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Major Pests And Diseases Of Clove (Syzygium Aromaticum) And Nutmeg (Myristica Fragrans Houtt.) In The Dusung Agroforestry System Of South Buru Regency, Maluku, Indonesia

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Abstract. Clove (*Syzygium aromaticum*) and nutmeg (*Myristica fragrans* Houtt.) are important plantation crops cultivated in the traditional dusung agroforestry system in Maluku, Indonesia. This study aimed to document cultivation practices and assess damage intensity (DI) and the percentage of trees attacked (P) by major pests and diseases in South Buru Regency. Field observations and farmer interviews were conducted in six villages across three districts selected purposively. Cultivation practices were generally not intensive, with inconsistent sanitation, limited fertilization, and variation in planting distances and planting material. In clove, stem borer infestation by *Nothopeus* spp. had an average DI of 41.15% and P of 47.08%, both classified as moderate. Leaf spot associated with *Cylindrocladium* sp. had a DI of 8.77% (mild), but P reached 52.48% (severe). In nutmeg, stem borer infestation by *Batocera hercules* had a DI of 9.43% and P of 2.30%. Wet fruit rot associated with *Colletotrichum* sp. had a DI of 1.43% and P of 6.45%, while dry fruit rot associated with *Stigmina myristicae* had a DI of 3.75% and P of 11.67%. Both parameters were classified as mild for all three problems in nutmeg. These findings reveal differences in damage severity and the distribution of affected trees between the two crops. The results provide baseline information for prioritizing pest and disease monitoring and management in the dusung agroforestry system of South Buru Regency.

Keywords: clove; nutmeg; pest and disease assessment; damage assessment; dusung agroforestry

1. Introduction

Clove (*Syzygium aromaticum*) and nutmeg (*Myristica fragrans* Houtt.) are high-value perennial spice crops that contribute substantially to rural livelihoods and the plantation economy of Maluku Province, Indonesia. Their products are used in the food, cigarette, cosmetic, pharmaceutical, and spice industries. In 2024, clove plantations in Maluku covered 44,872.19 ha, with a production of 21,809.34 tons, while nutmeg plantations covered 36,394.42 ha and produced 5,786.00 tons [1]. South Buru Regency is an important production area for both commodities. In the same year, clove plantations covered 5,679.11 ha and produced 2,272.44 tons, whereas nutmeg plantations covered 3,117.48 ha and produced 528.29 tons [1]. Maintaining the health and productivity of these crops is therefore important for the region's plantation sector and farming communities.

In Maluku, clove and nutmeg are commonly cultivated in dusung, a traditional agroforestry system that combines perennial crops with other tree species and, in some locations, annual crops. This system supports agricultural production and household livelihoods while maintaining a tree-based agricultural landscape. Previous studies have documented the vegetation, management practices, and socioeconomic importance of dusung in Maluku [2], [3]. However, cultivation practices and plantation conditions

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may vary among locations, potentially influencing the occurrence and severity of pest and disease problems. Assessing crop damage across dusung farming areas can provide locally relevant information on these problems.

Previous studies in Maluku have examined pest and disease damage in clove and nutmeg, including damage to clove in Hitu Lama [4], nutmeg stem borer infestation and dry fruit rot in Leihitu [5], and pest and disease problems affecting both crops in Negeri Allang [6]. However, an integrated assessment of farmers' cultivation practices and damage caused by major pests and diseases in both clove and nutmeg across multiple villages in South Buru Regency remains lacking. Assessing damage intensity (DI) and the percentage of trees attacked (P) provides a basis for describing levels of damage across locations. Therefore, this study aimed to document farmers' cultivation practices and assess the levels of damage caused by major pests and diseases affecting clove and nutmeg in selected *dusung* farming areas of South Buru Regency, Maluku Province, Indonesia.

