

Chapter

Bryophyta around Syamsudin Noor International Airport, South Kalimantan, Indonesia

Yuninda Riyana, Sasi Gendro Sari and Gunawan Gunawan

Abstract

Research on biodiversity of bryophyta around Syamsudin Noor International airport has never been reported. The study purposed the types of mosses around the Syamsudin Noor International Airport. A purposive sampling method was used to collect bryophyta and then environmental parameters were directly measured in the field. Moss identification referred to the book *A Handbook of Malesian Mosses* volume 1 *Sphagnales to Dicranales* and volume 2 *Leucobryaceae to Buxbaumiaceae*. Morphological characteristics of mosses were observed at leaf parts, stem, and rhizoids. The results showed 7 species of mosses consisting of *Barbula javanica*, *Hyophila apiculata*, *Philonotis hastata*, *Ectropothecium falciforme*, *Fissidens atroviridis*, *Calymperes tenerum*, and *Hyophila involuta*. The dominant species was *Barbula javanica*. The range of environmental parameter valued air temperature 28.1–34.1°C, light intensity 20–35 lux, humidity 74–84%, and soil pH 6.5–7. The results of this study are preliminary data that can be used for further research and determine the changing conditions of the environment around Syamsudin Noor International Airport.

Keywords: airport, bryophyta, diversity, bioindicator, environmental

1. Introduction

Moss comes from two words, namely Bryon which means moss and Python which means moist or wet [1]. Several species of mosses which are still classified as thallus form faults and have never found further differences, but mosses are found which and body composition is close to the characteristics of higher plants, namely having stems, leaves, and rhizoids (still in a simple form) [2]. The characteristics of mosses have parts consisting of capsules, seta, leaves, stems (transition from thallus to cormus), and rhizoids (mosses do not yet have true roots) [1]. Moss is recorded to have approximately 18,000 species in the world and is a low-level plant group that ranks second after higher plants. While in Indonesia recorded 1500 species of moss that have been found. This is related to mosses that can live in humid areas because Indonesia is a tropical region which has humid areas so that it supports a lot of moss to live. Moss grows in clumps that cover the surface of the substrate such as weathered wood, litter, tree trunks, rocks, and leaves. Moss has several roles and benefits, one of which is an important component that plays a role in air balance and nutrient cycles

in an area, especially tropical rain forests. Lichens can act as pioneer plant nutrients in rich locations. Moss can also act as a bioindicator of environmental pollution in an area or area contaminated with pollutants [3]. This is because mosses have the opportunity to change the environment [4].

This is one of the interesting reasons in this study, the area that became the focus around the airport area which was originally a peat swamp and no human activity with developments that changed environmental conditions into a crowded location. In addition, the conditions around the airport have a view of humid conditions. Environmental changes are also affected by the biodiversity in the area. Thus, this study aims to reveal the diversity of mosses around the Syamsudin Noor international airport area, Banjarbaru, South Kalimantan, Indonesia.

2. Bryophyta around Syamsudin Noor airport

This research was carried out in 5 stages, the first activity was collecting moss samples using the purposive sampling method by taking the complete part of the moss and storing it to maintain moisture and safety. Second, measurement of environmental parameters includes air temperature, humidity, light intensity, and soil pH. Third, identification is carried out with reference books, namely A Handbook of Malesian Mosses Volume 1 Sphagnales to Dicranales [5] and A Handbook of Malesian Mosses Volume 2 Leucobryaceae to Buxbaumiaceae [5]. Fourth, the morphological characters of mosses consisting of leaves, stems, and rhizoids were observed using a stereo microscope. Fifth, data analysis was carried out descriptively. Several types of moss found around the Syamsudin Noor airport area are:

2.1 *Barbula javanica* Dozy and Molkenboer

B. javanica is found on rock and soil substrates. The most common moss found in various open or closed places in the research area. *B. javanica* can also be found in moist or wet soil [6]. Live in groups and side by side with other mosses when found in the field. Individual length at the time of measurement reached 4 mm. Rhizoid when observed shaped like a thread and firmly attached to the substrate. The stem when observed is almost invisible because it is covered by an arrangement of leaves. The stem shape is erect, brownish, unbranched, and can reach 7 mm in height [7]. The leaves when observed are green, lanceolate in shape, flat edges, and tapered ends, the leaf length reaches 0.6 mm, and shrivels when dry. The leaves curl when dry, are green, lanceolate, blunt tip, flat edge [6], and mother leaf bones are brownish in color [7]. The shape of leaf cells when observed is rectangular and the size of leaf cells reaches 2 m. The cells in the middle of the strands that make up the midrib are rectangular and the cells at the edges of the strands are rectangular [6]. In the field observations found gametophyte and sporophyte phases. The sporophyte phase was found to be seta with a length of 1.8 mm and a capsule with a length of 0.4 mm, calyptra with a length of 0.5 mm, the shape of the calyptra was long and tapered, the spores were round (**Figure 1**).

