

Research Article



Isolation and Identification of Diseases Affecting Dragon Fruit (*Hylocereus* sp.) in Banyuwangi and Bogor, Indonesia

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ABSTRACT

Dragon fruit (*Hylocereus* sp.) or pitahaya is a high-value horticultural commodity driven by strong domestic demand. However, national production remains insufficient, leading to continued reliance on imports. One of the main obstacles in dragon fruit cultivation is the emergence of diseases. Currently, information regarding dragon fruit diseases in Indonesia is still limited. This study aims to identify diseases affecting dragon fruit, characterize their symptoms, determine the causative pathogens, and calculate disease incidence. Sampling and disease incidence calculation were conducted in Bogor and Banyuwangi, followed by isolation and identification in the laboratory. Fungal diseases found in dragon fruit plants include anthracnose (*Colletotrichum* sp.), leaf blight (*Fusarium* sp.), dragon fruit stem canker (*Neoscytalidium dimidiatum*), rust disease (*Cephaleuros* sp.), and white stem disease. The bacterial disease found in dragon fruit plants is rot, which is believed to be caused by *Staphylococcus* sp. Symptoms of yellowish systemic spots are considered to be caused by a virus (*Cactus Virus X*). Nematodes identified on dragon fruit roots include *Helicotylenchus* sp., *Heterodera* sp., and *Rhabditis* sp. however, no typical symptoms usually associated with nematode attacks were observed on the host plants. Stem canker is the most prevalent disease, with an incidence ranging from 58.7% to 100%.



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1. Introduction

Hylocereus sp. or dragon fruit, originates from Mexico, Central America, and South America (Alfarabi and Yuniarti 2019). Asia, particularly China, Taiwan, Thailand, Malaysia, and Indonesia, is where this plant was subsequently cultivated. One popular type of cactus is dragon fruit, which is favored by many people for its attractive color, sweet taste, and various health benefits (Muas *et al.* 2020). In Indonesia, dragon fruit is a seasonal fruit that only blooms from October to March. The period when dragon fruit is not in bloom is called the

off-season, and it is during this time that dragon fruit is sold at two to three times the price (Setyawati 2019). In 2023, Indonesia produced 3,174 tons of dragon fruit, but only 2,900 tons in 2024 (BPS 2024). Plant diseases and pests are two challenges facing the Indonesian dragon fruit industry.

Pathogens have the ability to infect all parts of the dragon fruit plant. In the Philippines, dragon fruit has been reported to be infected by 17 genera and 25 species of pathogens (Balendres and Bengoa 2019). Dragon fruit diseases have also been reported to reduce production in several countries such as Malaysia, Vietnam, Taiwan, China, and Brazil (Ezra *et al.* 2013). Some of the reported diseases are anthracnose (*Colletotrichum gloeosporioides*), stem lesions (*Curvularia lunata*), soft

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rot (*Enterobacter cloacae*), postharvest rot (*Alternaria alternata*), Cactus Virus X, stem canker (*Neoscytalidium dimidiatum*), rot (*Fusarium fujikuroi*), and nematodes (*Tylenchorhynchus agri*) (Balendres and Bengoa 2019). In Indonesia, according to Wibowo *et al.* (2011), some diseases affecting dragon fruit crops are brown rot (*Fusarium* sp), anthracnose (*Colletotrichum* sp), scab (*Pestalotiopsis* sp), stem rot (*Erwinia* sp), root knot (*Meloidogyne* sp), and stem canker (*N. dimidiatum*). Identifying the causes of diseases and information about their symptoms is crucial for facilitating diagnosis and disease control. The purpose of this study is to identify diseases in dragon fruit and measure the incidence of dragon fruit diseases in Banyuwangi and Bogor.

2. Materials and Methods

2.1. Measuring Disease Incidence in the Field

Disease incidence was measured in Banyuwangi (Siliragung, Purwoharjo, and Tegaldlimo) and Bogor (Warso Garden and Sukamantri Garden IPB) in February 2024. A total of 100 plants per plot were observed to calculate the incidence of all diseases in dragon fruit. The experimental area covered approximately 800 m² and was divided into five plots. The study was conducted using two types of dragon fruit plants, namely red dragon fruit and white dragon fruit, which are the dominant varieties cultivated in the study location.

2.2. Collection of Diseased Plant and Nematode Samples

Sampling of diseased plants was conducted in Bogor and Banyuwangi in February 2024. Plant samples were collected using a purposive sampling method, targeting plant parts exhibiting characteristic disease symptoms. Nematode samples were obtained from five diagonal points within each sampling area and subsequently composited for analysis. The soil from the roots of dragon fruit plants was extracted using the method described by Caveness *et al.* (1955), and the roots were extracted using the method described by Hooper *et al.* (2005).

2.3. Isolation and Identification of Disease-Causing Pathogens in Dragon Fruit

Pathogens suspected to be part of the fungal group were isolated using Potato Dextrose Agar (PDA) medium by incubating surface-sterilized infected tissue. Symptomatic stems and fruits were cut into small pieces

(1.5 × 1.5 cm), soaked in 70% ethanol for 1 minute, and rinsed with sterile distilled water for 1 minute. After air-drying, each tissue piece was placed onto PDA medium and incubated. Fungal growth from the samples was then observed, and the fungi that emerged were subcultured onto fresh PDA to obtain pure isolates (Elfina *et al.* 2014).