2. Materials and Methods

2.1. Study Area

The study was conducted in six villages across three districts of South Buru Regency, Maluku Province, Indonesia (Figure 1). The study villages were Nalbessy and Leksula in Leksula District, Waelikut and Waemassing in Waesama District, and Siwar and Ulima in Ambalau District. The study focused on clove (*Syzygium aromaticum*) and nutmeg (*Myristica fragrans* Houtt.) cultivated in traditional agroforestry systems known as *dusung*. Clove-based and nutmeg-based *dusung* were surveyed in all six villages, with each system characterized by the dominance of the respective crop alongside other plant species.

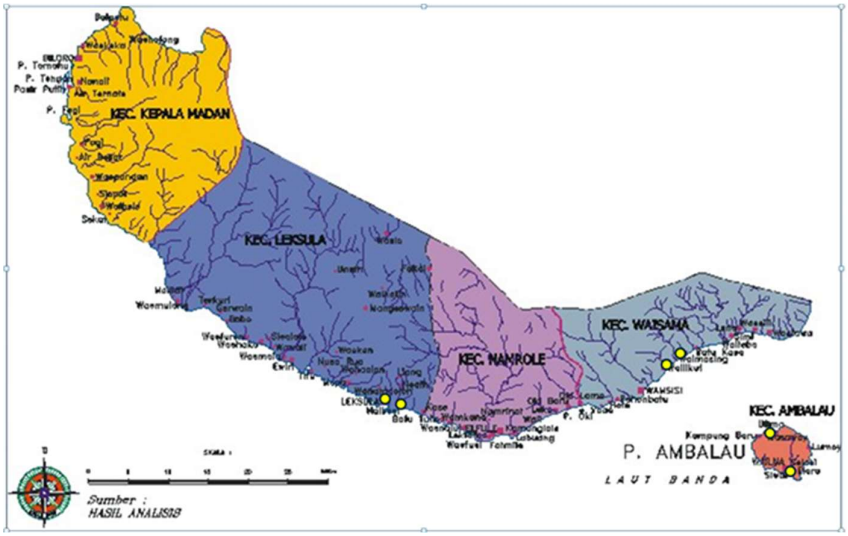


Figure 1. *Map of the study area showing the surveyed villages in South Buru Regency, Maluku Province, Indonesia. Yellow circles indicate the study locations*

2.2. Research Design, Population, and Sampling

A descriptive survey approach was used to document cultivation practices and assess pest and disease damage in clove- and nutmeg-based *dusung*. The study districts and villages were purposively selected based on the prevalence of clove and nutmeg cultivation. In each village, 10 clove farmers and 10 nutmeg farmers were selected using village records of farmers cultivating the respective commodities. The total sample comprised 120 farmers: 60 clove farmers and 60 nutmeg farmers.

For damage intensity (DI), at least 10% of the clove trees in each clove-based *dusung* and at least 10% of the nutmeg trees in each nutmeg-based *dusung* were observed. Tree selection followed a systematic sampling pattern along a diagonal transect within each

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dusung. Separately, all clove or nutmeg trees owned by each sampled farmer were censused to determine the percentage of trees attacked (P). The two procedures provided the data for calculating DI and P, respectively.

2.3. Data Collection and Identification

2.3.1. Field Observations and Farmer Interviews

Primary data were collected through direct field observations and farmer interviews. Field observations documented plant conditions, the occurrence of pests and diseases, and visible damage symptoms. The numbers of healthy and affected trees were recorded for each crop and assessed pest or disease. Farmer interviews documented cultivation practices, while secondary information was obtained from relevant institutions.

2.3.2. Morphological Identification of Insect Pests

Insect specimens collected during field observations were transported to the Plant Pest Laboratory, Faculty of Agriculture, Pattimura University, for morphological examination and identification. Identification was based on observable morphological characteristics, and specimens were identified to the taxonomic level supported by the available morphological evidence.