The environmental parameters of *B. javanica* consisted of air temperature of 28.1°C, light intensity of 35 lux, humidity of 84%, and pH 7. The results of environmental parameters are still in the range of good moss growth. Distribution of *B. javanica* is found in Tropical Asia, Central Africa, Cape Verde Islands, Guinea, Nigeria, Arabian Peninsula, Oman, Tropical Central America, United States, Florida, Hawaii, and Australia [8].

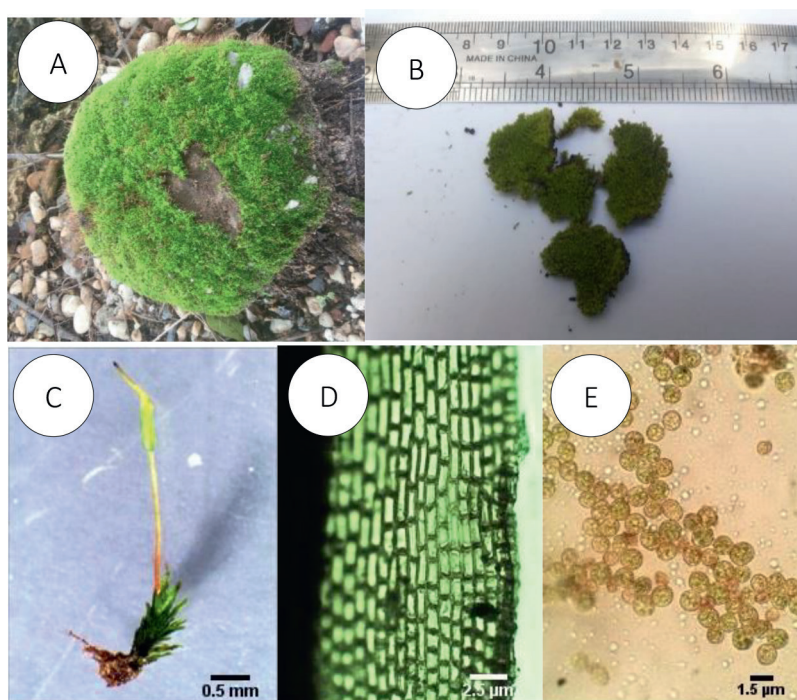


Figure 1.
Barbula javanica: A. Soil substrate, B. Colonies, C. Individual mosses, D. Leaf anatomy, E. Spores.

2.2 *Hyophila apiculata* Fleisher

Mosses are found in the soil substrate and grow in groups. *H. apiculata* can also be found on rock substrates [5]. At the time found living side by side with other mosses. The genus *Hyophila* is found in an open environment [4]. *H. apiculata* is on average small in stature [5] and looks like scales when viewed from above [3]. Individual length when measured reaches 5.5 mm. Morphological observations in the laboratory, rhizoids resemble threads and stick firmly to the substrate. Brownish rhizoids measuring less than 1 mm [4]. The stem when observed is covered by leaves so that it is not visible. Measuring less than 3 mm [5]. In the *Hyophila* genus, the upper stem is green and the lower part is red to reddish brown or dark green, reaching 1 cm high and sometimes branching [4]. The leaves are less than 2 mm in size and are ovate to spatulate [5]. When found with light green leaves, the shape of the leaves looks lanceolate or can be spatulate, flat edges, and pointed ends. The leaves can be lanceolate and light green in color [9] and the leaf edges are flat, the tips are tapered and curved, and the leaf arrangement is alternate (**Figure 2**) [10].

In the genus *Hyophila*, the leaf bones are large and erect from base to tip [4]. The shape of the leaf cells when observed was square and the cell size was 11 m. The sporophyte phase was not found in the field. Seta can grow to a length of 8 mm and there is a capsule and calyptra growing at the tip of the seta [9]. *H. apiculata* has environmental factors when found including air temperature 28.1°C, humidity of 84%, light intensity 35 lux, and pH 7. These results are in accordance with a good growth range in mosses. The distribution of *H. apiculata* is distributed in Malesia [5].