Bacterial pathogens were isolated from dragon fruit stems. A stem sample weighing 1 g was surface-sterilized using alcohol, ground with a mortar, and transferred into a test tube for serial dilution. The diluted suspensions were then spread onto nutrient agar (NA) medium (Permata & Purnawati 2024). A hypersensitivity test was subsequently performed using tobacco (*Nicotiana tabacum*) to assess pathogenicity. Bacterial identification was conducted based on colony morphology and Gram reaction using the 3% KOH test (Hardiansyah *et al.* 2020).

2.4. Inoculation of Fungi and Bacteria on Dragon Fruit Plants and Viruses on Indicator Plants

The morphologically characterized fungal isolate was taken from its hyphae and placed on dragon fruit cladodes (detached cladodes) without any wounding. Previously, the dragon fruit stems were disinfected with 70% ethanol first to reduce contamination. The species used were red dragon fruit, white dragon fruit, and yellow dragon fruit. The canker-causing isolate obtained from red dragon fruit was inoculated into both red and yellow dragon fruit species, whereas the isolate from white dragon fruit was inoculated exclusively into white dragon fruit species. The test plants were incubated in a moist box until they showed symptoms (Riska *et al.* 2023).

For bacterial inoculation, a suspension was prepared using nutrient broth (NB) medium and injected into dragon fruit stems (cladodes) at a volume of 1 ml per stem. Symptoms were observed for 14 days post-inoculation (dpi) (Asadi *et al.* 2024).

For virus detection, *Chenopodium amaranticolor* were inoculated with sap extracted from symptomatic plants collected in the field. The sap was prepared by grinding symptomatic stem pieces in 0.02 M potassium phosphate buffer (pH 7.1). Inoculation was carried out using 600-mesh carborundum as an abrasive. Symptoms development on *Chenopodium* plants was monitored for 25 dpi (Kim *et al.* 2016).

2.5. Re-isolation of Fungi on Dragon Fruit

The pathogen causing symptoms on inoculated plant cuttings is suspected to be the disease-causing pathogen. From these symptoms, re-isolation was performed on PDA medium for fungi and NA medium for bacteria.

2.6. Molecular Identification of Fungi, Bacteria, and Viruses

Genomic DNA was extracted from the isolates using standard procedures (Abd-Elsalam *et al.* 2003). PCR amplification was then performed using universal primers specific for each organism group: ITS1 and ITS4 for fungi, 63f and 1387r for bacteria and Potexvirus primers (Potex 1RC and Potex 5) for viruses.

3. Results

3.1. Symptoms and Causes of Dragon Fruit Diseases

Dragon fruit rust is characterized by the emergence of small yellow to brownish-orange spots on the stem surface, which later develop into irregular, rust-like lesions with a texture. This disease typically affects stem located near the soil surface, although it can also spread to stem on the branches. Red rust disease in dragon fruit is associated with alga infection caused by *Cephaleuros* sp. (Figure 1)

Stem white disease presents as the formation of a white layer on the surface of the dragon fruit stem. Over

time, this white layer peels off, leaving the stem surface brown, and eventually exposing only the woody tissue underneath (Figure 2).

Anthraxnose disease is characterized by round, blackish-brown spots with black dots in the center and a yellow halo around the edges. The infected area usually appears dried out. When observed under a microscope the black dots are identified as fungal acervuli. When isolating the causative pathogen, hyphae began to grow 3 days after incubation, with the isolate characterized by a blackish color. After isolation, the pathogen's morphological characteristics were observed macroscopically (colonies) and microscopically under a microscope. Fungal colonies grown on PDA medium appeared dark gray on both the upper and lower surfaces and had aerial hyphae. Microscopically, the hyphae were septate and hyaline. The conidia were oval-shaped, hyaline, and measured $17.6 \times 4.2 \mu\text{m}$. During the isolation and identification process, pathogens causing anthracnose are often found to infect simultaneously with pathogens causing dragon fruit stem canker. Inoculated dragon fruit stems showed symptoms at 10 days post-inoculation and the symptoms that appeared were the same as those of the disease in the field (Figure 3).

Brown rot disease is characterized by initial symptoms of stem tissue discoloration to brown, particularly at the base of the stem near the soil surface, which later develops into dry rot. Fungal isolates associated with this disease



Figure 1. Red rust disease. (A) Symptoms of red rust, (B) Microscopic red rust

were obtained and observed. Hyphal growth was visible on PDA medium after four days, from which pure cultures were derived. The colony appeared purplish-white on both the upper and lower surfaces. Microscopically, the hyphae were septate and hyaline, and the conidia were crescent-shaped, hyaline, and measured approximately $18.6 \times 3.2 \mu\text{m}$. Based on morphological characteristics, the isolate is suspected to be *Fusarium* sp. The isolate was inoculated into healthy dragon fruit stems. At 13 days post-inoculation, the inoculated stems exhibited

symptoms similar to those observed in the field, namely dry rot with a brownish discoloration (Figure 4).

