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Original Article

Detection of Airborne Spores at Coconut Area in Bukit Kor, Terengganu, Malaysia

Indra Rahmana [1] and Risnawati Risnawati [1,*]

[1] Department of Agricultural Product Technology, Faculty of Agriculture, Universitas Muhammadiyah Sumatera Utara, Medan Timur, 20238 Kota Medan, Sumatera Utara, Indonesia; (I.R.)
* Correspondence: risnawati@umsu.ac.id (R.R.)

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Abstract: The Coconut plant (*Cocos nucifera L.*) is an annual plant with many benefits. In addition to consumption, other parts of the coconut plant can also be used as indus. One of the obstacles in the cultivation of coconut plants is disease. Airborne spores often cause the spread of plant diseases. This study aimed to determine what spores are airborne in coconut plots in Bukit Kor, Terengganu, Malaysia. Spore samples were observed in September 2023 at the Bukit Kor Agricultural Complex laboratory, Marang, Terengganu, Malaysia, at 35 meters above sea level. This study uses a completely randomized design (CRD) method. The results showed that the spore colony samples observed were *Culvularia* and *Pestaloptiosis* fungal groups that can cause disease in coconut plants. This study concludes that the spores spread in the air in the form of Culvularia and Pestalotiopsi, which can cause disease and potentially infect other plants. Also, the spore colonies can grow optimally if the surrounding humidity is high enough, and their distribution can expand with the help of wind.

Keywords: Coconut; Spores; *Culvularia*; *Pestaloptiosis*; Disease.

1. Introduction

Coconut (*Cocos nucifera*) is the sole member of the Cocos genus of the Arenan or Arecace tribe—the coconut plant is versatile because all parts of the plant are helpful for human life (Karun et al., 2022; Thampi, 2024). Coconut plants also have a high cultural and economic value in people's lives (Luntungan, 2008). Coconut plants are classified as one of the most valuable annual plants because, from the community, they can utilize the leaves, pulp, and stems to roots. Every part of the coconut plant can be utilized for daily needs because coconut has a high economic, social, and cultural value (Jumiati et al., 2013). Bukit Kor is the experimental land of Universiti Malaysia Terengganu, which is the property of The kingdom of Terengganu was given to the Universiti of Malaysia Terengganu, which has a total area of Bukit Kor reaching 600 acres/ 250 hectares and the kingdom of Terengganu was given to be used for cultivation and new planting of 1 hectare. Bukit Kor is overgrown by various plants, including areas for head plants. Bukit kor is located in the highlands in the Marang area, Terengganu, Malaysia.

Diseases in cultivated plants are usually caused by fungi, bacteria, viruses, and environmental factors e.g., climate, soil, etc. (Elad & Pertot, 2014; Jones & Barbetti, 2012; Nazarov et al., 2020). Fungi are a group of living organisms that resemble higher plants because they have cell walls, do not move, and reproduce

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by spores, but do not have chlorophyll (Blackwell, 2011; Feofilova, 2001). Fungi do not have roots, stems, leaves, and vessel systems like other plants (Feofilova, 2001; Marcelina et al., 2022). Microorganisms can be found everywhere, one of which is in the air. One of the microorganisms in the air is fungi. Fungi in the air are found in microscopic spores that can spread through the air quickly (Apriliawati, 2009). Airborne spore dispersal is an important reproductive dispersal mechanism for many fungal genera. The small size of the spores and their hydrophobicity allow for the long-distance dispersal of fungi and can profoundly affect human and plant health (Odebode et al., 2020). Detection of airborne spores in the Bukit Kor permaculture area is critical to see whether or not many spores in the permaculture area can harm plants.

2. Materials and Methods

This study was conducted at Bukit Kor Agricultural Complex, Marang, Terengganu, Malaysia, at 35 meters above sea level. This study was conducted in September 2023. The tools used in this research are a timer, camera, microscope, dropper pipette, Bunsen lamp, ose rod, Bunsen burner, slide microscope, preparation glass, pen, book, and camera. The materials used in this study are agar media or PDA (Potato Dextrose Agar), Spores that grow, Sterilized water, 70% Ethanol, and Tissue. Observation of spore samples was carried out in the Bukit Kor Agricultural Complex laboratory, Marang, Terengganu, Malaysia. This study uses a completely randomized design (CRD) method. Sampling of spores taken from the coconut plant area (Cocos nucifera) was carried out using two treatments: placing the media below with a height of 10-20 cm and placing the media above with a height of 150-160 cm.

