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Attacks and Spatial Distribution of Clove Stem Borer in Southeast Minahasa Regency

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ABSTRACT

The main problem encountered in the field is the attack of borer pests that attack the stems of clove plants. This study aims to determine the types, percentage of attacks, and spatial distribution patterns of stem borers attacking clove plants in Southeast Minahasa Regency. The research method was to directly observe the symptoms of attacks by clove stem borers that had been randomly identified in several villages. The spatial distribution pattern was analyzed using the Standardized Morosita Index (Ip). The results of the study showed that the type of stem borer pest attacking clove plants in Southeast Minahasa Regency was *Hexamitodera semivelutina* Hell. (Coleoptera: Cerambycidae). The average percentage of stem borer pest attacks, *H. semivelutina*, in Pasan Subdistrict was highest in Liwutung 1 Village (33.50%) and lowest in Towuntu Village (25.10%); in East Ratahan District, the highest average percentage of attacks was in Wioi Village (30.40%) and the lowest in Wioi 3 Village (26.30%); while in Belang District, the highest average percentage of attacks was in Watuliney Village (29.90%) and the lowest in Belang Village (19.60%). Overall, the average percentage of attacks by the stem borer, *H. semivelutina*, in Southeast Minahasa Regency was 27.92%, ranging from 19.60% to 33.50%. The distribution pattern of the stem borer pest, *H. semivelutina*, in Southeast Minahasa Regency spreads in clusters with an Ip value of 2.16.

Keywords: Clove; *Hexamitodera semivelutina* Hell.; spatial distribution; Standardized Morosita Index

INTRODUCTION

Indonesia is one of the world's leading producers of cloves, contributing around 80% of global demand. The islands of Sulawesi and Java are the main centers of clove production in the country. Unlike other plantation commodities, which are generally managed by the private sector or the government, around 90% of clove production in Indonesia comes from smallholder plantations. Therefore, this sector is closely linked to the economic conditions of clove farming communities. Extensive clove plantations can be found in the provinces of North Sulawesi, South Sulawesi, Central Sulawesi, East Java, Central Java, West Java, Aceh, and North Maluku. These eight provinces contribute more than 70% of the total national clove production (Anonymous, 2014).

Clove productivity in Indonesia ranges from 150 to 600 kilograms per hectare, with North Sulawesi Province recorded as the region with the highest productivity (Runayat et al., 2014). This level of productivity is greatly influenced by factors such as the suitability of agroecological and agroclimatic conditions, as well as aspects of plant maintenance, including pest and disease control. In addition to the main pests and diseases that have long been known to attack cloves in North Sulawesi, such as the stem borer *Hexamitodera semivelutina* Heller (Kalshoven, 1981) and the clove leaf fall disease (GDC) (Van Wyk et al., 2005), recent research has also identified the presence of a new pest, *Cryptophasa watungi* (Sutrisno et al., 2015; Rante et al., 2017). Furthermore, Rante et al. (2016) reported the results of a survey in the South Bolaang Mongondow region which found symptoms of sudden death in clove plants. These symptoms were characterized by a complete change in leaf color to brown, as well as the presence

of holes in the stems, which were thought to be caused by insects of the genus *Agrilus* sp., a new pest of clove plants.

Pest and disease attacks disrupt plant growth, reduce production, and even cause plant death. The decline in clove production due to pest and disease attacks can reach 10.0–25.0% (Anonymous, 2016). As reported by Kalshoven (1981) and Liew et al. (2003), several important pests and diseases that attack clove plants are stem borers, branch borers, aphids that attack leaves, fungal pathogens that attack leaves, including leaf pox and cloves leaf fall (GDC), causing leaf fall and even plant death. Research conducted by Rante et al. (2015) found several types of pests and diseases that had not previously been reported to attack clove plants. These pests and diseases include *Paraputo odontomachi* (Hemiptera: Pseudococidae), *Paralecta* sp. (Lepidoptera: Xyloryctidae) and several other types of pests and diseases. Furthermore, it was reported by Rante et al. (2016), that a survey in South Bolaang Mongondow Regency also found several types of pests that had never been reported to attack clove plants. One of these important pests is from the genus *Agrilus* sp. (Coleoptera: Buprestidae), which severely damages clove stems. Several researchers in the United States have reported that this pest is very destructive to trees and has become a national problem in the United States (USA) and North America (Smitley et al., 2008; Bauer et al., 2015; Herms et al., 2014).

