants consisting of morphological, phenological, physiological, or molecular changes as an adaptation response (Wasilah, Perwitasari, & Su'udi, 2019). While abiotic factors consist of non-biological environmental factors, namely climate (temperature, humidity, light intensity), soil, and others (Hakim, 2019). The number of types of members of the Spermatophyta will certainly continue to increase along with the discoveries of new species that begin with research activities.

Research on the diversity of Spermatophyta in an area in Indonesia has often been carried out. This is because Indonesia is an area that has an optimal environment for the growth of various spermatophytes. Several studies on Spermatophyta include the diversity of spermatophytes (Aryani, 2017; Fananiar, Hidayati, & Widiyanto, 2018; Habibi & Damayanti, 2021; Hariyati, Zulmaidar, & Hasanah, 2018; Huda, Amrul, & Susilo, 2020; Isti, Hariani, & Murdiyah, 2015; Krisnawati & Febrianti, 2019), spermatophytic epiphytic diversity (Nabila *et al.*, 2021), herbaceous plant diversity (Dui & Hendrik, 2019), phanerogamae diversity (Ulfa, 2019). The number of studies on Spermatophyta indicates that in areas in Indonesia, various Spermatophyta have the potential for life. Many Spermatophyta plants are also planted and conserved for certain purposes such as research, protection, cultivation, and others. In a campus or university environment such as at the Universitas Veteran Bangun Nusantara (Univet Bantara) Sukoharjo, there is a biological garden (greenhouse) that contains plants that are useful for learning, research, and cultivation purposes, especially for students and lecturers of biology education.

Previous research has been conducted on the diversity of spermatophytes in the Bantara Sukoharjo University campus with the results that there are 106 species of spermatophytes consisting of 2 gymnosperms and 104 angiosperms (Nugroho, 2018). This study has not specifically identified the spermatophytes in the biological greenhouse. The composition of spermatophyte plants in the biological greenhouse is quite diverse, so it is necessary to identify it to obtain an overview of the composition of the spermatophyte plants in the biological greenhouse of Univet Bantara Sukoharjo. Identification of spermatophyta

composition emphasizes more on the presence of species found and in this study does not reach the calculation of diversity The composition of the Spermatophyta includes the divisions of gymnosperms and angiosperms, monocot and dicot classes, families, and species. The results of the research on the composition of the biological greenhouse can also be used as a reference for the further development of the biological greenhouse.

METHODS

This research is exploratory description research with a cruising method (survey). Exploration was carried out by visiting a biological greenhouse and then making observations to identify all Spermatophyta plants that grew in the area. The research was carried out in December 2021 and was carried out in the biological greenhouse of the Univet Bantara Sukoharjo campus which has an area of about 350 m2. The research procedure can be seen in Figure 1 below.

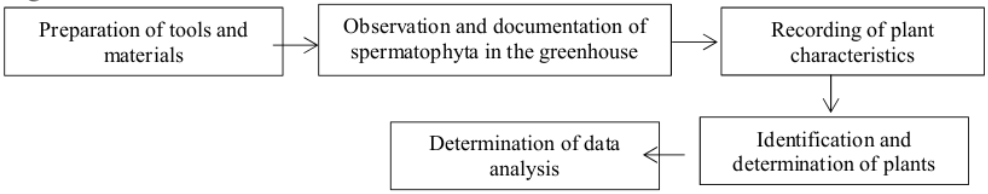

Figure 1. Research Procedure

The first step is the preparation of tools and materials. The tools and materials used in this study include 1) writing instruments to record a list of plants and their characteristics, 2) documentation tools (cameras) to take pictures of plant and plant body samples as a whole, 3) cutters and scissors to cut plant parts taken. samples of body parts to be identified, 4) references in the form of flora books, journal articles about Spermatophyta, Spermatophyta reference books to conduct a literature review in the identification and determination of plants. The second step is to observe the plants that grow in the biological greenhouse area. Observations were assisted by a documentation tool in the form of a cellphone camera to photograph the morphology and plant habitus. The third step is recording the characteristics of the observed plants. Plant records include morphology, habitus, plant height, location of discovery, and other characters deemed important for identification. The fourth step is to identify and determine the plants that have been observed and recorded. Identification and determination of plants are carried out to determine the classification of each plant observed or found. These activities are carried out directly at the observation site and in the biology laboratory. Identification and determination are carried out with the help of references (Tjitrosoepomo, 2013) that have been prepared to facilitate these activities.