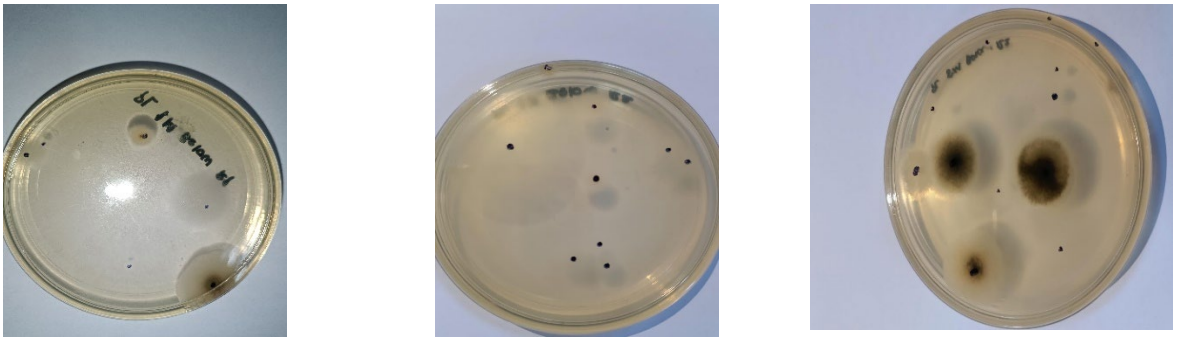
In 2 treatments, three replications were carried out, with a time of 1, 3, and 5 minutes. In each of the 3 replicates, there were 3 samples until all the plates totalled 18. To take samples, open a Petri dish containing PDA with 3 samples at a predetermined height, and count using a timer with a predetermined time. Do the same for each replicate and treatment. After sampling on PDA, the samples were taken to the laboratory. Arrange the agar media and keep it for 3 days so that the spores grow on the plate. After 3 days, prepare the tools and materials used. Take the spores that grow slowly on the plate using an ose rod that has been heated using a Bunsen burner. Then, take a small sample and do not clot. Spray the microscope slide with 70% Ethanol and then wipe using tissue. If so, drip the microscope slide with sterilized water. Place the spores that have been taken onto the microscope slide. After that, cover the microscope slide containing sterilized water and spores with preparation glass. Then, observe the sample using a microscope.

3. Results

The results are presented in the following Table, which shows the average of each treatment in a different number of minutes.

Table 1. Spore Observation Results in Permaculture Area

Treatment	Replicate		
	1 Minute	3 Minute	5 Minute
On the Ground	8,6	11	8,3
Above the Ground	5,6	12,3	9



(**a**) 1 minute (**b**) 3 minutes (**c**) 5 minutes

Figure 1. PDA Sample on the Ground and Above the Ground

Table 1 shows the average spores on each PDA plate with different time treatments. The higher spore count was on the ground treatment in the first minute. At 3 and 5 minutes, the average number of spores is higher in the above-the-ground treatment. Figure 1 captures PDA plate is overgrown with spore colonies.

The spore colonies developed well on the PDA plates used in treatment 1 at 10-20 cm height or treatment 2 at 150-160 cm. It can be said that the spores can grow perfectly because external factors such as temperature and surrounding conditions support the spores in growing well. This aligns with Sieverding's (1991) statement that 02, C02, humidity, temperature, soil nutrient status, and nutrient sources affect spore germination. In mixed inoculum, the slow germination of spores to infect the roots can be compensated by hyphal propagules and infected roots.