METHODS

The research was conducted in clove plantations in Southeast Minahasa Regency from May to December 2024. The materials and equipment used in the research were stem borer pest samples, hand counters, insect nets, collection bottles, brushes, loupes, sample boxes, machetes/larvae collection tools, plastic bags, cameras, writing instruments, and others. The research was conducted using a survey method at predetermined locations. The locations surveyed were villages in Southeast Minahasa Regency that had clove trees. Two villages with the highest number of clove trees were selected in each subdistrict as observation sites, which were coordinated in advance with the Southeast Minahasa Regency Agricultural Office.

The activities carried out in this study were: (1) identifying the types of stem borers, based on the presence or absence of powder/dirt and/or blackish stains/liquid found on the surface of the clove stems; (2) determining the percentage of stem borer attacks on clove plants; two observation points were designated in each village, and 100 clove trees were selected as observation samples at each observation point. Each plant is observed based on the symptoms visible on the clove plant stems and (3) to determine the spatial distribution pattern of these pests. The spatial distribution pattern of stem borers on clove plants is calculated using the Standardized Morisita Index (Ip) formula (Jongjitvimol, 2005). Furthermore, it was stated that to calculate Ip, the Morisita Index (Iδ) must first be calculated. If $Ip < 0$, the distribution pattern is uniform; $Ip = 0$, the distribution pattern is random; and $Ip > 0$, the distribution pattern is clustered.

RESULTS AND DISCUSSION

A. Types of Stem Borers

Based on observations of the symptoms of attack visible on the stems of clove plants, the type of stem borer pest attacking clove plantations in Southeast Minahasa Regency is *Hexamitodera semivelutina* Hell. (Coleoptera: Cerambycidae) (**Figure 1A-1B**). Meanwhile, the stem borer pest, *Agrilus* sp. (Buprestidae), was not found to have attacked the stems of clove plants during observations in Southeast Minahasa Regency. As reported by Rante et al. (2019), to date, the stem borer pest, *Agrilus* sp. (Buprestidae), has only been found attacking clove tree stems in Pinolosian Subdistrict, South Bolaang Mongondow Regency (**Figure 1C-1D**).

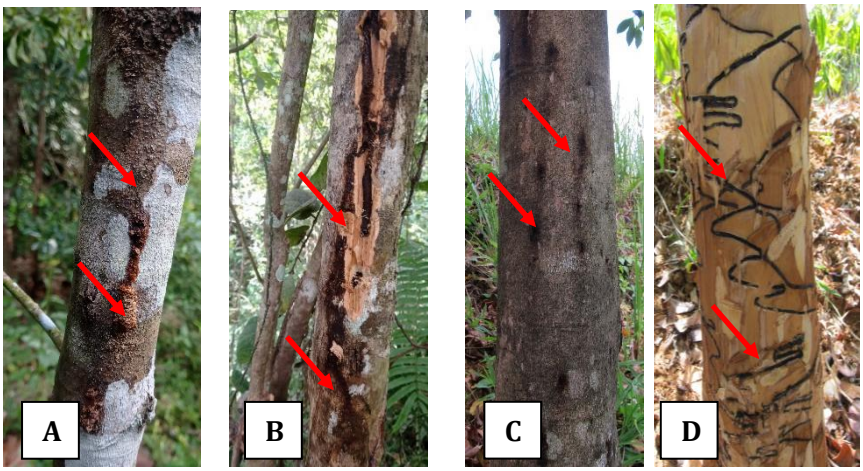

Figure 1. Symptoms of Stem Borer Pest Attack
A. *H. semivelutina* frass on the surface of the stem
B. *H. semivelutina* larval frass
C. Black spots/fluid from *Agrilus* sp. on the surface of the stem
D. *Agrilus* sp. larval frass on the cambium when the bark is peeled