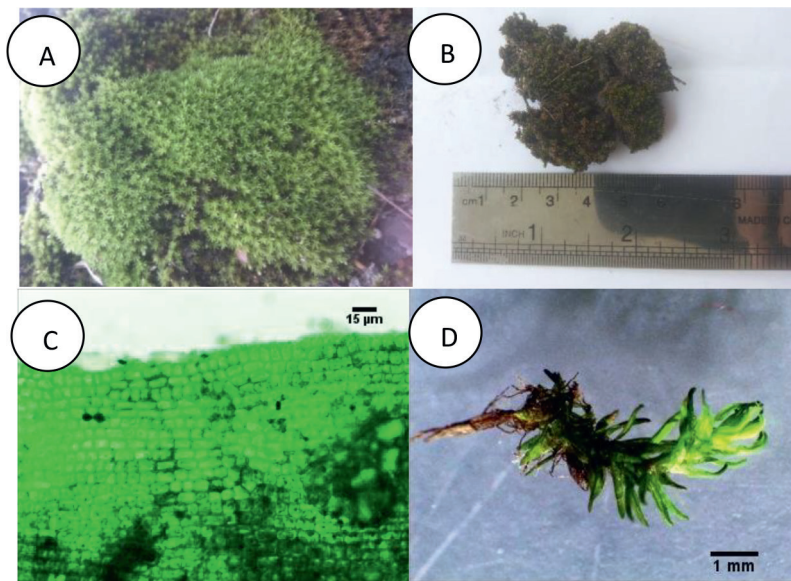


Figure 2.
Hyophila apiculata: A. Soil substrate, B. Colonies, C. Individual mosses, D. Leaf anatomy.

2.3 *Philonotis hastata* Wijk and Margadant

P. hastata is found in soil substrates. In addition to soil, it can also be found on rock substrates [3] and tree substrates [10]. When found living in groups and side by side with other mosses. This moss looks like a sponge and is thick [10]. Observations in the laboratory individual length reaches 4 mm. Rhizoid when observed as threads firmly attached to the substrate. It is smooth and small [3], and in the genus *Philonotis* rhizoid it is thin [11]. The stem when observed is almost invisible because it is covered with leaves. The shape of the stem is upright and 2–8 mm long [3]. The leaves are green to yellowish according to [11] *P. hastata* is bright green to yellowish green. Spiral leaf arrangement and curls when dry [3]. Leaf length when measured reached 1.1 mm, lanceolate shape, flat edge, and pointed tip. The shape is lanceolate, the tip is pointed, the leaf edge is flat [3]. The shape of the leaf cells when observed was rectangular and the length of the leaf cells was 11 m. The sporophyte phase was not found in the field. The environmental parameters of *P. hastata* consisted of air temperature of 28.1°C, humidity 84%, light intensity 35 lux, pH 7. These results are in accordance with a good growth range in mosses. The distribution of *P. hastata* is found in Mexico, Central and South America, Africa, Asia, Australia, Brazil, and Oceania (Figure 3) [12].

2.4 *Ectropothecium falciforme* Dozy and Molke

E. falciforme was found in the base of the tree substrate. Other substrates commonly grown by *E. falciforme* are rock, tree roots, and leaf epiphytes and the habitat for growing is usually in a slightly open environment [4]. Lives creeping on the substrate and side by side with other mosses when found in the field. Individual length when measured reaches 9 mm. Rhizoid when observed like a thread firmly attached to the substrate. The observed stems spread on the substrate according to research sources that the stems spread on the substrate and are covered with leaves [3]. The length of