Stem canker disease initially presents as small, yellowish-white spots, with center resembling needle pricks, over time, these spots enlarge eventually forming sunken brown necrotic lesions. In severe cases, yellowish pycnidia develop, often containing black specks at their centers. The dragon fruit stem canker-causing isolate has the characteristic of aerial hyphal growth. On the first and second days after isolation, the mycelia were white. It will



Figure 2. Symptoms of white stem disease on dragon fruit stem

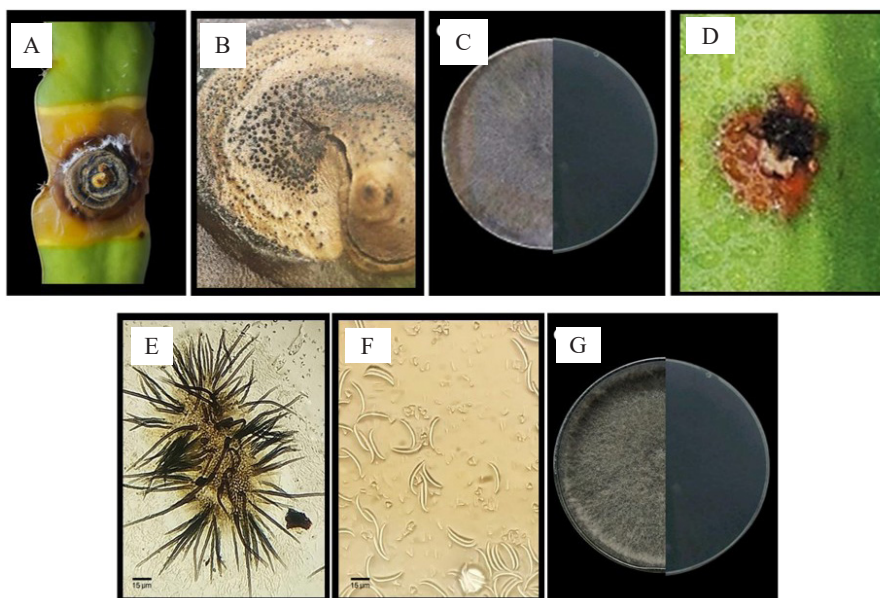


Figure 3. Anthracnose disease. (A) Symptoms on the stem, (B) Acervuli, (C) Isolates on the upper and lower surfaces in PDA medium, (D) Inoculation on the stem, (E) Acervuli, (F) Conidia of the pathogen, (G) Isolate from reisolation on PDA medium

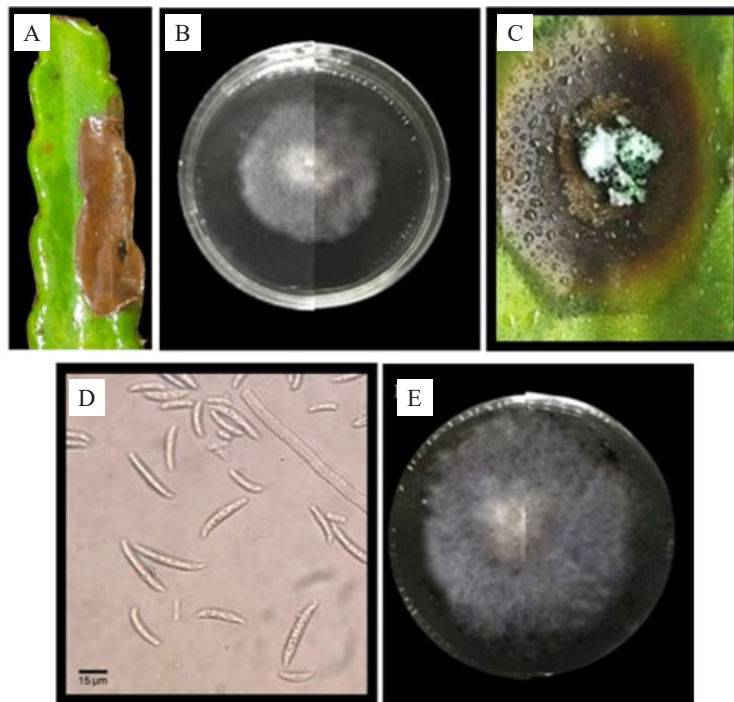


Figure 4. Brown rot disease. (A) Symptoms on the stem, (B) Isolates on the upper and lower surfaces in PDA medium, (C) Koch's postulates on the stem, (D) Conidia of the pathogen, (E) Isolate from reisolation on PDA medium

then turn blackish-gray on the upper surface and black on the lower surface. Microscopic observation reveals septate hyphae and conidia of various shapes, including chains, ovals, and rod-like structures. The arthroconidia are chain-like (elliptical), brownish in color, and measure approximately $51.54 \mu\text{m} \times 5.20 \mu\text{m}$. The conidia are cylindrical, hyaline, aseptate, and measure around $13.11 \mu\text{m} \times 3.14 \mu\text{m}$. Based on morphological characteristics, the isolate was identified as *Neoscytalidium dimidiatum*. On white dragon fruit stems, symptoms caused by isolates from white dragon fruit began to appear at 28 dpi. In contrast, inoculation using isolates from red dragon fruit showed symptoms on red and yellow dragon fruit stems at 31 and 32 dpi, respectively. The initial symptom observed was greenish spotting resembling needle pricks, which gradually developed into brownish patches around the inoculation site (Figure 5).

