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Identification of Fern Species (Pteridophyta) in The Salak Orchard Area of Cimande Village, Caringin District, Bogor

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Abstract

Background: *Ferns (Pteridophyta) are components of ecosystems and can become important weeds in plantations, including salak orchards. Research on Pteridophyta in salak orchards has not yet been reported; therefore, an inventory of fern species is necessary.* **Methodology:** *The method used was an exploration survey conducted throughout the salak orchards, covering an area of 8,519 m². Each fern species encountered was collected, described, and documented, and the results were subsequently presented using a qualitative descriptive approach. Fern identification was carried out using relevant books, scientific journals, and online resources.* **Findings:** *A total of 18 fern species (Pteridophyta) belonging to 9 families were recorded. Regarding habitat preference, 67% of the fern species were terrestrial, 22% were epiphytic, and 11% were found in both terrestrial and epiphytic habitats. The environmental factors at the study site included soil pH ranging from 6.2–6.8, soil moisture of 70–100%, air temperature of 25–29°C, air humidity of 84–96%, and light intensity of approximately 141–152 lux.* **Contributions:** *Environmental conditions were associated with the diversity of fern species recorded in the salak orchards of Cimande Village, Caringin District, Bogor Regency, West Java. Although often considered weeds, ferns may contribute to maintaining soil moisture, and this study provides baseline information on their diversity and habitat associations in salak orchard agroecosystems.*

Keywords: *Cimande Village; Ferns (Pteridophyta); Salak Orchards; Species; Weed*

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INTRODUCTION

Pteridophyta or ferns, are primitive vascular plants that do not produce flowers or seeds but reproduce by spores (Nurza & Andriyani, 2021; Simbolon et al., 2023; Yatskievych, 2003). It is estimated that approximately 13,600 fern species are found worldwide, distributed across both terrestrial and aquatic environments (Mildawati et al., 2020; Sureshkumar et al., 2020). In Indonesia, there are estimated to be fewer than 1,300 fern species, with approximately 38% occurring on Java Island (Ritonga et al., 2026). Pteridophyta is divided into four classes; Psilotopsida, Equisetopsida, Marattiopsida, and Polypodiopsida (Pradipta et al., 2023). They possess true roots, stems, and leaves (Hidayah et al., 2021; Simbolon et al., 2023). These plants are easily recognized by a distinctive characteristic, their young leaves are coiled or rolled up (Suryana et al., 2020). Their life cycle consists of a free-living gametophyte phase and a sporophyte phase (Boavida & McCormick, 2010; Muhaimin & Damayanto, 2022). They are considered pioneer plants and are highly adaptable to various environmental conditions, with fossil evidence suggesting that they have existed for approximately 230 million years (Ritonga et al., 2026; Sureshkumar et al., 2020; Zainudin & Ramadanil, 2020).

Ferns have various uses, including as medicinal plants, food sources, ornamental plants, construction materials, natural dyes, and ecosystem stabilizers (Hidayah et al., 2021; Muhaimin & Damayanto, 2022). In agriculture, these plants can also be considered important weeds, including in salak plantations (Irawan et al., 2024; Sarjono & Zaman, 2017; Simbolon et al., 2023). Salak is a native Indonesian fruit crop and therefore deserves special attention (Ritonga et al., 2024; Widodo et al., 2019). The presence of weeds in salak plantations can have both beneficial and detrimental effects. Although weeds can interfere with the growth of the main crop, they also play an important role in maintaining the ecological balance of the surrounding plantations ecosystem (Iqbal et al., 2024).

Salak has been known since prehistoric times and has been cultivated in almost all regions of Indonesia (Hakim, 2022), including Cimande Village, Caringin District, Bogor. The salak cultivated in Cimande Village belongs to the Pondoh variety, which is well known for its sweet taste (Pinem, 2018). Pondoh belongs to the species *Salacca zalacca* (Gaertn.) Voss which is native to Java (Uhl & Dransfield, 1987). Salak Pondoh originates from Sleman Regency, Yogyakarta, and has since spread to other regions, including Central Java, West Java, East Java, and Sumatra (Caesari et al., 2021; Djaafar, 1992; Pinem, 2018).

