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Diseases and Pests on Avocado Intercropping Plantations with Mango and Durian in Watulembu, Wonogiri

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ABSTRACT
One strategic fruit commodity is avocado because it has high economic value. Pests and diseases are the main problems faced by farmers. This research aims to identify diseases and pests in avocado intercropping with mango and durian in Watulembu District, Wonogiri Regency by observing the symptoms of attacks and the control measures that have been taken. Observations of avocado plant abnormalities and field conditions around the planting area were also carried out visually, recorded using a digital camera, then described and identified based on symptoms and literature review. Observation results showed the presence of leaf spot algae, anthracnose, sooty mold, and *Planococcus citri*. Pest and plant disease control that can be recommended includes cultivation techniques, avoiding plant stress, and also the use of chemical pesticides.

Keywords: avocado, Watulembu, disease, pest, control.

ABSTRAK
Salah satu komoditas buah-buahan yang strategis adalah alpukat karena memiliki nilai ekonomi yang tinggi. Hama dan penyakit merupakan masalah utama yang dihadapi petani. Penelitian ini bertujuan untuk mengidentifikasi penyakit dan hama pada tanaman sela alpukat dengan mangga dan durian di Kecamatan Watulembu Kabupaten Wonogiri dengan mengamati gejala serangan dan tindakan pengendalian yang dilakukan. Pengamatan kelainan tanaman alpukat dan kondisi lapangan di sekitar areal penanaman juga dilakukan secara visual, direkam menggunakan kamera digital, kemudian dideskripsikan dan diidentifikasi berdasarkan gejala dan tinjauan pustaka. Hasil pengamatan menunjukkan adanya alga bercak daun, antraknosa, kapang jelaga, dan *Planococcus citri*. Pengendalian hama dan penyakit tanaman yang dapat dianjurkan antara lain teknik budidaya, menghindari stres tanaman, dan juga penggunaan pestisida kimia.
Kata kunci: alpukat, Watulembu, penyakit, hama, pengendalian.

INTRODUCTION
Tropical fruits are rich in nutrients and are very popular with consumers because they taste delicious and are healthy. Avocados are a popular food among mangoes and pineapples. Avocados account for more than 50% of global trade due to their high nutritional content and health with a mild taste (FAO, 2022; FAO, 2023). In 2022, global avocado exports are expected to reach around 2.5 million tonnes (FAO 2022). Avocado (Persea americana Mill) is a dicotyledonous plant from the family Lauraceae and the genus Persea, which includes two subgenera: Persea and Eriodaphne (Marais, 2004; Elhadi, 2012). Almost 80% of

avocados can be eaten, with components consisting of 72% water, 6.8% fiber, and various bioactive compounds such as β-carotene, tocopherol, and β-sitosterol which provide health benefits. These external characteristics are generally compared with other fruits (USDA, 2019). Avocados only ripen after being harvested, the ripening process occurs quickly due to strong respiration (Azriel, 2005). Avocado ripeness is determined by biochemical changes, including high ethylene production, increased respiration rate, and significant changes in physical characteristics. (Elhadi, 2012; Defilippi et al., 2018).

The loss of avocado production is mainly caused by harmful microorganisms and fungi that easily grow with an abundance of nutrients to reproduce in avocados (Coyotl-Pérez et al., 2022; López-López et al., 2022). The most severe damage is caused by anthracnose disease triggered by fungal strains such as *Colletotrichum gloeosporioides, Lasiodipodia theobromae, Clonostachys rosea, Neofusicoccum parvum*, and others (López-López et al., 2022; Correa-Pacheco et al., 2022; Osondu et al. ., 2022). Even small impacts can change the appearance of the avocado, causing subtle changes that can result in consumer rejection.

Identification of diseases in avocado plantations is critical to the growth and sustainability of the industry. ASBVd, a sunspot disease of avocado that causes viroids, can be found on virus-carrying trees that do not show symptoms, so accurate detection is important (Jooste, 2021). Other diseases, such as Phytophthora root rot, bacterial canker, and diseases caused by viruses, also pose significant threats (Nel, 2004). A polyphasic approach has been used to identify various diseases and disorders in avocado cv. Hass, including root rot and fruit sunburn (Ramírez-Gil, 2019). The use of image processing and machine learning techniques has been proposed for the semi-automatic detection of *Lasiodiplodia theobromae*, a fungus-causing disease of avocado trees (Cabrera, 2020). These studies underscore the importance of disease identification in avocado plantations for effective management and control.