2.3.3. Isolation and Morphological Identification of Disease-Associated Fungi

Plant parts showing disease symptoms were collected in the field and transported to the Plant Disease Laboratory, Faculty of Agriculture, Pattimura University. For fungal pathogens that could be isolated and cultured, diseased tissues were surface-disinfected with 70% alcohol, cut at the boundary between diseased and healthy tissues, and cultured on potato dextrose agar (PDA). The cultures were incubated at room temperature, and identification was based on colony morphology and microscopic examination of fungal structures using a VISION DX 21 binocular bright-field microscope at 400× magnification.

For two fungal pathogens that could not be successfully isolated and cultured, identification was performed through direct microscopic examination of simple preparations made from symptomatic plant tissues using the same microscope at 400× magnification. Identification was based on the morphological characteristics of the observed fungal structures.

2.3.4. Assessment of Damage Intensity and Percentage of Trees Attacked

Damage intensity (DI) was calculated differently for absolute and localized damage, following Indonesian plantation protection guidelines [7]. For absolute damage, DI was calculated as the percentage of damaged plant parts relative to the total number of damaged and healthy plant parts:

$$DI = \boldsymbol{a}/(\boldsymbol{a} + \boldsymbol{b}) \times 100\ \%$$

where (a) is the number of damaged plant parts and (b) is the number of healthy plant parts.

For localized damage, plant parts were scored according to the percentage of damage observed (Table 1), using a quantitative ordinal scale [8]. DI was calculated using a weighted scoring formula [7], [9]:

$$DI = (\sum (\boldsymbol{n}_i \times \boldsymbol{v}_i))/(\boldsymbol{Z} \times \boldsymbol{N}) \times 100\ (\%)$$

where (n_i) is the number of plant parts assigned to damage score (i), (v_i) is the corresponding damage score, (Z) is the maximum damage score (4), and (N) is the total number of plant parts observed.

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Table 1. Damage scoring scale based on the percentage of plant damage

Damage scale (v)	Percentage of plant damage
0	No damage (0%)
1	0 < x ≤ 25%
2	25 < x ≤ 50 %
3	50 < x ≤75 %
4	x > 75%

Note: (x) is the percentage of damage observed on each assessed plant part.

The percentage of trees attacked (P) was calculated from the census of all corresponding crop trees owned by each sampled farmer:

$\boldsymbol{P} = \boldsymbol{a}/\boldsymbol{b} \times 100\ \%$,

where (a) is the number of trees affected by the pest or disease being assessed and (b) is the total number of corresponding crop trees censused.

For descriptive interpretation, DI and P were classified according to the categories presented in Table 2. The same percentage thresholds, based on a classification scheme used in previous

Table 2. Operational classification of damage intensity (DI) and percentage of trees attacked (P)

DI or P (%)	Category
0	No attack
0 < x ≤ 25	Mild
25 < x ≤ 50	Moderate
50 < x ≤ 75	Severe
x > 75	Very severe

2.4. Data Processing and Analysis

Data on DI and P were analyzed descriptively. For localized symptoms, DI was calculated separately for each sampled tree and averaged across sampled trees for each farmer. For damage assessed using the absolute-damage formula, DI was calculated for each farmer based on the recorded numbers of damaged and healthy plant parts. The percentage of trees attacked was calculated separately for each farmer using the census data.

Farmer-level values were averaged across the 10 farmers surveyed for each crop in each village to obtain village-level values. District-level values were calculated as the arithmetic means of the two village-level values within each district. Regency-level values were subsequently calculated as the arithmetic means of the three district-level values. These calculations were performed separately for each crop and pest or disease. The results were presented in descriptive tables to characterize the intensity of

damage and the distribution of affected trees across the surveyed villages, districts, and regency. No inferential statistical tests were conducted.