Based on the above description, greater attention should be given to weeds, particularly ferns. Research specifically focusing on pteridophytes in salak orchardss has not yet been conducted, however Nasution (2018) conducted an inventory of weeds in salak plantations in Padangsidimpuan, North Sumatra, and found that ferns were among the dominant weed groups. A similar study was conducted by Iqbal et al., (2024) in oil palm plantation areas at the Institut Teknologi Sawit Indonesia campus, with similar findings, namely that the vegetation was dominated by ferns.

Based on this information, ferns, particularly those found in salak orchards, need to be documented. This study was conducted to identify the species of ferns

(Pteridophyta), determine their pioneer role in agricultural land, and examine the species and management practices of ferns as weeds in salak orchards in Cimande Village, Caringin District, Bogor, West Java. This is particularly important because ferns play a significant role as weeds and as major components of vegetation structure within an ecosystem (Muhaimin & Damayanto, 2022; Sureshkumar et al., 2020; Yatskievych, 2003).

Figure 1. Research location: A. Map of the research location; B. Research plot; and C. Salak orchards (Sources: A–B. Google Earth; C. Personal documentation).

METHOD

Sample or Participant

The study was conducted in July 2025 in a salak orchard in Cimande Village, Caringin District, Bogor Regency, West Java, Indonesia. The salak orchard covers an

area of 8,519 m² and is located at coordinates 06°43′38.2″ S 106°51′10.7″ E, with an elevation of 576 m above sea level. The equipment and materials used in this study included an *Olympus OM System TG-7* camera, writing instruments, a measuring tape, a soil tester, a thermohygrometer, observation sheets, and a field guide for the identification of ferns (Pteridophyta). The study material consisted of fern species (Pteridophyta) found in the salak orchard in Cimande Village.

Procedure

Observations were conducted using an exploration method in the salak orchard in Cimande Village. Each fern species encountered was documented and collected for herbarium purposes, followed by identification based on its morphological characteristics. Environmental factor data were collected once during the observation period at 08:00 AM, 12:00 PM, and 04:00 PM. The data were analyzed using a qualitative descriptive approach.

Plant Identification

Each fern (Pteridophyta) encountered during the study was identified using identification guides, relevant scientific journals, and related websites, such as: https://www.gbif.org/ (GBIF, 2023), Min et al., (2006), https://www.indonesiaplants.org/ (Mustaqim et al., 2021); Nurza & Andriyani (2021), https://powo.science.kew.org/ (POWO, 2025); Ridianingsih et al., (2017) and https://www.worldfloraonline.org/ (WFO, 2025).

RESULT AND DISCUSSION

Based on the results of the study, 18 fern (Pteridophyta) species belonging to 9 families were recorded in the salak orchards in Cimande Village, Caringin District, Bogor. These species were found in two habitat types, namely epiphytic and terrestrial habitats, with some species occurring in both habitats (Table 1).

Table 1. Species of Ferns Found in the Salak Orchard in Cimande Village.

Family	Species	Habitat
Aspleniaceae	*Asplenium nidus* L.	epiphyte
	Asplenium normale D.Don	epiphyte/terrestrial
Davalliaceae	*Davallia denticulata* (Burm.fil.) Mett.	epiphyte
Dennstaedtiaceae	*Microlepia speluncae* (L.) T.Moore	terrestrial
Dryopteridaceae	*Pleocnemia irregularis* (C.Presl) Holttum	terrestrial
Nephrolepidaceae	*Nephrolepis biserrata* (Sw.) Desv.	epiphyte/terrestrial
Polypodiaceae	*Drymoglossum piloselloides* (L.) C.Presl	epiphyte
	Drynaria quercifolia (L.) J.Sm.	epiphyte
Pteridaceae	*Adiantum latifolium* Lam.	terrestrial
	Adiantum philippense L.	terrestrial
	Adiantum raddianum C.Presl	terrestrial

Family	Species	Habitat
	Pityrogramma calomelanos (L.) Link	terrestrial
	Pteris ensiformis Burm.	terrestrial
	Pteris vittata L.	terrestrial
Tectariaceae	*Tectaria melanocaulos* (Blume) Copel.	terrestrial
	Tectaria crenata Cav.	terrestrial
Thelypteridaceae	*Christella dentata* (Forssk.) Brown. & Jermy	terrestrial
	Christella parasitica (L.) H.Lév.	terrestrial