This research was conducted to observe pests and diseases associated with intercropping of avocado with mango and durian in Watulembu District, Wonogiri, Central Java. Pests and diseases at this location have not been reported, so the information obtained from this research can be used to develop pest and disease control strategies.

METHODS

The research was conducted on an avocado plantation in Watulembu District, Wonogiri, Central Java, from May to August 2023. The land area is 18.7 ha and is located on the riverbank. There were 286 plants planted consisting of avocado, mango, seedless guava and durian. This research was carried out by observing abnormalities in avocado plants and field conditions around the planting area using a purposive sampling method. Observations were made visually, recorded using a digital camera, then described and identified based on symptoms and literature review.

RESULT AND DISCUSSION

The avocado plantation area is bordered by the river. This land is bordered by forest on the north and east sides. The west side of the plantation is bordered by residential areas, while land for food cultivation and horticulture is on the south side. This area is dominated by rock layers. The soil layer is thin, less than 20 cm. Therefore, farmers add fertile soil from other places. The land contour slopes from north to south (Figure 1).

Avocado plants are intercropped with durian plants, seedless guava and mango plants. The number of plants growing in this area is around 286 plants, while the number of avocado plants growing is 167 plants. Avocado plants are three years old from the time they are planted. The avocado plant has not yet produced fruit. Intercropping can create a more complex environment that inhibits pest movement and reduces the ability of pests to locate host plants (Chadfield et al, 2022). However, controlling pests and diseases in all crops still relies on the use of chemical pesticides. Weed control is done by weeding the weeds around the roots in a size that follows the plant canopy (Figure 2).

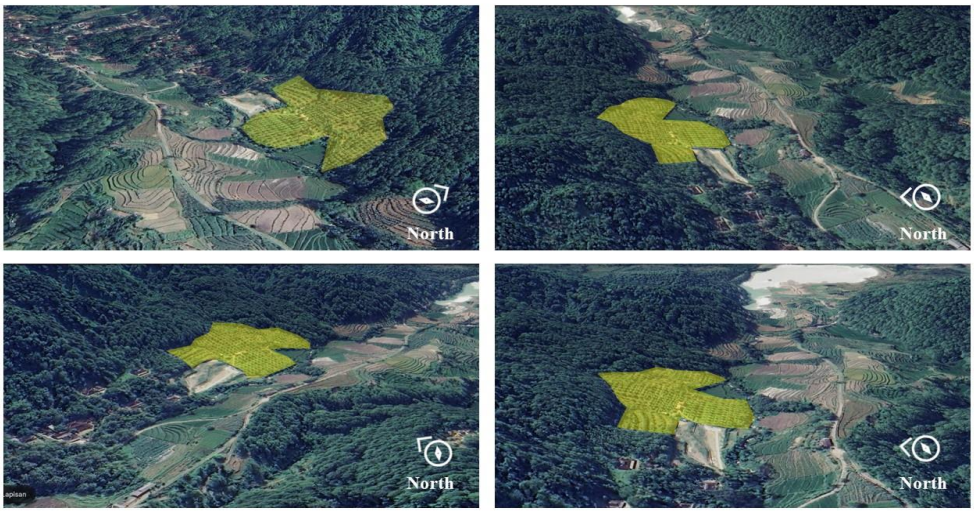


Figure 1. Avocado field aerial image.

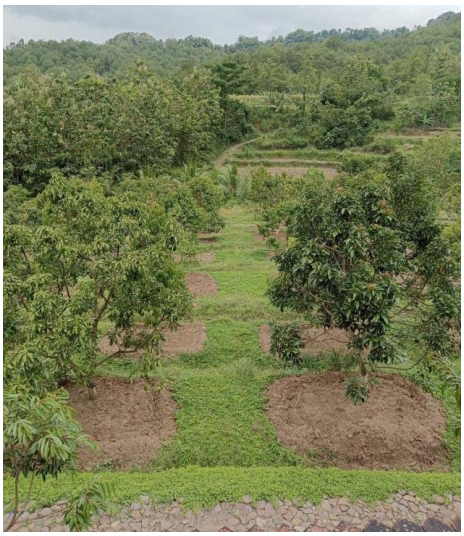


Figure 2. Weeding weeds around the roots in size following the plant crown.

Observation results on avocado plants showed the presence of algae leaf spot, anthracnose, sooty mold, and Planococcus citri.