The data collected and identified and determined are then analyzed descriptively qualitatively. The plant data is described including a description of its morphology and classification, then presented in a table containing taxon divisions, classes, families, species, and local names.

RESULTS AND DISCUSSION

Biological greenhouse is a garden that has the main function to support learning as a source of biology learning for biology education students at Univet Bantara Sukoharjo, besides that it is also an object of research for students and lecturers of biology education and as cultivation of various plants. Greenhouse is overgrown with various kinds of plants including Spermatophyta that grow naturally and intentionally planted. The results of the Spermatophyta research show that in the biological greenhouse there are various spermatophytes with various compositions. The composition of the spermatophytes found in the biological greenhouse can be seen in Table 1 below.

Table 1. Spermatophyta composition in biological green house univet bantara sukoharjo

Division (Gymnospermae/ Angiospermae)	Classes	Family	No	Species	Local Name
Angiospermae	Dicotyledon	Mimosaceae	1	*Laucaena leucocephala*	Petai cina, lamtoro
			2	*Mimosa pudica*	Sihirput, sikerput,
		Moraceae	3	*Ficus pumila* L	Dollar
		Amaranthaceae	4	*Amaranthus spinosus*	bayam
			5	*Amaranthus cruentus*	Bayam merah
		Vitaceae	6	*Vitis vinifera* L.	Anggur
		Passifloraceae	7	*Passiflora edulis*	Markisa
		Myrtaceae	8	*Syzygium myrtifolium*	Pucuk merah
			9	*Syzygium aqueum*	Jambu air
		Cactaceae	10	*Opuntia cochenillifera*	Kaktus centong
		Rutaceae	11	*Citrus sinensis*	Jeruk baby
			12	*Citrus hystrix*	Jeruk purut
		Sapotaceae	13	*Manilkara kauki*	-
		Zingiberaceae	14	*Curcuma longa*	kunyit
		Moringaceae	15	*Moringa oleifera*	-
		Papilionaceae	16	*Glycine max*	Kedelai
			17	*Vigna sinensis* L.	Kacang panjang
			18	*Sesbania grandiflora*	Turi
		Euphorbiaceace	19	*Euphorbia milii*	Euporbia
			20	*Jatropha curcas*	Jarak pagar
			21	*Acalypha australis*	Anting-anting
			22	*Euphorbia hirta*	Patikan kebo
		Begoniaceae	23	*Begonia sp*	Begonia
		Lythraceae	24	*Cuphea hyssopifolia*	Taiwan beauty
		Rubiaceae	25	*Hedyotis corymbosa* L.	Rumput mutiara
		Phyllanthaceae	26	*Sauropus androgynus*	Katuk
		Acanthaceae	27	*Ruellia simplex*	Bunga pletekan
		Sapindaceae	28	*Nephelium lappacum* L.	Rambutan
		Caesalpinaceae	29	*Manihot esculenta*	Pohong, budin, boled
		Caricaceae	30	*Carica papaya*	Kates
		Oxalidaceae	31	*Averrhoa carambola*	belimbing
			32	*Oxalis barrelieri*	Calincing tanah
		Solanaceae	33	*Physalis angulata*	Ciplukan
		Asteraceae	34	*Synedrella nodiflora* L.	Keningkiran
		Caesalpiniaceae	35	*Paraserianthes falcataria*	Sengon sulaiman
	Monocotyledon	Orchidaceae	36	*Arachnis flosaeris*	Anggrek Kalajengking
			37	*Dendrobium anosmum*	Anggrek dendro
		Araceae	38	*Aglaonema sp*	Sri Rejeki
			39	*Colocasia esculenta*	Talas
			40	*Epipremnum aureum*	Sirih gading
			41	*Anthurium crystallinum* L	Kuping gajah
			42	*Philodendron sp*	-
			43	*Anthurium andreanum*	Jemani kobra
		Ruscaceae	44	*Sansevieria sp.*	Pedang-pedangan