This canker disease can also infect the fruit. The symptoms that appear are almost the same as those on the stem. The initial symptoms are small, yellowish-white spots with a needle-like puncture in the center of the spot. Over time, the spots will merge and enlarge to form brownish patches. After isolation, this canker disease isolate initially appeared white, then turned black. The disease isolate was inoculated into healthy dragon fruit,

and symptoms appeared after 4 dpi, including brown spots and hyphal growth around the inoculation point. (Figure 6).

The SPI2 (white dragon fruit) and SMI1 (red dragon fruit) isolates were molecularly identified using ITS 1 and ITS 4 primers. Visualization of the amplified 18S rRNA gene fragments by 1% agarose gel electrophoresis showed clear DNA bands at approximately ~ 600 bp. BLASTN analysis of the SPI2 and SMI1 sequences, aligned with the 18S rRNA gene sequences from GenBank, showed similarity to *Neoscytalidium dimidiatum* isolate PckPUfr294 from Taiwan with accession number OP223284.1 with 100% query cover. Isolate SPI2 showed 97.88% sequence similarity, while isolate SMI1 showed 99.42% similarity (Figure 7) (Table 1).

Bacterial infection in dragon fruit is characterized by symptoms of wet rot, yellowing of the stem, and the presence of slime exudation. Following a hypersensitive reaction (HR) test, four bacterial isolates tested positive. All four isolates were Gram-positive and were further evaluated using Koch's postulates on dragon fruit stems. Among the tested isolate, isolate 6 produced visible symptoms, showing brownish rot. Gram staining and the 3% KOH tests confirmed that the bacterium is Gram-positive and has a coccus (spherical) morphology. Isolates

6, 8, and 10 shared similar morphological characteristics, producing white colonies, whereas isolate 12 formed yellowish colonies (Figure 8).

After molecular identification, all four isolates showed a DNA band size of 1300 bp. The four isolates showed similarity to *Staphylococcus warneri* strain SP1 from Iran with accession number KP662717.1. Isolate 6, which was aligned with the 16S rRNA gene sequence in GenBank using the BLASTIN program, had a query cover value of 88% with a similarity of 93.97%. Isolate 8 had a query cover value of 86% with a similarity of 95.26%. Isolate 10 had a query cover value of 89% with a similarity of 92.76%, and isolate 12 had a query cover value of 94% with a similarity percentage of 86.57%, as also shown in the phylogenetic tree (Figure 9) (Table 2-5).

Viral infection in dragon fruit is by systemic yellow mottling on the stems observed under field conditions.

Following virus extraction, sap from the infected plants was inoculated into indicator plants. At 21 days post-inoculation (dpi), symptoms in the indicator plants appeared as systemic green spots (Figure 10).

Molecular identification of the virus was carried out using Potexvirus primers. Visualization of Isolate Po, on a 1% agarose gel revealed a DNA band of approximately 735 bp. Based on BLASTN analysis, isolate Po showed similarity to Cactus Virus X from Taiwan with accession number NC_002815.2, with a query cover of 97% and a similarity of 95.45%. In the phylogenetic tree, isolate Po was closely related to isolate CVX in Taiwan. (Figure 11) (Table 6).

Nematodes found in dragon fruit plantations include *Helicotylenchus* sp., *Heterodera* sp., and *Rhabditis* sp. In Banyuwangi, *Helicotylenchus* sp., and *Heterodera* sp. were detected in roots tissues, while *Rhabditis* sp. was

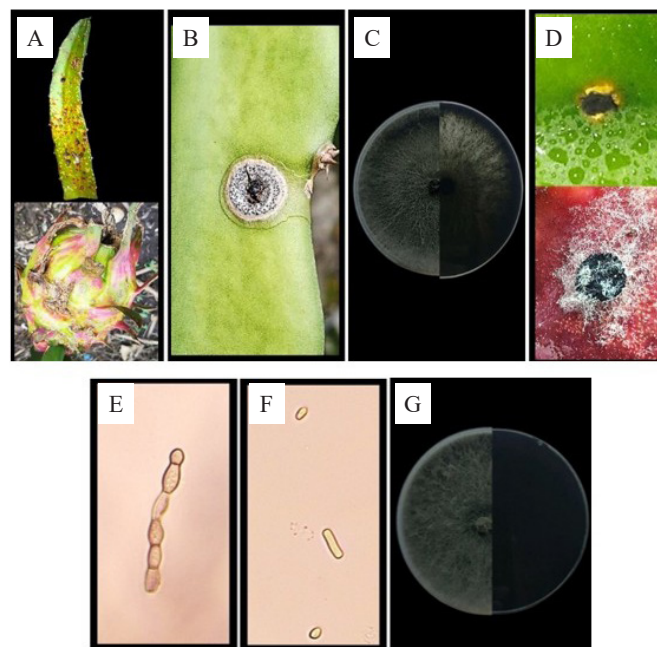


Figure 5. Stem canker disease. (A) Symptoms on stem, (B) Pycnidia, (C) Isolates on the upper and lower surfaces in PDA medium, (D) Inoculation on stem, (E) phragmospores (arthroconidia), (F) conidia (pycnidiospores), (G) Isolate from reisolation on PDA medium