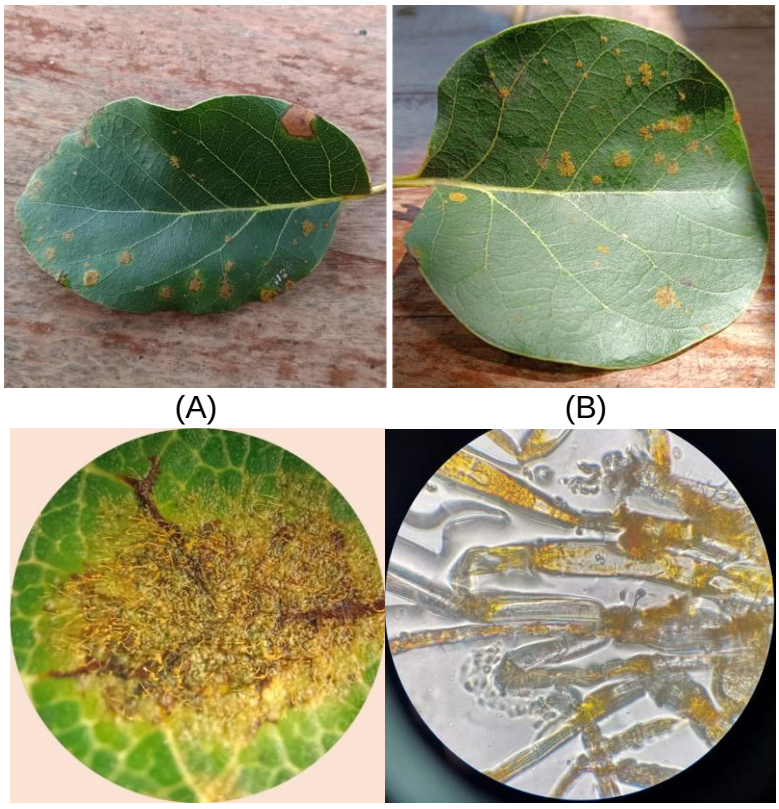
1. Algal leaf spot

Cephaleuros virescens is the causal agent of algal leaf spot. It is a green alga that lives in all tropical and subtropical regions of the world, between latitudes 32° N and 32° S. It has a broad of host plants, including avocado, as long as the temperature and high humidity are conducive to its growth and reproduction (Vasconcelos *et al*, 2019). The symptom was spesific necrosis beneath their thalli (Fig. 3A-B) which usually limited to the epidermal cells but occasionally includes palisade parenchyma and can extend to the lower leaf surface (Brooks *et al*, 2015). The avocado leaf showed reddish-brown necrosis on the upper leaf surface. They typically appear slightly elevated and have a velvety look because of sporangiophores and sterile hairs (setae) growing through the plant cuticle (Figure 3.C). The upright part of the algae, which includes sporangiophores with head cells, sporangiate-laterals, and setae, is known as the sign of *Cephaleuros* sp. (Brooks *et al*, 2015). *Cephaleuros* species are filamentous green algae known as parasites of higher plants. The genus is a member of the class Ulvophyceae, order Trentepohliales, family Trentepohliaceae, division of aquatic green algae (Chlorophyta) (Guiry and Guiry 2015). The genus *Cephaleuros* has been known to cause diseases with morphological characteristics similar to those caused by fungi. They are aerial and need free water to germinate (Sunpapao *et al*, 2016). Slow-growing lesions on leaves rarely affect plant growth unless they are severe, except in the case of tea. Since tea plants are cultivated for their leaves, foliar infections present a unique risk that can impact both yield and quality (Brooks *et al*, 2015). The managements of the disease were a) avoiding plant stress, as it is a major predisposing factor for severe algal infections; b) cultural control by improving plant vigor through cultural practices such as promoting good air circulation to reduce humidity and duration of leaf wetness with the destruction of affected plant portions and improving the nutrient status on the soil by application nitrogen, phosphorus, and potassium; c) resistant cultivar; and d) synthetic pesticide.