Division (Gymnospermae/ Angiospermae)	Classes	Family	No	Species	Local Name
		Musaceae	45	*Musa paradisiaca* L.	Gedang
		Cycadaceae	46	Cycas	Palem
		Asparagaceae	47	*Polygonatum verticillatum* L.	-
			48	*Asparagus officinalis*	Asparagus
			49	*Cordyline fruticosa*	Andong
		Olaeceace	50	*Nychanthes arbar*	Sri gading
		Liliaceae	51	*Lilium*	Bunga bakung
		Bromeliaceace	52	*Cryptanthus bivittatus*	Kriptantus
		Pandanaceae	53	*Pandanus amaryllifolius*	Pandan wangi
		Commelinaceae	54	*Zebrina pendulla-schnizl*	Sabrina
		Xanthorrhoeaceae	55	*Aloe vera*	Lidah buaya
		Urticaceae	56	*Pilea microphylla*	Gulma katumpangan
		Cyperaceae	57	*Cyperus rotundus*	Teki
		Gramineae	58	*Dactyloctenium aegyptium*	Rumput

Table 1 shows that there were 58 species found and the composition of the Spermatophyta in the biological greenhouse were all angiosperms which included dicot and monocot plants. Gymnosperms were not found in this area because gymnosperms are plants that are often found in certain areas and are rarely found in lowland areas (Sunarti & Rugayah, 2013). Angiosperms are the largest vascular plant group in the kingdom Plantae with a large number of species (Soltis & Soltis, 2004). The number of angiosperm species is estimated to reach 90% of all plant species widely distributed in the world or about 235,000 to 400,000 species (Daniel, 2011). The number of families found was 40 families. These results indicate that the biological greenhouse is not dominated by only a few families but many families that live in the area. The families and the number of species found can be seen in Figure 2 below.

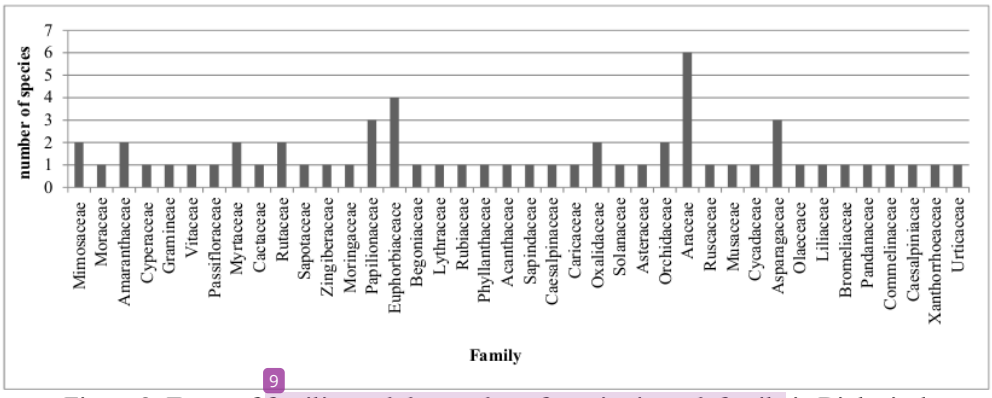

Figure 2. Types of families and the number of species in each family in Biological Greenhouse

Figure 2 shows that the family with the highest number of species is the Araceae family with 6 species consisting of *Aglaonema sp*, *Colocasia esculenta*, *Epipremnum aureum*, *Anthurium crystallinum* L, *Philodendron sp*, and *Anthurium andreanum*. The six

species are collection plants that are intentionally planted in a biological greenhouse. The Araceae family has distinctive characteristics that characterize the family, namely wet stems, compound buds consisting of a spathe that surrounds the cob (spadix) (Boyce *et al*., 2010). Plants from the Araceae family are often found and cultivated in Indonesia because these plants are easy to grow in tropical areas such as Southeast Asia, America, and Papua New Guinea (Tomlinson, Mayo, Bogner, Boyce, & Catherine, 1998).

In Indonesia, Araceae plants grow on various islands, namely the island of Borneo, there are 297 species, Sumatra has 159 species, Sulawesi has 49 species, and the island of Java has 67 species (Haigh *et a*l., 2009; Tomlinson *et al*., 1998). Many Araceae plants grow in Indonesia, so many studies in the last 10 years have been conducted on the diversity of Araceae in an area (Agung Kurniawan & Boyce, 2013; Maretni, Mukarlina, & Turnip, 2017; Rio Eka Desi Purwandari Hartanti, Sulmin Gumiri, & Siti Sunariyati, 2020; K. A. Sinaga, Murningsih, & Jumari, 2017; Sri Asih & Kurniawan, 2019). The plant from the Araceae family is an ornamental plant that is planted in a pot as a collection in the greenhouse. Most members of the species from the Araceae family are plants that have their own charm and also have high economic value so that many people plant them.