Based on Table 1, 67% of the ferns (Pteridophyta) recorded in the salak orchard in Cimande Village were terrestrial, 22% were epiphytic, and 11% were found in both epiphytic and terrestrial habitats (Figure 2). The study by Iqbal et al., (2024), reported that ferns (Pteridophyta) are among the dominant weeds in plantations, including oil palm, rubber, and salak plantations. This finding is supported by Nasution (2018) who reported that salak plantations in Padangsidimpuan were dominated by weeds consisting of ferns, particularly terrestrial Pteridophyta. The dominance of terrestrial ferns can be attributed to the absence of large trees or suitable substrates for epiphytic ferns. This is consistent with Dewi et al. (2025), who stated that epiphytic ferns require large trees or tall plants as substrates for growth. The epiphytic Pteridophyta found at the research site grew on shade trees, salak trees, and walls surrounding the study area. According to Dubuisson et al., (2009), epiphytic ferns naturally grow in accordance with their habitat.

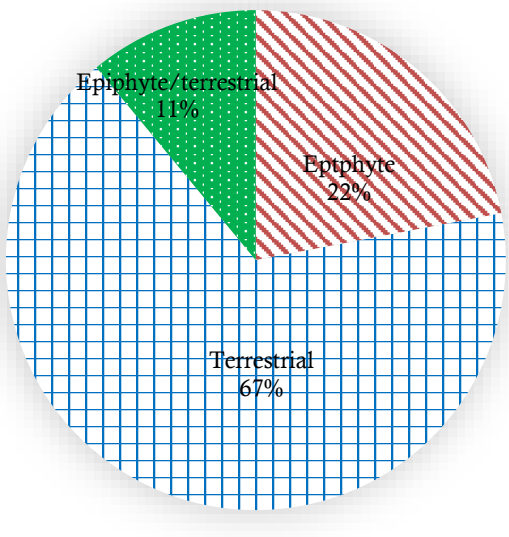

Figure 2. Percentage of Fern (Pteridophyta) Habitats in the Salak Orchard of Cimande Village

Description of Ferns (Pteridophyta)

***Asplenium nidus* L.**

Epiphytic, attached to shade trees in the salak orchard in Cimande Village. The stem forms a rosette, with the leaves arranged in a circular pattern resembling a bird's nest.

Leaves simple, lanceolate, with entire margins and acute apices, 15–38 cm long and 6–14 cm wide. Sori attached along the leaf veins on the abaxial surface, light brown in color. The species is utilized as an ornamental plant and traditionally used to treat fever, promote hair growth, as a contraceptive, and to treat venomous animal bites or stings (Darma & Peneng, 2007; Ridianingsih et al., 2017). Distributed from South Asia to the Pacific Islands (Mustaqim et al., 2021).

***Asplenium normale* D.Don**

Terrestrial, but also found growing epiphytically on the stems of salak plants. Rhizome erect, scaly. Rachis shiny, 2–10 cm long. Lamina very narrow, linear, pinnate, 8–12 cm long and 1–2 cm wide, and thin. Pinnae 15–25 pairs, with unequal bases, acroscopic bases rounded to truncate, short-stalked, apices obtuse, and coarsely serrated margins. The longest pinnae occur in the middle portion of the lamina and gradually decrease in size toward the apex. Sori with dark, fenestrate perispores and occasional projections. Distributed in tropical Africa and Asia (Mustaqim et al., 2021).

***Davallia denticulata* (Burm.fil.) Mett.**

Epiphytic, but sometimes also found growing terrestrially. At the research site, this species was found growing on salak stems, consistent with Darma & Peneng (2007), who reported that this Pteridophyta is commonly found on palm stems. Rhizome clearly visible, thick, and covered with reddish-brown scales. Fronds tripinnate and triangular in shape, 25–55 cm long, with the widest point measuring 12–30 cm. Petioles up to 20 cm long, glabrous, and hairy at the base. Pinnules deeply lobed, glabrous, and serrated, with acute apices. Sori marginal, located on the lobes of the pinnules and separated from one another. Indusia elongated, attached at the base and partly along the sides. Distributed across South Asia, East Asia, and Malesia, including Indonesia (Mustaqim et al., 2021).