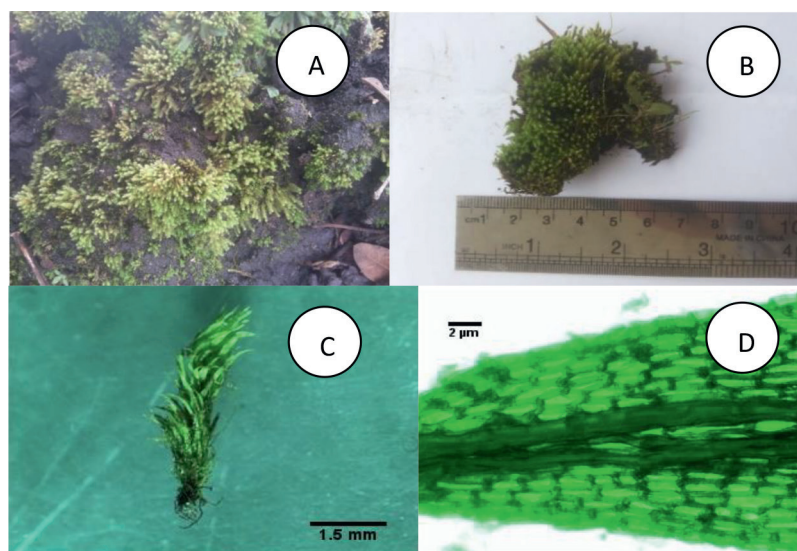


Figure 3.
Philonotis hastata: A. Soil substrate, B. Colonies, C. Individual mosses, D. Leaf anatomy.

the stem reaches 7.5 cm, the branches are slightly pinnate and narrow at the ends, are regular, and look dense because the arrangement of the leaves overlaps each other [4]. The leaves when measured have a length of up to 0.6 mm. The length of the leaves can reach 1 mm [4]. The leaves are light green, lanceolate in shape, flat edges, and pointed ends. The leaves are yellowish green, shiny, the leaves are round lanceolate, the edges of the leaf tips are jagged [4]. The leaves are small and have a pointed tip [3]. Leaf cell shape when observed like smooth muscle and leaf cell length reaches 3 m (**Figure 4**).

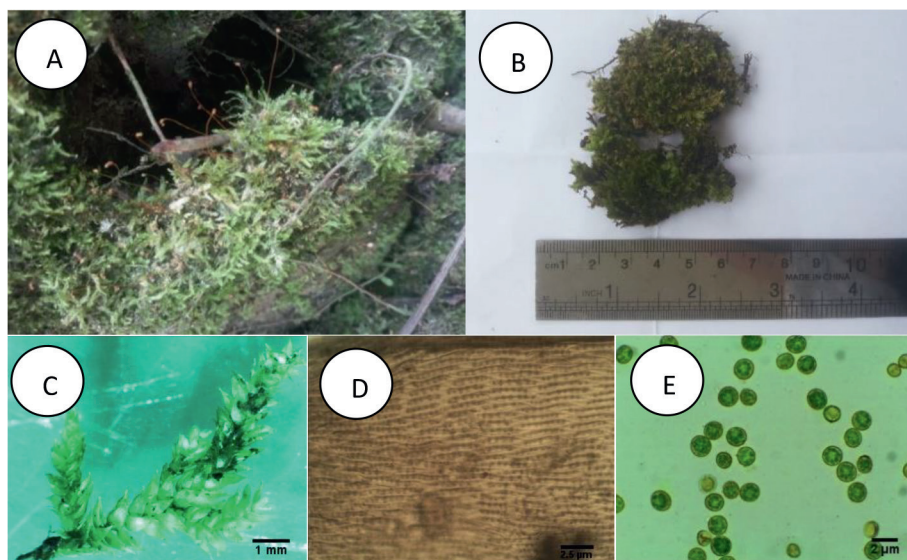


Figure 4.
Ectropothecium falciforme: A. Tree substrate, B. Colonies, C. Individual mosses, D. Leaf anatomy, E. Spores.

Gametophyte and sporophyte phases are found in this moss. The sporophyte structure consists of seta at the time of measurement which is 11 mm long and brown in color. The seta are brown and have a capsule at the end of the seta [3]. The capsules when measured were 0.9 mm long and brown in color. Calyptra on *E. falciforme* observations were not seen. The shape of the spores when observed is spherical and 1.4 m in diameter. The environmental parameters of *E. falciforme* consisted of air temperature of 34.1°C, humidity 79%, light intensity 20 lux, and pH 7. The results from both locations were still in a good growth range for mosses. Distribution in Indonesia is in Sumatra, Java, Lombok, Kalimantan, and Sulawesi [4].