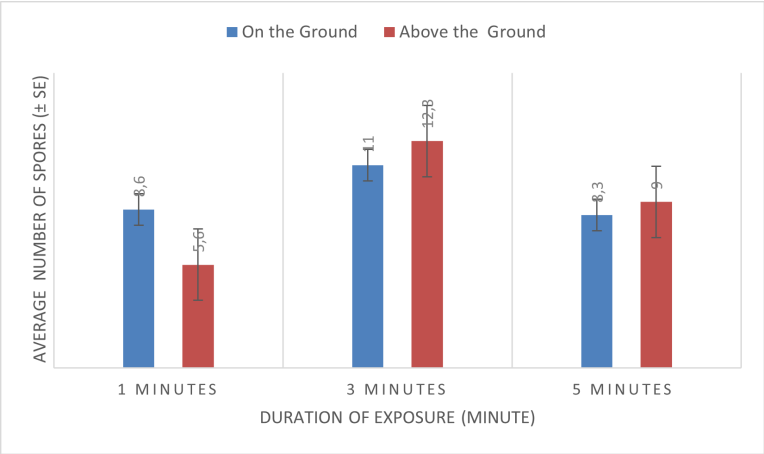
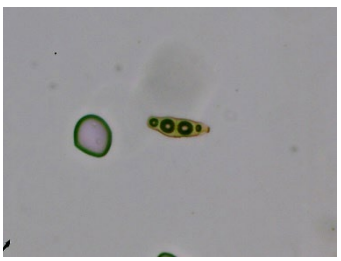


Figure 2. Sample PDA on the ground and above the ground

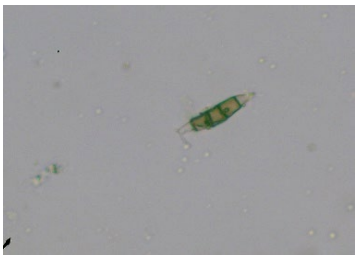
Figure 2 indicates that many spore colonies grow in treatment 2, where PDA is placed at a 150 - 160 cm height, while treatment 2 samples at 10-20 cm grow less. Spore colonies can achieve optimal spore growth because the fungal growth environment in the laboratory has sufficient humidity and not too much sunlight. This is justified by Rahayu et al. (2015), who state that moisture has a real influence on the growth of fungi. The higher the humidity, the more cell mass growth increases. The growth of fungi with 90% humidity gives a better effect than at 70% and 80% humidity. Nutrients are also needed in the development media for fungi's growth to be perfect. PDA media is a medium made from potato tuber extract because it turns potato starch into soluble sugars that can serve as a source of carbon and energy (Wongjiratthiti & Yottakot, 2017).

(**a**) 1 minute on the ground

(**b**) 3 minutes on the ground



(**c**) 5 minutes on the ground



(**a**) 1 minute above the ground

(**b**) 3 minutes above the ground

(**c**) 5 minutes above the ground

Figure 3. PDA sample observation on the ground and above the ground

4. Discussion

In observing spore samples, the spores or fungi identified were *Culvularia* and *Pestalotiopsis*. At the same time, the rest are only sterile hyphae. Culvularia usually attacks plants during the nursery period, especially on palms. This follows the statement of Yulianty (2012), who states that *Curvularia* is one of the fungi that attack the Araceae tribe. *Curvularia* is commonly found on coconut seedlings. In coconut and palm oil pants, this fungus is the main cause of disease that attacks the nursery stage, often called leaf spot disease. Leaf spot disease caused by Curvularia sp. in oil palm nurseries can reach 38% (Solehudin et al., 2012). The fungus or spore that was also identified was Pestalotiopsi. Semangu (1993) states that the wind spreads fungal spores. For short distances, they can be carried by water and insects. The spores of Pestalotiopsis, sp can only infect if there are exposed leaves on the plant. Diseases caused by the fungus *Pestalotiopsis, sp.* are more common in plants with poor growth. Excess nitrogen and excessive use of manure make plants more susceptible to disease.

Thus, the spores or fungi are scattered and carried by the wind, so they can potentially spread the disease to other plants in the neighborhood. With the help of air, the spread of spores can contaminate. This is reinforced by the statement of Sastrahidayat (2013) that the power of gravity influences the speed of the descent of spores, the density of the form, and the hardness of the spores. Spores spread through the air by the wind will settle back on the host surface and can cause infection. Spores and fungi found in Coconut areas in Bukit Kor have the potential to infect neighboring plants. Due to gravitational pressure and existing winds, airborne spores will settle in areas lower than the coconut area.

5. Conclusions

This study concludes that the spores spread in the air in the form of *Culvularia* and *Pestalotiopsi,* which can cause disease and potentially infect other plants. Also, the spore colonies can grow optimally if the surrounding humidity is high enough, and their distribution can expand with the help of wind.

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