Figure 1 shows that the symptoms of *H. semivelutina* stem borer attack are powder on the surface of the stem. Sometimes the powder appears wet, but it is also often found dry. Wet powder indicates that the larvae are actively boring into the clove tree stems. This is consistent with the report by Meray et al. (2021) that symptoms of clove stem borer infestation include powder on the surface of the stem. When compared to the stem borer, *Agrilus* sp. (Buprestidae), which attacks clove plants in South Bolaang Mongondow Regency, the symptoms are very different.

Rante et al. (2019) reported that symptoms of *Agrilus* sp. infestation include liquid spots on the surface of the trunk, not in the form of powder. When the bark of the clove tree is split open to search for larvae, the symptoms of infestation reveal circular movements of the larvae on the trunk of the clove tree, specifically gnawing on the cambium of the clove plant. This attack causes the clove plant to wither and slowly die due to the poor transport of water and nutrients to the surface of the plant as a result of damage to the xylem and phloem tissues.

B. Percentage of Clove Stem Borer Pest Attacks

The results of observations of the average percentage of stem borer pest attacks, *H. semivelutina*, in several villages and subdistricts in Southeast Minahasa Regency at each observation (observations 1-5) can be seen in **Table 1**.

Table 1. Average percentage of stem borer infestation, *H. semivelutina*, on clove plants in several villages and subdistricts in Southeast Minahasa Regency

Sub-District	Villages	Average Attack Percentage (%) in Observation					Average
		I	II	III	IV	V	
Pasan	Liwutung	27.00	26.50	39.00	25.00	31,00	29.70
	Liwutung 1	18.50	39.00	20.00	48.00	42.00	33.50
	Towuntu	29.50	27.00	29.00	22.50	17.50	25.10
	Tolombukan	32.00	29.50	29.00	31.50	39.50	32.30
Ratahan Timur	Wioi	36.50	33.50	26.00	39.50	16.50	30.40
	Wioi 3	22.00	28.50	25.50	36.50	19.00	26.30
	Wongkai	20.00	34.50	24.50	24.50	36.00	27.90
	Pangu	33.00	28.00	25.00	22.50	25.00	26.70
Belang	Belang	16.00	21.50	14.50	24.00	22.00	19.60
	Buku	24.50	36.00	35.50	13.00	26.50	27.10
	Ponosakan	25.00	36.00	34.00	22.50	15.00	26.50
	Watuliney	37.50	26.00	33.00	27.50	25.50	29.90
General Average							27.92

Based on **Table 1**, it can be seen that the average percentage of *H. semivelutina* stem borer attacks across all observation locations shows considerable variation. In Pasan Subdistrict, the highest attack rate occurred in Liwutung 1 Village with a percentage of 33.50%, while the lowest attack rate was found in Towuntu Village at 25.10%. In East Ratahan District, the highest infestation rate was found in Wioi Village (30.40%) and the lowest in Wioi 3 Village (26.30%). Meanwhile, in Belang District, the highest infestation was recorded in Watuliney Village at 29.90% and the lowest in Belang Village at 19.60%. Overall, the average percentage of *H. semivelutina* stem borer infestation in Southeast Minahasa Regency reached 27.92%, ranging from 19.60% in Belang Village to 33.50% in Liwutung 1 Village (**Figure 2**). 27.92%, with a range of attacks from 19.60% (Belang Village) to 33.50% (Liwutung 1 Village) (**Figure 2**).