3. Results and Discussion

3.1. Cultivation Practices

Field observations and farmer interviews indicated that clove and nutmeg cultivation in South Buru Regency was not managed consistently. Planting distances varied from approximately 6 × 6 m to 8 × 8 m, fertilization was limited or absent, routine pest and disease management was uncommon, and field sanitation was irregular, with reported intervals of 3–9 months. Pest-damaged and dead trees, including those affected by stem borers, were observed in the surveyed *dusung* plantations. However, the effects of individual cultivation practices on pest and disease occurrence were not directly assessed.

The understory vegetation included ferns, *Mimosa pudica*, *Ageratum conyzoides*, *Cyperus* spp., *Imperata cylindrica*, and *Eupatorium odoratum*. Inadequate weed management may increase competition for light, water, and nutrients, potentially affecting crop growth [10]. The clove stem borer, *Nothopeus* spp., can remain inside stems for approximately 130–350 days, and severe infestation may cause tree death [11]. Stem borers are also recognized as important pests of nutmeg in Maluku [12]. Although infested or dead plant material may provide potential sites for pest survival or, depending on the pathogen, sources of disease inoculum [13], these processes were not directly examined in the present study. Appropriate management of infested and dead plant material may therefore warrant attention in plantation sanitation.

Farmers commonly used self-produced planting material, and the selection criteria and quality of parent trees were not consistently established. The clove types reported by farmers included Tuni, Siputih, and Zanzibar, while Banda nutmeg was the predominant type cultivated. The limited use of fertilizer observed in the surveyed plantations may affect crop growth and physiological condition, although its relationship with pest and disease severity was not evaluated.

3.2. Pests and Diseases of Clove

The major pest and disease recorded in clove plantations in South Buru Regency were the stem borer, *Nothopeus* sp. (Coleoptera: Cerambycidae), and leaf spot disease associated with *Cylindrocladium* sp.

Stem borer. Clove trees affected by stem borers exhibited yellowing leaves. Under severe infestation, the leaves dried and fell, and the trees could eventually die (Figure 2a). Visible signs of infestation included stem holes approximately 3–5 mm in diameter (Figure 2b), often surrounded by thick exudates mixed with frass. Examination of infested stems revealed galleries inside the wood, where larvae were found (Figure 2c–d). The observed symptoms were consistent with the stem-boring habit of *Nothopeus* sp., whose larvae develop inside clove stems. Previous reports indicate that the larvae may remain inside the stems for an extended period and that severe infestation can lead to tree death [14]. These characteristics highlight the potential importance of stem borer infestation in clove plantations.

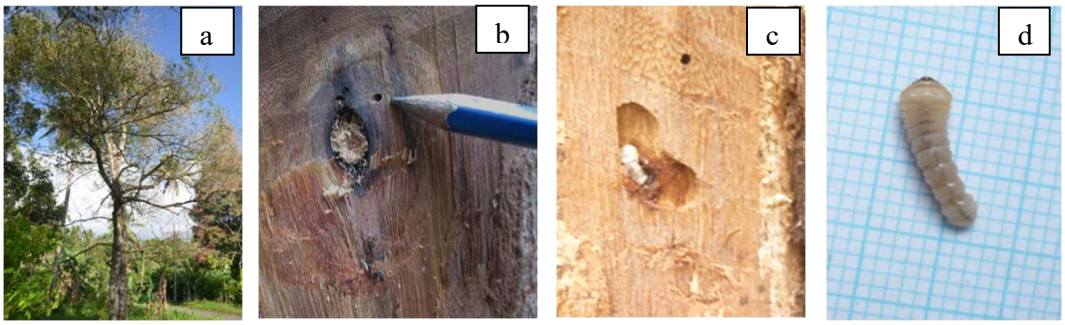


Figure 2. *Symptoms of stem borer infestation on clove: (a) affected clove tree; (b) borer holes on the stem; (c) galleries inside the infested stem; and (d) larva found inside a stem gallery.*

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Leaf spot disease. Leaf spot disease. Leaf spot symptoms were observed mainly on older leaves and appeared as yellowish-brown lesions originating from the leaf margins (Figure 3a). As the symptoms progressed, the affected tissues dried, making the leaf veins more conspicuous. In nursery plants, the disease was also reported to cause young leaves to fall and shoot tips to die.