***Microlepia speluncae* (L.) T.Moore**

Terrestrial, reaching up to 1.2 m in height. Rhizome creeping, straw-colored, and glabrous. Fronds scattered, stiff, usually densely hairy, short, and grayish-brown. Rachis and rachillae also straw-colored, with scattered fine hairs. Lamina green, becoming yellowish-green when mature, pinnate, ovate-oblong, 40–70 cm long and 20–35 cm wide, papery, densely hairy on both surfaces, with an acute apex. Pinnae 10–15 pairs, alternate, spreading obliquely upward, bipinnate, with the lowest pair slightly smaller. Pinnules 15–20 pairs, ascending, parallel to the rachis, and pinnately divided almost to the rachilla. Veins slightly prominent on the lower surface and pinnately branched. Sori located close to the margins of the lobules; indusia brownish, shallowly saucer- or fan-shaped, and densely hairy. Distributed in the Americas, tropical Africa, South, Central, East, and Southeast Asia, and Oceania (WFO, 2025).

***Pleocnemia irregularis* (C.Presl) Holttum**

Terrestrial. Rhizome short, thick, and scaly, with dark brown scales. Petiole scaly at the base, reaching up to 80 cm long. Lamina bipinnate at the base, oblong-subdeltoid, reaching up to 1 m long; middle pinnae oblong-lanceolate, with acute apices and a

large apical portion that is pinnate. Rachis glabrous. Pinnules sessile, caudate at the apex, green to yellowish-green, with glandular hairs along the margins and on the lower surface. Sori small, occurring on anastomosing veins and irregularly scattered; indusia present. Distributed from Myanmar, Thailand, and Cambodia through the Malesian region to Fiji (WFO, 2025).

***Nephrolepis biserrata* (Sw.) Desv.**
Terrestrial, but sometimes found climbing or growing epiphytically. Stolon and stipe scaly, with lanceolate, reddish-brown scales. Reaching up to 1 m in height. Fronds pinnate, with laminae reaching 60 cm or more in length. Pinnae relatively widely spaced, sometimes with small rounded auricles. Sterile pinnae 3–5 cm long and 0.8–1.2 cm wide, usually glabrous, occasionally bearing ciliate scales. Fertile pinnae 0.2–0.7 cm long and up to 0.4 cm wide, with more deeply serrated margins. Sori located between one-half and two-thirds of the distance from the costa to the margin, with kidney-shaped indusia. Widely distributed throughout tropical regions (Mustaqim et al., 2021).

***Drymoglossum piloselloides* (L.) C.Presl**
Epiphytic. Roots fibrous, dark brown, with a hairy surface. Stem in the form of a creeping, cylindrical rhizome, with a scaly surface bearing dark brown scales. Young stems light green, becoming blackish-brown when mature. Fronds dimorphic. Sterile fronds simple, oblong, with rounded apices, tapered bases, entire margins, and both upper and lower surfaces covered with trichomes; venation reticulate; thick, soft, and green, 1.5–3 cm long and 1–2 cm wide. Fertile fronds simple, lanceolate, with rounded apices, tapered bases, entire margins, and reticulate venation; both surfaces smooth, fleshy, and green, 7–15 cm long and approximately 0.5 cm wide. Sori located along the margins of the fertile fronds, linear and brown, without indusia. Distributed from East Asia and Southeast Asia to the Pacific Islands (Mustaqim et al., 2021).

***Drynaria quercifolia* (L.) J.Sm.**
Epiphytic and sometimes found growing on walls. Rhizome short-creeping, with spreading scales that are dark brown to blackish-brown, linear, narrow, and with elongated apices. Fronds dimorphic. Sterile fronds basal and sessile, 15–40 cm long and 10–23 cm wide, shallowly lobed. Fertile fronds stalked, with stipes reaching up to 20 cm long; lamina pinnate, 30–60 cm long and 18–40 cm wide, with a deciduous apex; broadly pinnate. Sori arranged in two rows between the costa and the margin, rounded or oblong, regular or occasionally irregular. Distributed from India, Sri Lanka, southern China, Indochina, Thailand, Malesia, and Fiji to Australia (WFO, 2025).