The family that has the second most species in the greenhouse is the Euphorbiaceae family. A total of 4 species of Euphorbiaceae were found consisting of *Euphorbia milii*, *Jatropha curcas*, *Acalypha australis*, and *Euphorbia hirta.* The Euphorbiaceae family is the fourth largest family of 5 vascular plant families with more than 1000 species. The plants from the Euphorbiaceae found were planted intentionally (*Jatropha curcas* and *Euphorbia milii*) or cultivated or wild (*Acalypha australis* and *Euphorbia hirta*) in the biological greenhouse area. Many plants from this Euphorbiaceae are also found in other areas such as previous research on the types of species from the Euphorbiaceae which are found in an area (Yanti & Fitriani, 2019) and some are endemic plants (Djarwaningsih, 2017). Plants from the Euphorbiaceae have many benefits such as medicinal plants, oil producers, biopesticides, human and animal food ingredients, and ornamental plants (Adhil, Iqbal, & Ramadanil, 2019; Dalimartha, 2000; Dea, Jumari, Wiryani, & Alhamd, 2016; Djawarningsih, 2007). In some areas, such as in the Morowali area of Central Sulawesi, Euphorbiaceae plants are widely planted to treat various diseases (Hermin, Ibrahim, & Nugrahani, 2016).

The next family is Papilionaceae and Asparagaceae which each found 3 species. Species from Papilionaceae are *Glycine max*, *Vigna sinensis* L, and *Sesbania grandiflora*, while species from Asparagaceae are *Polygonatum verticillatum* L, *Asparagus officinalis*, and *Cordyline fruticosa*. The Papilionaceae family in Indonesia has quite a lot of types, which are more than 12,000 species (Cahyono, 2007). The three species of Papilionaceae found, *Sesbania grandiflora* are plants that are intentionally planted in the greenhouse area as a shade for the environment, while the other 2 species grow wild in the greenhouse area. Papilionaceae is included in the large family, namely Fabaceae or Leguminosaceae with its characteristic fruit in the form of legumes, while Papilionaceae itself has a characteristic flower shaped like a butterfly (Danarto, 2008). The habits of this family are in the form of trees, shrubs, shrubs, and herbs (Rahmita, Ramadanil, & Iqbal, 2019).

Many plants from the Papilionaceae are also planted because they have many benefits from their body parts such as seeds, fruit (pods), flowers, bark, stems, leaves, tubers, and roots (Agil, 2021; Danarto, 2008). Several species of this family also can fix (fixation) free nitrogen directly from the air because these species have a symbiotic relationship with certain bacteria in their roots or stems. The tissue on the roots or stems containing symbiotic bacteria usually looks swollen and forms nodules. Papilionaceae which have an important role in ecosystems as well as for the benefit of humans have been widely studied, such as research on the diversity of Papilionaceae (Agil, 2021; Danarto, 2008). Apart from Papilionaceae, 3 species were found, namely the Asparagaceae family (*Polygonatum verticillatum* L, *Asparagus officinalis*, *Cordyline fruticosa*). This species of Asparagaceae is a collection plant

grown in a greenhouse. Some plants from the Asparagaceae are plants that have aesthetics so that they have the potential to become ornamental plants that have economic value (Sriastuti, Herawatiningsih, & Tavita, 2018). In certain areas, several species of Asparagaceae are endemic plants, as reported that *Dracaena jiewhoei* is endemic to Sumatra (Hambali, Sulistiarini, & Rugayah, 2020).

Furthermore, the families found with 2 species were Mimosaceae, Amaranthaceae, Myrtaceae, Rutaceae, Oxalidaceae, and Orchidaceae. The six families mostly contain plants that are intentionally planted in greenhouses as collection plants. Mimosaceae is a family with a habitus of trees, shrubs, shrubs that are sometimes thorny and climbing. Plants from this family have bulb-shaped flowers, on the surface of the seeds, there is generally a U-shaped pleurogram (Halley and Taylor, 2007). In addition, this plant contains non-protein amino acids in the seeds and contains a lot of tannins (Dasuki, 1994). As a member of the Fabaceae which is a legume, the Mimosaceae plant group also has a symbiotic relationship with N-fixing bacteria. Plants that have a symbiosis with N-fixing bacteria can grow on soils that lack nutrients, can compete with grass plants, which mostly grow dominantly in damaged areas, can grow in the dry season, and also the litter can enrich soil nutrients (Indriyanto, 2010). Mimosa genus has approximately 500 species which are commonly found in the tropics. This genus has thorny body characteristics, leaves that can close because they are sensitive to touch, and the fruit segments can detach when ripe (Langran, 2010). The two Mimosaceae species found are wild plants that grow in the biological greenhouse area.