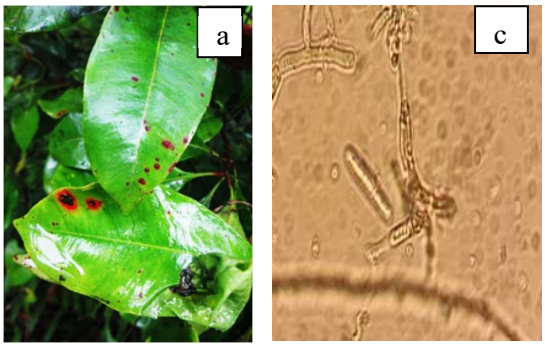


***Figure 3**. Symptoms of clove leaf spot disease and morphological characteristics of the associated fungus: (a) leaf spot symptoms; and (b) conidia of Cylindrocladium sp. observed under a microscope at 400× magnification*

Microscopic examination revealed rounded to cylindrical conidia consisting of one or two cells (Figure 3b). These morphological characteristics, considered alongside the general fungal identification criteria described by Barnett and Hunter [15], provided preliminary evidence for identifying the associated fungus as *Cylindrocladium* sp. However, the observed characteristics were insufficient to confirm its identity at the species level.

3.3. Damage Intensity (DI) and Percentage of Trees Attacked (P) by Pests and Diseases of Clove

Stem borer infestation by *Nothopeus* spp. showed moderate DI and P at the regency level, with substantial variation among districts (Table 1). Waesama recorded the highest damage levels, with severe DI and very severe P, whereas both indicators were mild in Leksula. Ambalau showed moderate levels for both indicators.

Table 1. Damage intensity (DI) and percentage of trees attacked (P) by stem borer and leaf spot disease in clove plantations in South Buru Regency, Maluku, Indonesia.

District	Villages	Stem Borer (*Nothopeus* sp)		Leaf spot disease (*Cylindrocladium* sp)	
		DI (%)	P (%)	DI (%)	P (%)
LEKSULA	NALBESSY	16.30	20.70	12.45	72.23
	LESUKLA	24.83	23.12	8.92	47.87
	Average Disrict	20.56	21.91	10.69	60.05
WAESAMA	WAELIKUT	61.42	85.39	15.50	73.28
	WAEMASSING	65.25	93.38	7.13	43.05
	Average District	63.34	89.39	11.32	58.17

AMBALAU	SIWAR	38.25	33.28	6.15	49.90
	ULIMA	40.83	26.58	2.45	28.55
	Average District	39.54	29.93	4.30	39.23
AVERAGE REGENCY		**41.15**	**47.08**	**8.77**	**52.48**

Field observations and farmer interviews revealed differences in plantation management among districts. Sanitation was reportedly conducted every three months in Leksula but generally only once a year in Waesama. Clove trees in Waesama were also generally older (50–75 years) than those in Leksula (25–50 years), while planting distances ranged from 6 × 6 m to 8 × 8 m across the study sites. Infested or dead trees and tall weeds were observed in some plantations. These differences may be associated with the observed variation in stem borer damage, although their individual effects were not assessed. Regular monitoring and appropriate sanitation of infested plant material may therefore be relevant, particularly in areas with high infestation levels.

Leaf spot disease associated with *Cylindrocladium* sp. showed a different pattern: DI was mild at the regency level, whereas P was severe (Table 1). Symptoms occurred on a relatively high proportion of clove trees, but the average severity of visible tissue damage was low. At the village level, P was highest in Waelikut and Nalbessy. Symptoms were observed mainly on older leaves in the lower and middle parts of the canopy, while young leaves near the shoots appeared less affected. The factors underlying this symptom distribution were not investigated.