***Adiantum latifolium* Lam.**
Terrestrial and very common as a weed in salak orchards. Rhizome creeping, with dark brown, linear to lanceolate scales. Petiole dark brown to black. Lamina bipinnate, 20–35 cm long, delta-shaped to oblong; pinnules 1.5–4 cm long and 0.5–3 cm wide, trapezoidal, sometimes falcate, with truncate acroscopic bases, rounded to acute

apices, and glabrous surfaces. Sori marginal, occurring along the acroscopic margins, with each sorus covered by an indusium. Indusia oblong to linear. Distributed in Central and South America, as well as Sri Lanka, India, Thailand, the Malay Peninsula, Singapore, and Indonesia (Muhaimin, 2017).

***Adiantum philippense* L.**
Terrestrial, reaching up to 40 cm in height. Rhizome erect, short, with dark brown, lanceolate scales. Fronds clustered; stipe shiny, 6–25 cm long, terete, with the base covered by scales similar to those on the rhizome. Rachis with the apex usually elongated into a whip-like stolon that roots and produces new plantlets. Pinnae 6–12 pairs, alternate and spreading obliquely. Stalks jointed and persistent after the pinnae have fallen. Lamina simply pinnate, up to 25 cm long and approximately 5 cm wide, green to greenish-brown; both surfaces glabrous, upper margin rounded, apex obtuse or recurved downward. Sterile pinnae stalked, asymmetrical on both sides, while fertile pinnae are subentire. Sori 2–6 per pinna; pseudo-indusia dark brown to greenish-brown, linear-oblong, membranous, with an upper margin that is entire and straight or slightly concave, and persistent. Perispores finely granular. Distributed from Africa, parts of West Asia, South Asia, East Asia, and Southeast Asia to Australia (POWO, 2025).

***Adiantum raddianum* C.Presl**
Terrestrial or occasionally growing on rocks. Rhizome flat, with lanceolate-linear scales. Petiole glabrous. Lamina oblong-deltate to oblong-lanceolate, pinnate, and glabrous; rachis glabrous and somewhat flexible, with 6–10 pairs of pinnae. Ultimate segments obovate to rhomboid, with variably lobed distal margins and broadly cuneate to rounded bases. Indusia kidney-shaped to reniform, located along the distal margins of the fronds. Native to Central and Latin America and distributed to Europe, Africa, and Asia, including Indonesia (POWO, 2025).

***Pityrogramma calomelanos* (L.) Link**
Terrestrial, growing in open areas. Roots fibrous and black. Stem dark brown to black, becoming greenish-brown toward the apex. Reaching up to 60 cm in height. Leaves pinnately compound and evenly pinnate, alternate, light green, 4–5 cm long and 0.5–0.7 cm wide, with acute apices and serrated margins. The lower surface of the leaves is covered with a white, powdery substance. Sori located at the leaf apices, elongated and dark brown to blackish-brown. Believed to be native to tropical America and distributed throughout tropical Asia (Ridianingsih et al., 2017).

***Pteris ensiformis* Burm.**
Terrestrial, reaching up to 50 cm in height. Rhizome erect, sometimes creeping, with blackish-brown scales at the apex. Fronds densely clustered and dimorphic; sterile fronds shorter than fertile fronds. Stipe and rachis straw-colored and slightly glossy. Lamina oblong-lanceolate, 10–25 cm long and 1–3 cm wide, pinnate to bipinnate; pinnae 2–6 pairs, opposite. Pinnules opposite, adjacent, shortly stalked, oblong-lanceolate, with divided and entire bases and obtuse apices. Sori located on the lower

surface of the fronds, brown in color. Distributed throughout subtropical and tropical Asia to the Pacific (POWO, 2025).

***Pteris vittata* L.**
Terrestrial, but sometimes growing on rocks, walls, and even roofs. Roots fibrous. Plants reaching up to 20 cm in height, with cylindrical, elongated, jointed stems; stem surface smooth and greenish-brown. Leaves pinnately compound and evenly pinnate. Pinnae elongated, 3–5 cm long and 0.5–0.7 cm wide, with acute apices and entire margins. Leaves green with a rough surface. Sori located on the lower surface of the leaves, brown in color. Distributed worldwide, except in deserts and areas permanently covered by snow (GBIF, 2023).