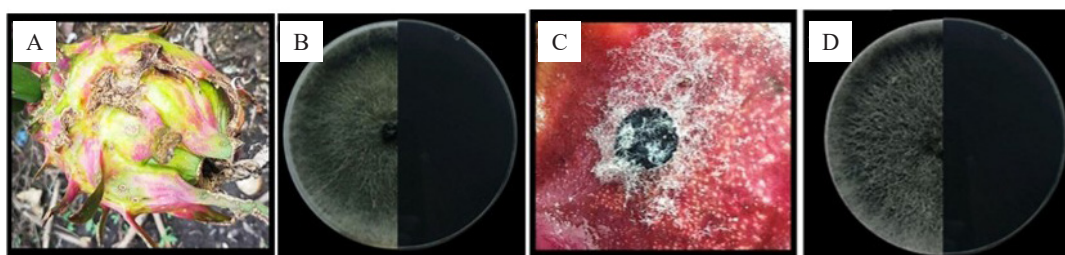


Figure 6. Canker disease in dragon fruit. (A) symptoms of canker disease in fruit, (B) canker disease isolate, (C) Koch's postulates in dragon fruit, (D) reisolation of isolate

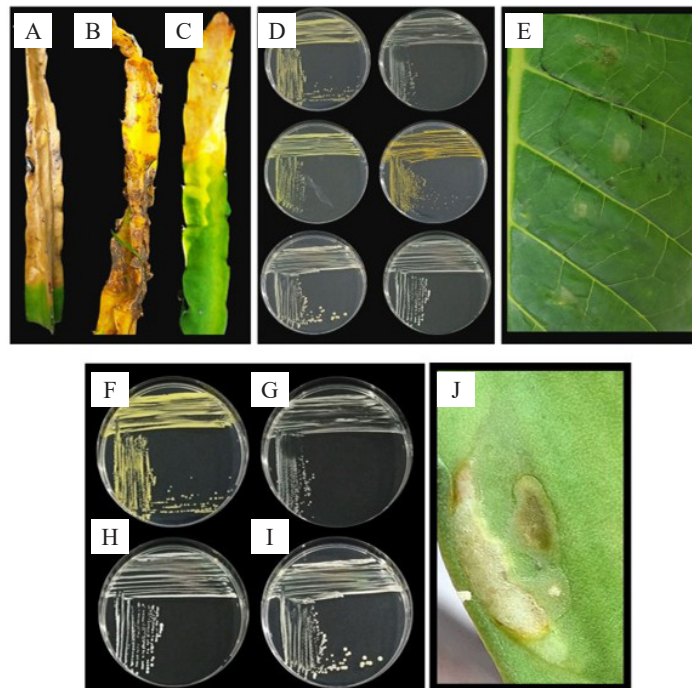


Figure 8. Disease caused by bacteria. (A) symptoms of bacterial disease in Warso Farm, (B) symptoms of bacterial disease in Sukamantri Farm, (C) symptoms of bacterial disease in Banyuwangi, (D) first isolation isolate, (E) HR test in tobacco, (F) isolate 12, (G) isolate 10, (H) isolate 8, (I) isolate 6, (J) pathogenicity test on dragon fruit of isolate 6

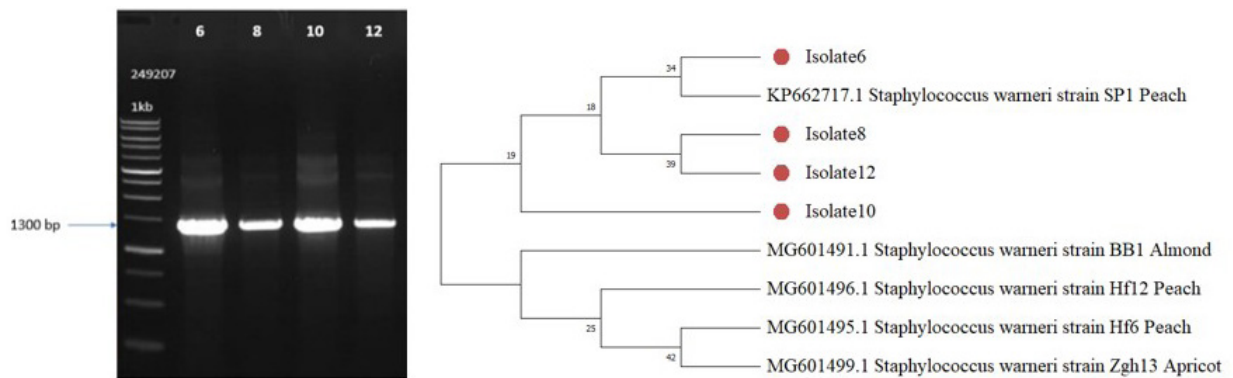


Figure 9. Visualization of genes and phylogenetic trees of 6,8,10 and 12 isolates