South Buru Regency had reported annual rainfall of 2,246.25 mm, an average temperature of 26.4°C, relative humidity of 86.5%, and average wind speed of 3.3 knots. Although warm and humid conditions have been associated with diseases caused by *Calonectria* sp. on other hosts [16], the influence of local climatic conditions on the disease observed in this study was not directly assessed. The fungus was provisionally identified as *Cylindrocladium* sp. based on morphological observations. Because *Cylindrocladium* has historically been used for the asexual morphs of fungi now classified in *Calonectria*, and species identification within this group can be difficult based on morphology alone, assignment to a particular *Calonectria* species is not justified [17]. The formation and role of persistent microsclerotia in the isolate were also not investigated.

Overall, stem borer infestation was most severe in Waesama, whereas leaf spot disease affected a relatively high proportion of trees despite low average damage intensity. These findings support prioritizing stem borer monitoring and management in heavily affected areas and maintaining surveillance for leaf spot disease. The effects of either problem on clove yield were not quantified and cannot be inferred from DI and P alone.

3.4. Pests and Diseases of Nutmeg

Three major pest and disease problems were observed in nutmeg plantations in South Buru Regency: stem borer infestation, wet fruit rot, and dry fruit rot. The stem borer was identified as *Batocera hercules*, while the fungi associated with wet and dry fruit rot were provisionally identified morphologically as *Colletotrichum* sp. and *Stigmina myristicae*, respectively.

Stem borer. Nutmeg trees attacked by *Batocera hercules* exhibited yellowing and wilting leaves, followed by leaf fall and drying of twigs. Infestation symptoms included holes and cracks in the stem, approximately 0.5–1 cm in diameter, with sawdust-like frass accumulating at the base of the stem (Figure 5b–c). When infested stems were split open, dark brown to blackish galleries were visible, and larvae were found inside the galleries (Figure 5c). Severe infestation was associated with tree decline and, in some cases, tree death. These symptoms are consistent with stem borer damage previously reported on nutmeg in Maluku [5].

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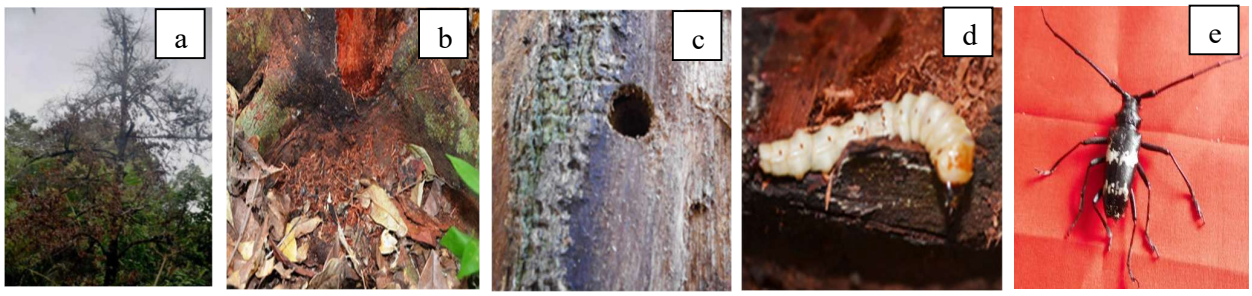


***Figure 5**. Symptoms of stem borer infestation on nutmeg caused by Batocera hercules: (a) affected tree; (b) accumulation of frass at the base of the stem; (c) borer hole in the stem; (d) larva inside the stem gallery; and (e) adult beetle.*

Wet fruit rot. Symptoms of wet fruit rot began as brown lesions at the base of the nutmeg fruit. The lesions enlarged, and the underlying tissues became soft, watery, and rotten (Figure 6a). The fungus isolated from symptomatic fruit produced moderately thick, slightly convex colonies on potato dextrose agar (PDA), with a greyish-white color, even margins, and a cottony texture (Figure 6b). Microscopic examination revealed hyaline, oval, aseptate conidia (Figure 6c). These morphological characteristics were consistent with descriptions of *Colletotrichum gloeosporioides*, which produces hyaline, aseptate conidia that are generally cylindrical to oval ([18]. However, the observed characteristics were not sufficient to confirm the isolate as *C. gloeosporioides*, because morphological identification alone may not reliably distinguish species within the *C. gloeosporioides* species complex. Therefore, the fungus associated with wet fruit rot in South Buru was provisionally identified as *Colletotrichum* sp.