***Tectaria crenata* Cav.**
Terrestrial. Rhizome short, erect, with the apex covered by scales; scales linear-subtriangular, dark brown, and rigid. Petiole 30–50 cm long, stramineous, densely scaly at the base and becoming glabrous toward the upper portion. Lamina pinnate, broadly oblong, 30–60 cm long and 20–45 cm wide. Rachis scaly and winged in the upper portion. Sori terminal on free minor veins, arranged in two rows between adjacent main veins; indusia naked and persistent. Distributed from Malesia to the Pacific Islands (Mustaqim et al., 2021).

***Tectaria melanocaulos* (Blume) Copel.**
Terrestrial. Rhizome short, densely fronded, and scaly at the apex; scales rigid, purplish-brown with paler margins. Petiole up to 40 cm long, dark purple to black. Lamina up to 50 cm long and wide, bipinnate, with a abruptly tapered base; lobes oblique, oblong-subtriangular, acute at the apex, and undulate along the margins. Sori located at the tips of short free veins, rounded and small, irregularly scattered over the entire lower surface, with small indusia. Distributed from the Andaman Islands, Thailand, and Malesia to the Pacific Islands (Mustaqim et al., 2021).

***Christella dentata* (Forssk.) Brownsey & Jermy**
Terrestrial, with fibrous, dichotomously branched roots. Stem growing above the ground, unbranched, and covered with brown scales; succulent when young and becoming woody with maturity. Reaching up to 60 cm in height. Leaves compound and monomorphic, with obtuse bases, tapering apices, serrated margins, and pinnate venation; green to dull yellowish-green in color. Spores located on the lower surface of the leaves. Used in traditional medicine and reported to have antimicrobial properties (Ridianingsih et al., 2017). Widely distributed from Europe to tropical regions (Mustaqim et al., 2021).

***Christella parasitica* (L.) H.Lév.**
Terrestrial, 25–80 cm tall. Roots stiff and brown; rhizome creeping, with a brown, scaly surface. Stipe cylindrical, 5–10 cm long, hairy, and green. Leaves compound and monomorphic, with obtuse bases, tapering apices, serrated margins, pinnate venation, and hairy surfaces; green in color. Sori without indusia, rounded, arranged along the

margins of the pinnules, and brown in color. Distributed throughout tropical regions (Mustaqim et al., 2021).

Figure 3. Ferns (Pteridophyta) in the Salak Orchard of Cimande Village: A. *Asplenium nidus* L.; B. *Asplenium normale* D.Don; C. *Davallia denticulata* (Burm.fil.) Mett.; D. *Microlepia speluncae* (L.) T.Moore; E. *Pleocnemia irregularis* (C.Presl) Holttum; F. *Nephrolepis biserrata* (Sw.) Desv.; G. *Drymoglossum piloselloides* (L.) C.Presl; H. *Drynaria quercifolia* (L.) J.Sm.; I. *Adiantum latifolium* Lam.; J. *Adiantum philippense* L.; K. *Adiantum raddianum* C.Presl; L. *Pityrogramma calomelanos* (L.) Link; M. *Pteris ensiformis* Burm.; N. *Pteris vittata* L.; O. *Tectaria crenata* Cav.; P. *Tectaria melanocaulos* (Blume) Copel.; Q. *Christella dentata* (Forssk.) Brownsey & Jermy & R. *Christella parasitica* (L.) H.Lév.

Environmental Factors

Dotaniya et al., (2018) explained that environmental factors are important considerations in research because of the close relationship between research results and natural environmental conditions. In this study, the environmental factors measured included air temperature, air humidity, soil pH, soil moisture, and light intensity. The results of the environmental factor measurements are presented in Table 2.

Table 2. Average Environmental Factors in the Salak Orchard of Cimande Village.

Air Temperature	Air Humidity	Soil pH	Soil Moisture	Light Intensity
25-29°C	84-96%	6.2-6.8	70-100%	141-152 lux

According to Irawan et al., (2024), ferns (Pteridophyta) are capable of growing in soils with a pH ranging from 5 to 8. In the present study, soil pH in the salak orchard in Cimande Village ranged from 6.2 to 6.8. This condition is highly

favorable for the growth of ferns, particularly terrestrial species. This indicates that the study site provides suitable habitat conditions for Pteridophyta, although fern growth is also influenced by other environmental factors. The light intensity ranged from approximately 141 to 152 lux, which was relatively similar to the findings of previous studies. In the salak orchard, soil moisture, air temperature, and air humidity ranged from 70–100%, 25–29°C, and 84–96%, respectively. Based on the statement by Katili (2013), soil moisture in fern habitats generally ranges from 60–80%, while the study site had higher soil moisture, which may be attributed to the high rainfall in the area. The air temperature remained within a similar range, namely 25–30°C. However, air humidity was slightly different, ranging from 60–80%. This difference may be attributed to variations in elevation between the study locations.