Table 2. Results of homology analysis of the nucleotide sequence of the 18s rRNA gene isolate 6 in Genbank

Isolat code	Species homolog (Gnebank)	Query cover (%)	Per. iden (%)	Country of origin	Plant	Accession number
6	<i>S. warneri strain</i> Hf6	68	93.08	Iran	Peach	MG601495.1
	<i>S. warneri strain</i> Hf12	68	93.08	Iran	Peach	MG601496.1
	<i>S. warneri strain</i> SP1	88	93.97	Iran	Peach	KP662717.1
	<i>S. warneri strain</i> BB1	68	93.21	Iran	Almond	MG601491.1
	<i>S. warneri strain</i> Zgh13	51	91.53	Iran	Apricot	MG601499.1

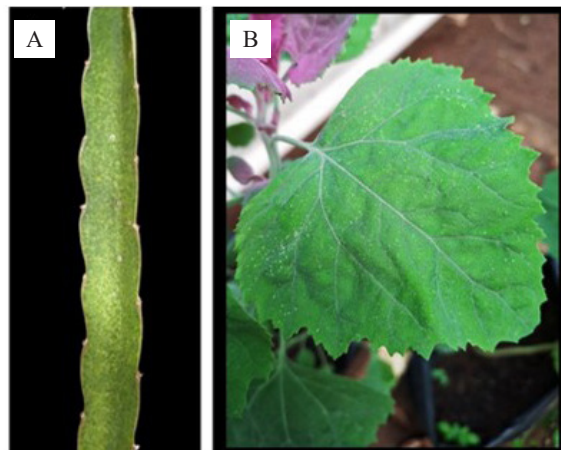


Figure 10. Virus diseases. (A) symptoms of *Cactus Virus X* on dragon fruit at Sukamantri Farm, (B) inoculation on indicator plants

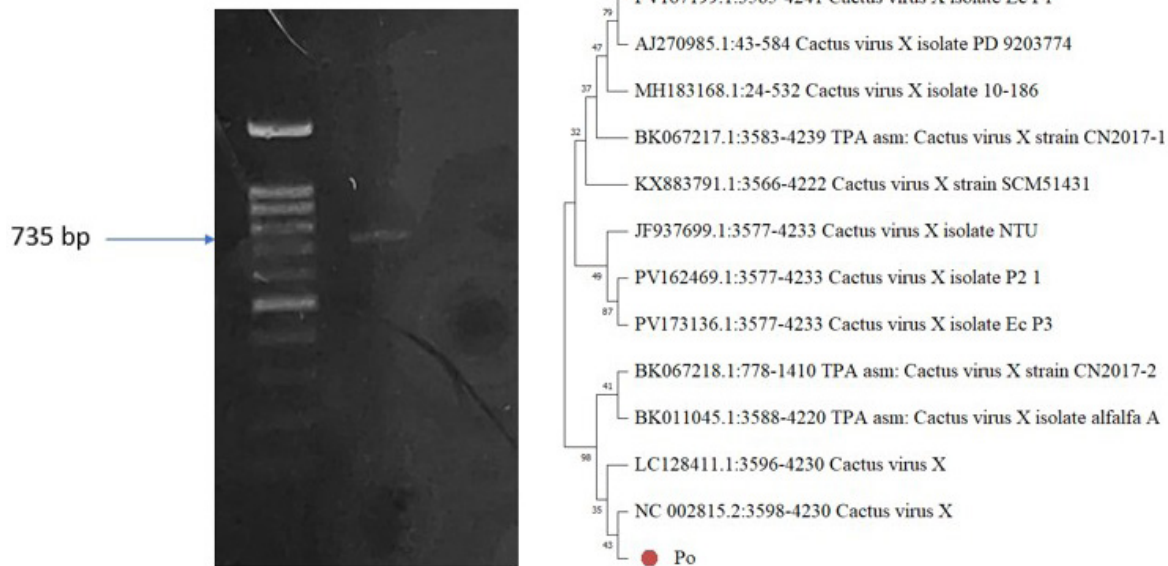


Figure 11. Visualization of genes and phylogenetic trees of Po isolates

Table 3. Results of homology analysis of the nucleotide sequence of the 18s rRNA gene isolate 8 in Genbank

Isolat code	Species homolog (Gnebank)	Query cover (%)	Per. iden (%)	Country of origin	Plant	Accession number
8	<i>S. warneri strain</i> Hf6	81	95.31	Iran	Peach	MG601495.1
	<i>S. warneri strain</i> Hf12	81	95.26	Iran	Peach	MG601496.1
	<i>S. warneri strain</i> SP1	86	95.44	Iran	Peach	KP662717.1
	<i>S. warneri strain</i> BB1	81	93.77	Iran	Almond	MG601491.1
	<i>S. warneri strain</i> Zgh13	61		Iran	Apricot	MG601499.1

which are deformed female nematode bodies. For the nematode *Rhabditis* sp. this nematode is a non-parasitic, cylindrical nematode measuring 800 μm . The mouth may possess small teeth, depending on the species. The basal bulb is rounded and clearly visible. The habitat of these nematodes is usually moist soil, decaying organic matter, and compost (Figure 12).