***Figure 6.** Symptoms of wet fruit rot of nutmeg and morphological characteristics of the associated fungus: (a) symptomatic fruit; (b) fungal colony on potato dextrose agar (PDA); and (c) conidia observed under a microscope at 400× magnification.*

Dry fruit rot. Nutmeg fruits affected by dry fruit rot exhibited brown, sunken, and hardened lesions. As symptoms progressed, the affected fruits split open and eventually fell (Figure 7a). Microscopic examination of symptomatic fruit tissue revealed septate, conidium-like structures associated with the diseased tissue (Figure 7b). The observed structures were broadly consistent with descriptions of Stigmina, which produces cylindrical, septate conidia and short conidiophores that may occur in dense clusters associated with stromatic tissue [19]. However, these morphological characteristics alone are insufficient to confirm the identity of the fungus as *Stigmina myristicae*. *Stigmina myristicae* has previously been reported in association with dry fruit rot of nutmeg in Maluku [5]. However, the identification of the fungus in the present study remains provisional because it was based solely on morphological observations.

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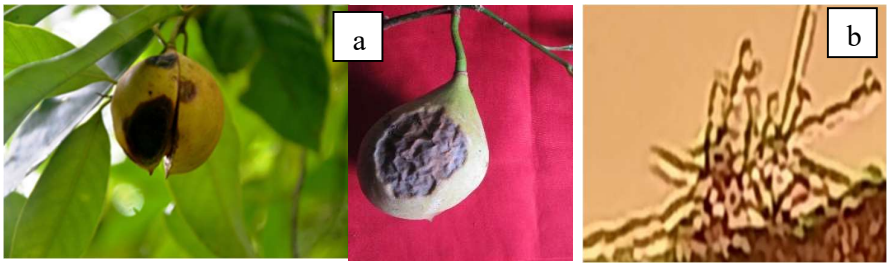


Figure 7. *Symptoms of dry fruit rot of nutmeg and morphological characteristics of the associated fungus: (a) symptomatic fruit; and (b) conidia and conidiophores observed under a microscope at 400× magnification.*

3.5. Damage Intensity (DI) and Percentage of Trees Attacked (P) by Pests and Diseases of Nutmeg

Stem borer infestation by *Batocera hercules* had a mild average DI (9.43%) and P (2.30%) at the regency level (Table 2). Among the three districts, Waesama recorded the highest DI (21.67%) and P (6.42%), whereas both indicators were low in Leksula and Ambalau. No stem borer damage was recorded in Nalbessy or Siwar during the assessment. The absence of recorded attacks in these villages may be related to the immature condition of the observed nutmeg trees, although this relationship was not investigated. Field observations also revealed that some infested or dead plant materials remained in plantations. Although sanitation of such materials may be relevant to pest management, the effects of sanitation practices and other cultivation factors on infestation levels were not directly evaluated. Regular monitoring and appropriate management of infested trees are therefore warranted, particularly in Waesama.

Table 2. Damage intensity (DI) and percentage of trees attacked (P) by pests and diseases of nutmeg in South Buru Regency, Maluku, Indonesia.