2.5 *Fissidens atroviridis* Besch

F. atroviridis was found on soil substrates. *F. atroviridis* can grow on moist and shady soil and rocks [5]. In addition, it can be found on weathered tree substrates [13]. Coexists with other mosses when found in the field. Small in stature [5] and looks like a comb from above [3]. Individual length when measured reaches 7 mm. The individual length of *F. atroviridis* can reach 10–15 mm [14]. The structure when dry will bend [5]. Rhizoid when observed like a thread firmly attached to the substrate. The rhizoid structure in the *Fissidens* genus is smooth or has palillae [11]. The stem when observed is almost invisible because it is covered by leaves. The leaves that have been observed are dark green. *F. atroviridis* is dark green in addition, there is also a pale yellowish to transparent dull green color (Figure 5) [5].

The leaves when measured were 1.9 mm long. The leaf length can reach 2.5 mm [5]. The arrangement of the leaves is pinnate and very tight so it looks piled up [9]. Thick leaf margins [14]. The shape of the lancet, flat edge, and pointed tip are in accordance with the characteristics of the research found [9]. The shape of the leaf cells when observed was hexagonal and the length of the leaf cells was 1.1 m. The hexagonal leaf cells are irregular, very thin-walled, and the cells are large [14]. In *F. atroviridis*

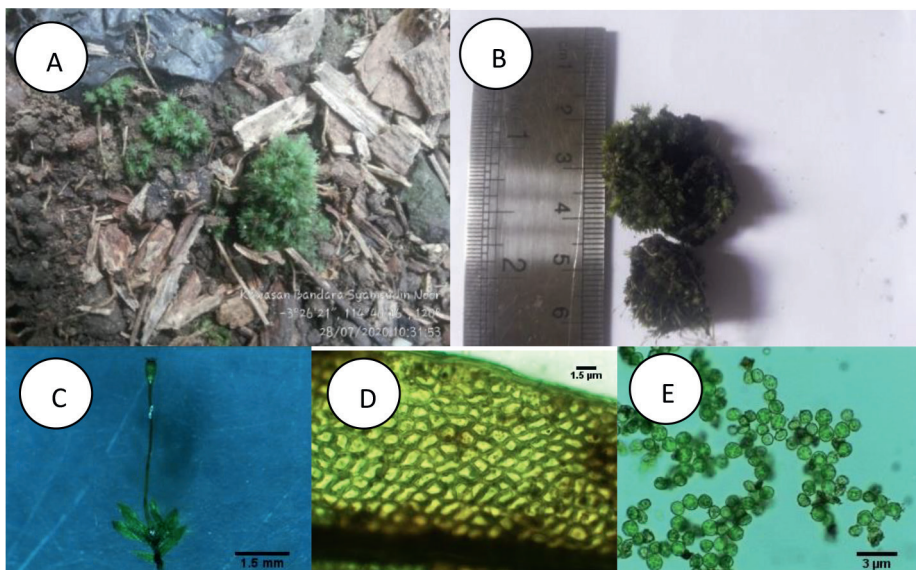


Figure 5. *Fissidens atroviridis*: A. Soil substrate, B. Colonies, C. Individual mosses, D. Leaf anatomy, E. Spores.

gametophyte and sporophyte phases were found. The sporophyte phase in this moss consists of seta which is brownish green when observed and the measured length reaches 3.2 mm and that the length of the seta can reach 4 mm [5]. The capsule when observed was green and the length of the capsule when measured was 0.4 mm. The capsules are symmetrical [14]. Caliptra was measured to reach 0.5 mm and was brown in color, the shape of the spores when observed was round, and the diameter of the spores when measured was 0.8 m. The environmental parameters of *F. atroviridis* consisted of air temperature of 32.2°C, humidity 84%, light intensity 22 lux and pH 6.5. The results from both locations were still in a good moss growth range. Distribution of *F. atroviridis* is found throughout Indo-Malaya from India to New Guinea [5].