Only two fern species were reported by Iqbal et al., (2024) in the oil palm plantation area of the ITSI Medan campus. In contrast, 32 fern species were recorded in the Nirmala Tea Plantation, Citalahab, Sukabumi (Irawan et al., 2024). Based on the two statements above, environmental conditions have a significant influence on fern growth. The oil palm plantation at the ITSI Medan campus is located in a lowland area with relatively high temperatures and low humidity, whereas the Nirmala Tea Plantation in Citalahab, Sukabumi, is located at an elevation of 1,075 m above sea level and therefore has relatively lower temperatures and higher humidity. These conditions provide a favorable habitat for the growth of Pteridophyta. In contrast, the salak orchard in Cimande Village is located at a moderate elevation of 576 m above sea level. This condition differs considerably from the two studies described above, and the number of fern species recorded was also relatively moderate, with only 18 species identified.

Roles and Management of Ferns

Ferns (Pteridophyta) are considered pioneer plants that are capable of growing in open areas with low nutrient availability and have a cosmopolitan distribution (Ritonga et al., 2026). This is because Pteridophyta reproduce through spores that can be easily dispersed by wind over long distances. The spores can survive under extreme conditions, both dry and wet, for relatively long periods, allowing ferns to establish colonies in particular areas following environmental disturbances (Thomas & Cleal, 2021). In addition to being pioneer plants, ferns also play important ecological roles as components of ecosystems, including plantation ecosystems. Pteridophytes also serve as environmental bioindicators and contribute to nutrient cycling and the maintenance of microclimatic stability within an area (Banapon et al., 2026).

The high adaptability of ferns to various environmental conditions enables these plants to colonize and dominate certain ecosystems, leading to their classification as weeds. Weeds are generally regarded as undesirable plants in agricultural areas due to their highly aggressive reproductive capacity (Sahrawat et al., 2020). These plants compete with the main crops for nutrients and obstruct the availability of sunlight (Babu et al., 2024). Nevertheless, weeds can still provide benefits as food sources, herbal medicines, ornamental plants, and natural pest-control agents. Therefore, the management of fern weeds in ecosystems such as plantations should be carried out wisely and appropriately. In the salak orchard in Cimande Village, the presence of

ferns is managed carefully to prevent them from becoming dominant. Pteridophytes that interfere with salak plants are removed, whether they grow directly on the plants or in their immediate surroundings, whereas ferns growing farther away are allowed to remain to help maintain soil moisture in the plantation and to provide fodder for livestock. Nurjanah et al., (2019) further stated that fern management in plantation environments can influence species composition due to differences in crop management practices, including water management and fertilization. Differences in the morphology and characteristics of the constituent vegetation can also alter the microclimate, resulting in different responses among weed species.

CONCLUSION

A total of 18 fern (Pteridophyta) species belonging to 9 families were recorded in the salak orchard in Cimande Village, Caringin District, Bogor Regency, West Java. Regarding habitat distribution, 67% of the ferns were terrestrial, 22% were epiphytic, and 11% occurred in both habitats. The high proportion of terrestrial ferns was attributed to the limited availability of shade trees or suitable substrates, which made it difficult for epiphytic species to establish in the salak orchard in Cimande Village. The environmental conditions at the research site included soil pH ranging from 6.2 to 6.8, soil moisture of 70–100%, air temperature of 25–29°C, air humidity of 84–96%, and light intensity of approximately 141–152 lux. These environmental conditions provide a favorable setting for fern growth and may influence the number of fern species found at the research site. Pteridophytes also have important ecological functions in the salak orchard area, including maintaining soil moisture, serving as a food source, providing medicinal plants, and supplying edible plant resources around the salak orchard in Cimande Village, Caringin, Bogor.

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