The next family found 2 species, namely Amaranthaceae. The two species are *Amaranthus spinosus* and *Amaranthus cruentus*. *Amaranthus spinosus* is a plant that lives wild in the greenhouse area, while Amaranthus cruentus is a collection plant. In the family Oxalidaceae, two species were found, namely *Syzygium myrtifolium* and *Syzygium aqueum*. Both species are plants grown in greenhouses as collections. The genus Syzygium is a genus that is commonly found in Java and there are 52 species recorded (Shaw, Backer, & van den Brink Jr., 1967). Two species of the Rutaceae family were also found, namely Citrus sinensis and Citrus hystrix, both of which are collection plants in the biological greenhouse. Rutaceae (oranges) is one of the families of the order Rutales which has about 150 genera and 1500 species members. The citrus genus is a genus of Rutaceae which has many types (Hardiyanto, Mujiarto, & Sulasmi, 2007). The citrus genus is often found in sub-tropical areas with an altitude of up to 650 meters above sea level and lives in tropical areas up to 2000 meters above sea level (Manurung & Warsodirejo, 2019).

The next family, Oxalidaceae, found 2 species (*Averrhoa carambola* and *Oxalis barrelieri*). *Averrhoa carambola* is a plant grown as part of the collection and *Oxalis barrelieri* was found growing wild in a biological greenhouse. This family belongs to the order Oxalidales and consists of 6 genera covering 775 species (Simpson, 2019). Oxalidaceae are widely distributed in the tropics, sub-tropics and some can also grow in temperate climates (Simpson, 2019; Singh, 2016). The sixth family found 2 species, namely Orchidaceae (orchids). The two species are *Arachnis flosaeris* and *Dendrobium anosmum*. Both species are collections of plants in the biological greenhouse that have a fairly large number of individuals. Orchidaceae is one of the largest families which occupies 7-10% of flowering plants and has approximately 20,000 to 35,000 species members (Hartati & Darsana, 2015; Read & Dressler, 1982). Members of the Orchidaceae are widely collected because of the beauty of their flowers, so most of them have high economic value.

In Figure 2, it is also known that there are 30 families where only 1 species is found. Some of the species in this family are planted as collections, but some are growing wild in the greenhouse area. At the biological greenhouse of Univet Bantara, the composition of Spermatophyta is quite diverse when viewed from the number of families found, but when viewed from the species found, there are not many species in each family. Greenhouse biology which functions as a source of learning biology for biology education students and

other academic interests, is necessary to develop further by adding to the collection of plants to make it more diverse. In addition, it is also necessary to cultivate several collections of plants so that they are not only of various types but also of many individuals.

CONCLUSION

Spermatophyta is a group of seed plants that are often found in the surrounding environment. The biological greenhouse of Univet Bantara is filled with various compositions of spermatophyte plants. The composition of the Spermatophyta in the biological greenhouse, namely there were 58 species found and the composition of the Spermatophyta in the biological greenhouse were all angiosperm groups which included dicotyledonous and monocotyledonous plants. The number of families found was 40 families. These results indicate that the biological greenhouse is not dominated by a few families but many families that live in the area. Families with more than one species are the Araceae family with 6 species, the Euphorbiaceae family with 4 species, Papilionaceae and Asparagaceae each with 3 species, Mimosaceae, Amaranthaceae, Myrtaceae, Rutaceae, Oxalidaceae, and Orchidaceae were found 2 species. At the Biological Greenhouse of Univet Bantara, the composition of Spermatophyta is quite diverse when viewed from the number of families found, but when viewed from the species found, there are not many species in each family. The development of a biological greenhouse is needed by adding to the collection or cultivating so that it can enrich the composition and diversity of Spermatophyta plants.

SUGGESTION

Research was limited to Spermatophyta that grow in greenhouse biology so that further research can cover a wider range of plants, namely lower plants such as ferns (Pteridophyta) and mosses (Bryophyta). This study has not measured environmental factors such as temperature, soil pH, soil moisture, and air. These environmental factors may affect the growth and development of Spermatophyta plants so that further environmental factors can be measured and used as material for discussion.

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