2.6 *Calymperes tenerum* Müll. Hall

C. tenerum was found on the base of the tree substrate. In addition to tree substrates, *C. tenerum* can be found in rock, soil, and rotting wood [15]. Coexists with other mosses when found in the field. Individual length when measured reaches 4.6 mm. The length of *C. tenerum* rarely grows more than 7 mm and is very small [5]. Rhizoid when observed like a thread firmly attached to the substrate. The stem when observed is almost invisible because it is covered with leaves. The stem grows upright and acrocarp [15], and has a length of up to 1 cm [14]. The leaves when measured have a length of 1.4 mm, green color, lanceolate shape, flat edge, and the tip has a capsule and immediately grows together with the seta. The length of the leaves is between 1.5–2 mm, dull green in color, does not or almost does not widen below the base of the branch, the leaves are almost uniform, and the leaf edges are intact [5]. The shape of the leaf cells when observed was round and the length of the leaf cells reached 1 m. *C. tenerum* leaf cells have 1 layer, the shape is not always rounded and has thin walls in the upper branches [14]. *C. tenerum* found gametophyte and sporophyte phases. The sporophyte phase observed consisted of seta with a length of up to 1.9 mm and green in color. The capsules when observed were cylindrical and brown in color according to [14] which stated that the capsules were cylindrical. The capsules look like thorny spheres, this is in accordance with research [15] which mentions capsules like thorns that characterize this moss. The capsule when observed measuring 0.1 mm. The spores are spherical in shape and 0.9 m in diameter. The environmental parameters of *C. tenerum* consisted of air temperature of 34.1°C, humidity 79%, light intensity 20 lux, and pH 7. The results of environmental parameters from both locations were still in a good growth range for mosses. The distribution of *C. tenerum* is found around the coast of tropical Asia, India, the Pacific islands to Hawaii, the lowlands of Malesia, especially near the sea (Figure 6) [14].

2.7 *Hyophila involuta* Jaeger

H. involuta is found on rock substrates and grows in groups. Other substrates can be found in soil, logs, and walls. Small upright stature with a height of 1 mm, but can grow up to 1.5 cm [5]. At the time found living side by side with other mosses. Living in an open environment [4]. The rhizoids when found are thread-like and firmly attached to the substrate. Rhizoid is thin [11] and looks wrinkled [5]. The stems when observed are covered by leaves so that they are not visible. In the genus *Hyophila*, the upper stem is green and the lower part is red to reddish brown or dark green, reaching 1 cm high and sometimes branching [4]. The leaves when observed are green. This is in accordance with [16] that the leaves are green but can be colored to dark yellowish green. Leaves spread when moist and curl when dry [5]. The genus *Hyophila* has alternate leaf

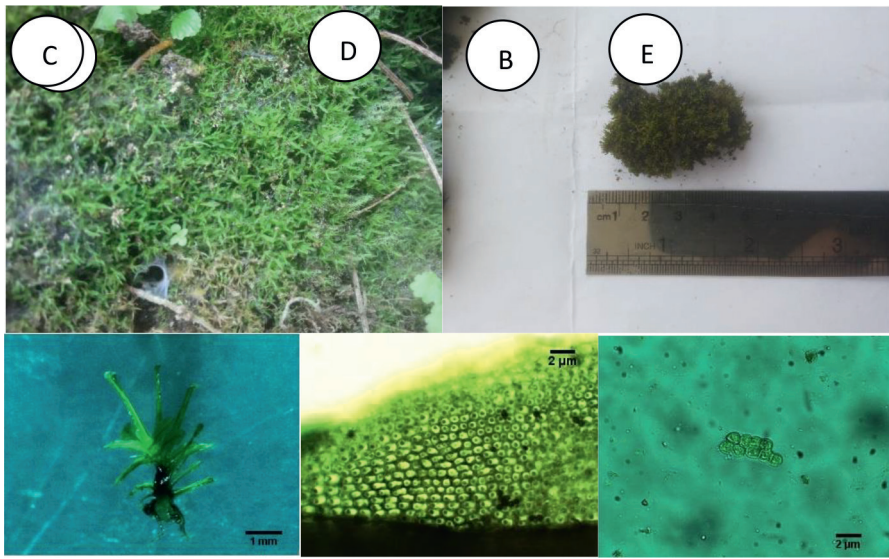


Figure 6.
Calymperes tenerum: A. Tree substrate, B. Colonies, C. Individual mosses, D. Leaf anatomy, E. Spores.

sitting [4]. Observations in the laboratory leaf length reached 0.6 mm, lanceolate shape, flat edge, and pointed tip. This is in accordance with [4] that the genus *Hyophila* has flat leaf edges, grows upright from the base to the tip of the leaf, and according to [16] pointed leaf tips. The mother leaf bone is strong, brownish or reddish, protruding, and grows to the tip of the leaf [14]. The shape of leaf cells when observed is square according to [5] that the upper lamina cells are rectangular, the cell walls are solid, and the cell width reaches 7–9 m. Leaf cell length when measured reached 1.1 m. At the base of the leaf is colorless, small, and the cells are rectangular and thin-walled (**Figure 7**) [5].