3.2. Disease Incidence in Banyuwangi and Bogor

Field observations revealed the presence of three fungal diseases in dragon fruit: stem canker, anthracnose, and brown rot. Two diseases caused by algae were also identified red rust and white stem disease. In addition, one bacterial disease caused by *S. warneri*, and one viral disease caused by *Cactus Virus X*. In Banyuwangi (Tegaldlimo, Purwoharjo, and Siliragung), stem canker was the most dominant disease, with incidence rates ranging from 58.7% to 84.7%. Anthracnose, brown rot, and red rust showed relatively low incidence, varying from 2% to 2.9% for brown rot, 2.9% to 5.3% for anthracnose, and 2.3% to 3.3% for red rust. White stem disease occurred at a low to moderate level (1.3%-6%), while bacterial rot caused by *Staphylococcus warneri* showed a slightly higher incidence, ranging from 6.6% to 12.6%. These results suggest that although several diseases were present, stem canker remained the major problem in Banyuwangi plantations.

In Bogor (Sukamantri and Warso), disease incidence tended to be higher and more diverse. Stem canker reached 75%-100%, representing the most severe disease in the area. Anthracnose showed a notably higher incidence than in Banyuwangi, ranging from 32% in Sukamantri to 60% in Warso. White stem disease was also more prevalent, with incidences of 15%-43%. Red rust occurred at moderate levels (12%-23%), while bacterial rot ranged from 28% to 31%. *Cactus Virus X* (CVX) infection was detected only in Sukamantri, with an incidence of 2%. The high disease diversity and incidence in Bogor are likely influenced by

higher humidity and poor field sanitation, which favor the development and spread of pathogens. In Banyuwangi, all the land in the three sub-districts has good cultivation methods, such as the application of biological agents to control diseases and regular fertilization. However, the environmental sanitation conditions around the land are still considered low, as evidenced by the presence of agricultural waste that is not optimally managed. This was also found in Bogor, at the Warso and Sukamantri, where land sanitation is still considered low. This condition causes soil moisture to tend to be high and supports the growth of both pathogenic microorganisms and disease vectors (Figure 13).

4. Discussion

The most prevalent dragon fruit disease has been identified in Bogor. This occurrence is primarily attributed to excessively close planting distances, combined with the environmental conditions in Sukamantri and Warso, which are at an altitude of approximately 500-600 meters above sea level, which favor disease development due to high humidity levels. A similar disease has also been detected in Banyuwangi, albeit with a lower incidence rate. This difference is likely due to Banyuwangi's relatively drier climate, along with the implementation of appropriate planting distances and effective sanitation practices, which help suppress disease proliferation.

Most commonly observed disease in dragon fruit stem canker. Symptoms on the stem vary, but ultimately lead to stem hollowing prior to the formation of pycnidia, which serve as structures for pathogen survival and dissemination. According to Sudarjat *et al.* (2019), the most prevalent disease in the field in Pangandaran is bacterial disease, with an incidence of 32.1%. This can occur due to poor sanitation, and the fact that land that was originally flooded rice fields can be a contributing factor. In Malaysia, stem canker is considered the most



Figure 12. Nematodes on dragon fruit. (A) *Helicotylenchus* sp. (B) *Heterodera* sp. on roots in Banyuwangi, (C) *Rhabditis* sp. on soil in Banyuwangi (D) *Rhabditis* sp. on soil in Bogor (E) *Heterodera* sp. on roots in Bogor