2. Anthracnose

Anthracnose can reduce the quantity and quality of avocado fruit production during on-off farm. In this cultivation, this disease was one of the important diseases in avocado plantations. The causal fungus is *Colletotrichum* sp., it has a wide host range. High humidity is a suitable microclimate for germinating their spores. The spores on the leaves were primary sources of inoculums when fruit bears (Marais, 2007). The symptoms on leaves may have large brown necrotic areas appearing in the center and on their margins. Leaf tissues showing typical anthracnose symptoms on avocado (Figure 4.). This fungus is favored by high temperatures and humid or moist water. Only when acervulli are wet, the conidia are released. This usually spreads by splashing and blowing rain or by coming in contact with insects, other animals, tools, etc (Agrios, 2007). Managing anthracnose disease involves cultural practices that reduce the inoculum and create conditions unsuitable for infection, especially in high-rainfall areas. These

practices include pruning and burning dead twigs, branches, and fungus-infected fruit, removing mummified fruit, untangling and removing dead leaves from the tree canopy, and ensuring good ventilation through pruning. Another preventive measure is using resistant varieties. If necessary, high-volume sprays of copper fungicides can reduce anthracnose infection. During the wet season, a combination of copper fungicides and systemic fungicides, such as prochloraz and benomyl, can help suppress the disease (Agrios, 2007 ; Marais, 2007).



(A) (B)

(C) (D)

Figure 3. Algal leaf spot on Avocado; avocado leaf exhibiting rounded lesions symptoms (**A-B**); Microscopic of rounded lesions with 50x magnification (**C)** and 100x magnification (**D**).

(A) (B) (C)

Figure 4. Leaf symptoms on avocado by anthracnose fungus (A-C); severe symptoms

3. Sooty mold

Avocados are not infected by sooty molds, and they usually do no harm. The only exception is if leaves were heavily covered so that photosynthesis was severely inhibited, leading to chlorosis and an early loss of leaves. Fruit may be degraded in the packing house if it is clearly fouled (Anonymous, 2017). Sooty mold fungi thrive on "honeydew," a sticky substance released by plant-sucking insects like aphids, scale insects, mealybugs, and whiteflies. These insects extract sap from plants and excrete the excess sugars. The fungi reside solely on the plant's surface and are not a systemic problem. While the fungi themselves do not kill the plant, they can cover the leaves extensively, blocking sunlight and reducing photosynthesis.

Figure 5. Sooty mold symptom on avocado leaf.

Sooty molds use the honeydew produced by plants or sap-sucking insects like aphids and scale insects. They do not have a specific host preference and can consist of mixed populations of eight or more species. These molds may form a thin network of hyphae, a velvety layer, or a dark crust on leaves and small twigs (Hughes 1976).

Improving air circulation by pruning branches is beneficial. You can also remove the mold by spraying it off with a strong jet of water. Additionally, the fruit is safe to eat once the sooty mold is washed off. Manage sooty mold by controlling the insects that produce honeydew. In avocados, honeydew-producing insects are often well-controlled by natural enemies. To preserve these beneficial parasites and predators, control ants, minimize dust, and avoid broad-spectrum insecticides. If direct insect control is necessary, use selective insecticides whenever possible.

4. Planococcus citri

The citrus mealybug, *Planococcus citri*, is a mealybug species originally from Asia that has spread to Europe, the Americas, and Oceania (Cabi, 1999). This pest poses a considerable threat to agriculture, affecting various crop plants, ornamental plants, and wild vegetation. While it is notorious for infesting citrus fruits, it can also infect other plants, including avocados (Gill *et al*., 2022). *P. citri*

causes leaves to become chlorotic, wilted, distorted, yellow, and cause leaf fall. Sweet honeydew secreted by mites causes the growth of sooty mold and reduces fruit quality (Griffiths and Thompson 1957).

The eggs are light yellow in color, oval in shape, about 0.3 mm long, and are stored in cottony masses with a germination rate of 300 - 600 eggs (Kerns *et al*., 2001). Nymphs are yellow, oval-shaped with red spots, and covered by white wax particles (Griffiths and Thompson, 1957). Female nymphs go through four instars and resemble adult females in shape, while male nymphs are more elongated and have three instars (Kerns *et al*., 2001). Adult insects measure between 3 mm and 4.5 mm. Female adults are wingless, white to light brown with brown legs and antennae, and coated with white wax. Females can live up to 29 days. Adult males are winged and have a similar color to females (Anonymous 2007, Griffiths and Thompson 1957).

Figure 6. *Planococcus citri (Insekta : Hemiptera : Pseudococcidae)*

CONCLUSION

Pests and diseases found in avocado plantation intercropped with durian and mango in Watulembu District, Wonogiri, Central Java, include algal leaf spot, anthracnose, sooty mold, and *Planococcus citri.* Control measure for those diseases and pest still relay on synthetic pesticide.

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