H. involuta did not find a sporophyte phase, while according to library sources the size of the seta reached 7 mm to 1.5 cm [11], red to brown at the base, pale at the top, cylindrical capsule shape [5]. Environmental parameters of *H. involuta* from air temperature have a value of 28.1°C, humidity 84%, light intensity 35 lux, and pH 7 which is still in good growth for mosses. Distribution is found in tropical Asia as generally found throughout the Malesia region and the genus *Hyophila* is the only genus scattered in this region and spread in sub-tropics such as Polynesia, northern Australia [5]. Distributions elsewhere include Africa, Asia (China, India, Himalayas, Japan, Malaysia, Philippines, Sri Lanka, Taiwan, Thailand), Europe, Oceania, North and South America [14].

2.8 Environmental parameters

Environmental conditions had a significant influence on mosses. The differences of each species of mosses to environmental factors will affect the level of adaptation, species composition, and distribution of mosses [14]. Mosses that live in the tropics can live at temperatures above 25°C [14] with air humidity above 50% [17]. While good light intensity for moss growth can reach 1000 lux [4] and for good soil pH for moss growth it ranges from 4.9 to 8.3 [18]. Based on this, the environment around the Syamsudin Noor airport area is still in the range of environmental conditions that support the growth of moss considering that the place is an open and urban area where there are many activities that cause changes in environmental conditions, one

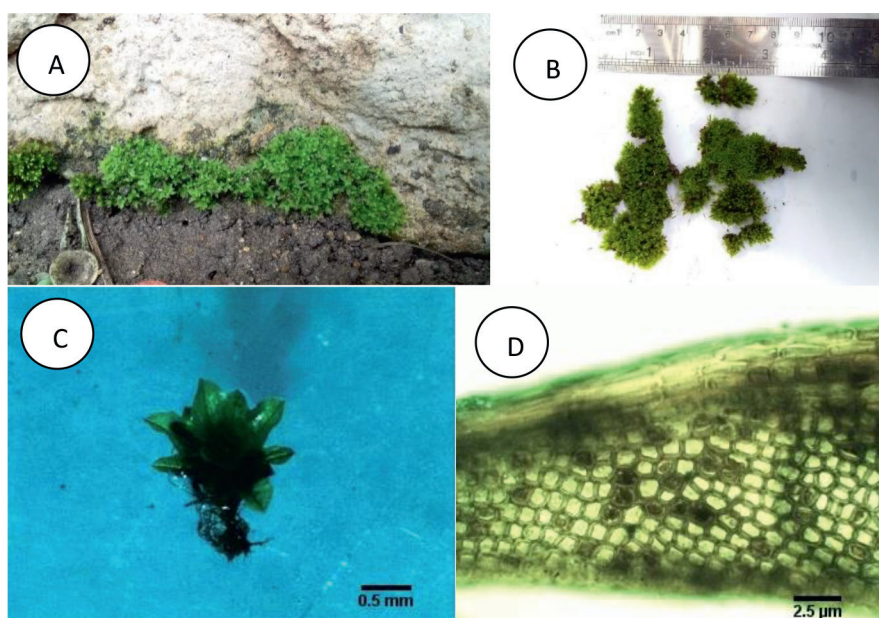


Figure 7.
Hyophila involuta: A. Stone substrate, B. Colonies, C. Individual mosses, D. Leaf anatomy.

of which is pollution. While in open areas direct sunlight penetrates into the ground, this affects the humidity of the area. In addition, the open area has homogeneous vegetation and only has a few trees as windbreaks. It is different when in forest areas which have heterogeneous vegetation with a wide and closed canopy so as to minimize sunlight entering the lower part of the forest [19]. Environmental changes can occur at any time, so this initial data is very important to know environmental changes in the future, given that mosses can be used as an indicator of environmental change.

3. Conclusion

Bryophyta in the vicinity of Syamsudin Noor International Airport, South Kalimantan, Indonesia, found 7 species of moss which are found both in open and closed places and the most dominant species is *Barbula javanica*. Considering that the airport is an open area, the dominant moss growing in this area has a good standard of living, as can be seen from environmental parameters including air temperature, humidity, light intensity, and soil pH. In addition, this study is preliminary data that can be used to determine other types of moss around Syamsudin Noor International Airport.

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