District/ Plantation Area (ha)	Villages	Stem Borer (*B. hercules*)		wet fruit rot (*Colletotrichuum sp*)		dry fruit rot (*S. myristicae*)	
		DI (%)	P (%)	DI (%)	P (%)	DI (%)	P (%)
LEKSULA/	NALBESSY	0.00	0.00	0.00	0.00	4.69	5.70
	LESUKLA	12.50	0.53	4.83	10.33	0.67	4.65
	Average District	6.25	0.27	2.42	5.17	2.68	5.18
WAESAMA/	WAELIKUT	33.33	5.15	2.17	14.83	1.50	18.21
	WAEMASSING	10.00	7.69	1.54	13.54	0.45	6.85
	Average District	21.67	6.42	1.86	14.19	0.98	12.53
AMBALAU/	SIWAR	0.00	0.00	0.00	0.00	9.73	17.22
	ULIMA	0.71	0.39	0.00	0.00	5.46	17.37
	Average District	0.36	0.20	0.00	0.00	7.60	17.30
AVERAGE REGENCY		**9.43**	**2.30**	**1.43**	**6.45**	**3.75**	**11.67**

Dry fruit rot associated with *Stigmina myristicae* was recorded in all three districts. Regency-level DI was mild (3.75%), while P was 11.67%, also classified as mild (Table 2). Ambalau recorded the highest district-level DI (7.60%) and P (17.30%), indicating that dry fruit rot was more prevalent there than in the other districts. Diseased fruits and plant debris were observed in some plantations. Such materials may serve as potential sources of inoculum for certain plant pathogens, depending on their survival

and life-cycle characteristics (Kerdraon et al., 2019). However, the survival of the fungus on fallen nutmeg fruits and its contribution to disease spread were not examined. The observed field conditions therefore highlight sanitation as a potential management consideration rather than demonstrating a cause of the differences among districts.

Wet fruit rot associated with *Colletotrichum* sp. was recorded in Leksula and Waesama but was not observed in Ambalau during the survey (Table 2). At the regency level, DI was mild (1.43%) and P was 6.45%. Although the average severity of visible damage was low, Waesama had a higher percentage of affected trees (14.19%) than Leksula (5.17%). Species of *Colletotrichum* are associated with fruit rot and other plant diseases, and infected plant tissues can serve as potential sources of inoculum. Rain splash is also a recognized dispersal mechanism for conidia in some *Colletotrichum*–host systems. Nevertheless, the identity of the fungus associated with wet fruit rot in this study remains provisional, and the roles of infected plant debris, rain splash, insects, and other potential dispersal agents were not directly investigated.

Overall, DI and P for all three problems were classified as mild at the regency level. Stem borer infestation had the highest average DI (9.43%), whereas dry fruit rot had the highest P (11.67%). The distribution of damage varied among districts, with Waesama showing the highest stem borer infestation and Ambalau showing the highest levels of dry fruit rot. These findings support continued monitoring and appropriate sanitation of infested trees and diseased fruits. However, the effects of these pests and diseases on nutmeg yield were not quantified and cannot be inferred from DI and P alone.

4. Conclusion

Cultivation practices in the surveyed *dusung* farming areas of South Buru Regency were generally inconsistent. Pest and disease assessments revealed contrasting patterns between clove and nutmeg. In clove, stem borer infestation by *Nothopeus* spp. had moderate damage intensity (DI; 41.15%) and percentage of trees attacked (P; 47.08%), whereas leaf spot associated with *Cylindrocladium* sp. had mild DI (8.77%) but severe P (52.48%). In nutmeg, stem borer infestation by *Batocera hercules*, wet fruit rot associated with *Colletotrichum* sp., and dry fruit rot associated with *Stigmina myristicae* all had mild DI and P at the regency level. Stem borer infestation had the highest DI (9.43%), while dry fruit rot had the highest P (11.67%). Wet fruit rot had a DI of 1.43% and P of 6.45%, indicating relatively low damage intensity and distribution during the survey. These findings highlight the importance of considering both damage intensity and the proportion of affected trees when assessing crop health. Regular monitoring, improved plantation sanitation, and appropriate pest and disease management are recommended, particularly in locations with higher infestation or disease occurrence.

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