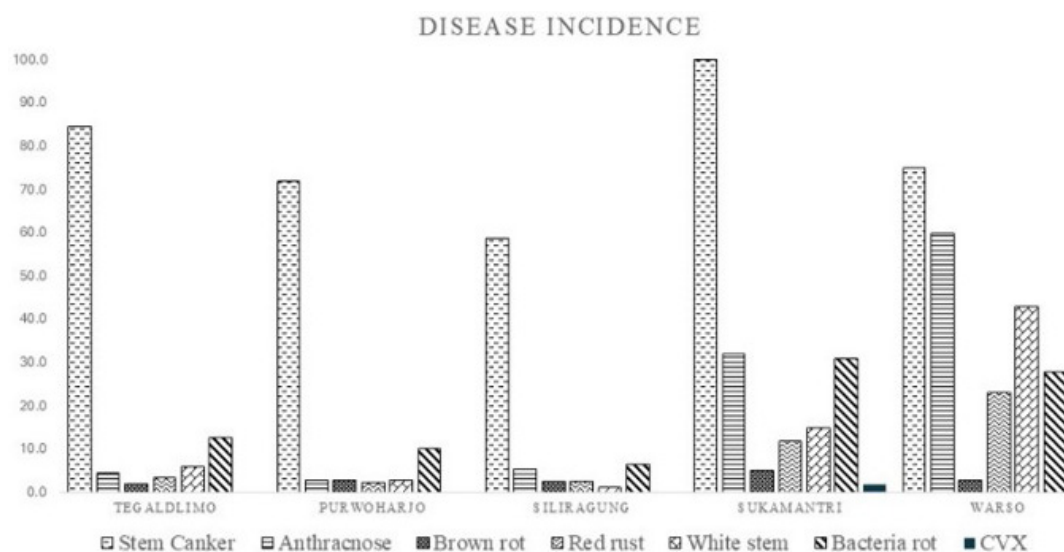


Figure 13. Diseases incidence in Banyuwangi and Bogor

Table 4. Results of homology analysis of the nucleotide sequence of the 18s rRNA gene isolate 10 in Genbank

Isolat code	Species homolog (Gnebank)	Query cover (%)	Per. iden (%)	Country of origin	Plant	Accession number
10	<i>S. warneri strain</i> Hf6	63	93.38	Iran	Peach	MG601495.1
	<i>S. warneri strain</i> Hf12	63	93.38	Iran	Peach	MG601496.1
	<i>S. warneri strain</i> SP1	89	92.76	Iran	Peach	KP662717.1
	<i>S. warneri strain</i> BB1	63	93.51	Iran	Almond	MG601491.1
	<i>S. warneri strain</i> Zgh13	46	91.68	Iran	Apricot	MG601499.1

Table 5. Results of homology analysis of the nucleotide sequence of the 18s rRNA gene isolate 12 in Genbank

Isolat code	Species homolog (Gnebank)	Query cover (%)	Per. iden (%)	Country of origin	Plant	Accession number
12	<i>S. warneri strain</i> Hf6	60	90.26	Iran	Peach	MG601495.1
	<i>S. warneri strain</i> Hf12	60	90.26	Iran	Peach	MG601496.1
	<i>S. warneri strain</i> SP1	94	86.57	Iran	Peach	KP662717.1
	<i>S. warneri strain</i> BB1	60	90.41	Iran	Almond	MG601491.1
	<i>S. warneri strain</i> Zgh13	43	88.15	Iran	Apricot	MG601499.1

Table 6. Results of homology analysis of the nucleotide sequence of isolate Po in Genbank

Isolat code	Species homolog (Genbank)	Query cover (%)	Per. iden (%)	Country of origin	Accession number
Po	<i>Cactus Virus X strain</i> 2017-1	97	95.45	China	BK067217.1
	<i>Cactus Virus X isolate</i> P2_1	97	95.45	United States	PV162469.1
	<i>Cactus Virus X isolate</i> Ec_P3	97	95.45	United States	PV173136.1
	<i>Cactus Virus X</i> SCM51431	97	95.30	China	KX883791.1
	<i>Cactus Virus X</i> Ec_P1	97	94.99	United States	PV167199.1
	<i>Cactus Virus X</i> NTU	97	94.08	Taiwan	JF937699.1
	<i>Cactus Virus X isolate</i> PD9203774	80	93.57	Netherlands	AJ270985.1
	<i>Cactus Virus X isolate</i> 10-186	76	94.52	United States	MH183168.1
	<i>Cactus Virus X strain</i> 2017-2	94	83.41	China	BK067218.1
	<i>Cactus Virus X isolate</i> alfalfa	94	83.41	United States	BK011045.1
	<i>Cactus Virus X</i>	94	82.83	Korea	LC128411.1
	<i>Cactus Virus X</i>	94	82.05	Taiwan	NC 002815.2

potentially destructive disease affecting dragon fruit. The reported incidence of stem canker in dragon fruit is 60% with a disease intensity of 55% (Hawa *et al.* 2015).

Stem canker caused by *Neoscytalidium dimidiatum* as the most destructive disease in dragon fruit plantations across Southeast Asia and Taiwan, with incidence rates often exceeding 70% under humid conditions (Chuang *et al.* 2012). Brown rot of dragon fruit plants infected by *Fusarium* spp. has been reported in Malaysia and Indonesia (Mohd *et al.* 2013). Anthracnose of dragon fruit is caused by four *Colletotrichum gloeosporioides* is the most widely reported, and is hosted by all three popular cultivated dragon fruit species (*H. undatus*, *H. monacanthus* and *H. megalanthus*) (Takahashi *et al.* 2008).

Dragon fruit is one of the favorite fruits in Indonesia, even though it is still relatively new to the country, having only been introduced in 2001. Understanding the pathogens causing the disease is the initial step before designing appropriate control methods. The diseases found in Banyuwangi and Bogor are anthracnose (*Colletotrichum* sp), brown rot (*Fusarium* sp), stem canker (*Neoscytalidium dimidiatum*), white stem, rust, bacterial soft rot (*Staphylococcus* sp), and *Cactus Virus X*. However, CVX was only found in Bogor. Stem canker was the disease with the highest incidence of 58.7%-100%.

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