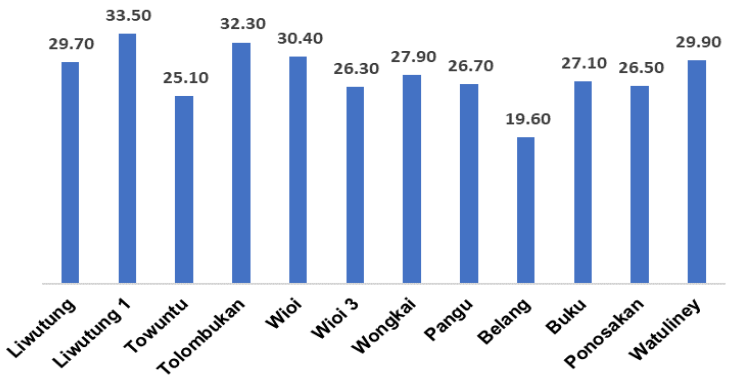

Figure 2. Average percentage of stem borer attacks, *H. semivelutina*, at several sampling locations

When compared to conditions in East Bolaang Mongondow Regency, the incidence of *H. semivelutina* stem borer infestation was found to be higher, ranging from 49.20 to 79.40% (Meray et al., 2021). Meanwhile, according to a report by Rante et al. (2022), the average percentage of *H. semivelutina* infestation in Minahasa Regency reached its highest level in Seretan Village at 46.90% and its lowest in Tincep Village at 31.80%. In South Minahasa Regency, the highest infestation occurred in Kumelembuai Village at 47.20%, while the lowest was in North Pakuweru Village at 30.30%. In contrast, attacks by the clove stem borer *Agrillus* sp. (Coleoptera: Buprestidae) were only found in South Bolaang Mongondow Regency; there were no signs of attacks by this pest at the observation sites in Southeast Minahasa Regency. This condition is in line with the results of studies by Meray et al. (2021) and Rante et al. (2022), which reported that *Agrillus* sp. pests had not been found to attack clove plants in East Bolaang Mongondow, Minahasa, or South Minahasa Regencies.

C. Distribution Pattern of Stem Borer Pests

Based on the results of the standardized Morisita Index (Ip) calculation for the stem borer pest *H. semivelutina*, an Ip value of 2.16 was obtained in Southeast Minahasa Regency. This value indicates that the spread of the *H. semivelutina* pest is aggregative, as indicated by an Ip value > 0. Knowing the distribution pattern of a Plant Pest Organism is very important because this information is used to determine the appropriate sampling method to support the effectiveness of integrated pest control and management (IPM), as well as a basis for research planning (Rante et al., 2019). Furthermore, understanding pest distribution patterns can also be utilized in determining observation locations for monitoring activities, developing IPM management programs, and forecasting potential pest population outbreaks in the field.

To determine the appropriate sampling pattern and number, it is necessary to first understand the distribution pattern of a pest (Jongjitvimol, 2005). Furthermore, it is explained that in general there are three types of insect distribution patterns that are often found in the field, namely uniform, random, and clustered patterns. An even distribution pattern is rarely found, because this condition implies that the distance between individual pests is the same, so that their distribution is completely uniform. According to Southwood (1975), most types of insects tend to have a clustered distribution pattern. Based on the results of this study, it is known that the spatial distribution of the stem borer pest *H. semivelutina* on clove plants in Southeast Minahasa Regency shows a clustered pattern. Therefore, the most appropriate sampling method for observing this pest is to use a regular or systematic pattern.

CONCLUSIONS

The type of stem borer pest that attacks clove plants in Southeast Minahasa Regency is *Hexamitodera semivelutina* Hell. (Coleoptera: Cerambycidae). No clove stem borer pests, *Agrilus* sp. (Coleoptera: Buprestidae), have been found to attack clove plants in the regency. Overall, the average percentage of *H. semivelutina* attacks in Southeast Minahasa Regency is 27.92%, ranging from 19.60% to 33.50%. The distribution pattern of the stem borer pest, *H.*

semivelutina, in Southeast Minahasa Regency is clustered (Ip > 0) with a value of Ip = 2.16.

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