

Species Composition of Rice Stem Borers in Bone Regency, South Sulawesi

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Abstract
Rice stem borers are one of the important pest groups in rice plants that can cause damage during both the vegetative and generative stages and potentially reduce yield. Information on the species composition of rice stem borers in a given region is needed to determine the presence and dominance of species as a basis for effective pest management. The purpose of this study is to determine the species composition of rice stem borers collected from rice fields in Bone Regency, South Sulawesi. Adult insects were collected using two methods: confining rice plants showing deadheart symptoms for approximately 15 days and setting up light traps for one growing season. The adults collected were identified based on their morphological characteristics, and the proportion of each species was then calculated. The results of the plant enclosure experiment showed two species: *Scirpophaga innotata* (70%) and *Scirpophaga incertulas* (30%). Meanwhile, the light traps yielded three species: *S. innotata* (57.39%), *S. incertulas* (36.45%), and *Chilo suppressalis* (6.16%). Overall, the species composition of rice stem borer pests in Bone Regency consists of *S. innotata*, *S. incertulas*, *C. suppressalis* and *Sesamia inferens*. *Scirpophaga innotata* is the most dominant species based on the proportion of adults collected through plant trapping and light traps.

Keywords: Adult insect, light trap, *Chilo suppressalis, Scirpophaga incertulas*, *Scirpophaga innotata*

1. Introduction

Rice stem borers (*Scirpophaga* spp.) are major pests of rice that cause significant losses in Indonesia and several countries in Asia (Sarawan *et al*., 2024) . Stem borer larvae damage plant tissues by boring into the stems, causing deadheart symptoms, characterized by the death of the plant shoots during the vegetative stage, and whitehead symptoms, characterized by panicles that emerge white and empty during the generative stage (Saleh, 2023) . In most rice-producing regions, stem borer complexes consisting of several species cause significant yield losses (Horgan, 2023; Sanyal *et al*., 2025). Major changes in rice production practices can cause shifts in the composition of regional stem borer communities, including changes in species dominance (Horgan *et al*., 2021). Horgan (2023) also stated that native stem borer communities can sometimes experience shifts in species dominance; for example, in Japan, Korea, and China, dominance shifted from *Scirpophaga incertulas* (Walker) to *Chilo suppressalis* (Walker) beginning in the 1960s. In some regions of Malaysia, dominance shifted from *Chilo polychrysus* (Meyrick) to *Scirpophaga incertulas* during the 1970s (Khari & Hamid, 2022), and in some parts of the Philippines, from *Scirpophaga incertulas* to *Scirpophaga innotata* (Walker) during the 1980s (Litsinger *et al*., 2011). These shifts in dominance were partly caused by changes in rice production practices, including increased irrigation, the transition from single to double cropping, the shift from staggered to synchronized planting, and the widespread adoption of improved rice varieties (Horgan *et al*., 2021).

The species composition of rice stem borers shows variations in dominance across regions. A study of rice ecosystems in Karaikal, Puducherry, India, identified *Scirpophaga incertulas* as the dominant species (Nishanthini & Kandibane, 2025). Similar results were reported in the coastal region of Andhra Pradesh, India, with *Scirpophaga incertulas* as the most dominant species, followed by *Sesamia inferens* (Swarupa *et al*., 2024). Horgan (2023) identified *Scirpophaga incertulas*, *Chilo suppressalis*, and *Scirpophaga innotata* as species that are often dominant in rice stem borer communities in Asia. Meanwhile, *Chilo suppressalis* has been reported as the predominant species in Northeast Asia (Horgan et al., 2021).

Outbreaks of rice stem borers are consistently reported in nearly all regions of Indonesia, and some areas show an increasing trend over time (Uguy *et al*., 2020). In Indonesia, there are six species of rice stem borers: the yellow rice stem borer (*Scirpophaga incertulas*), the white rice stem borer (*Scirpophaga innotata*), the pink rice stem borer (*Sesamia inferens*), the striped rice stem borer (*Chilo suppressalis*), the black-headed rice stem borer (*Chilo polychrysus*), and the shiny rice stem borer (*Chilo auricilius*) (Anwar *et al*., 2024; Sriningsih *et al.*, 2020; Bahar *et al*., 2020).

The dominance of rice stem borer species varies across regions in Indonesia. *Scirpophaga incertulas* has been reported as the dominant species in Jambi, Bali, Java, Lampung, and South Kalimantan provinces, followed by *Sesamia inferens*, *Chilo suppressalis*, and *Scirpophaga innotata* (Wilyus *et al*., 2013; Yuliadhi, 2021; Tjandrakirana *et al*., 2007). Meanwhile, *Scirpophaga innotata* is reported to be dominant in Central Sulawesi and North Sulawesi (Bahar *et al*., 2020; Manoppo *et al*., 2022). In South Sulawesi, the dominant species is *S. innotata*, followed by *Chilo suppressalis*, *Sesamia inferens*, and *Chilo polychrysus* (Tjandrakirana et al., 2007).

Bone Regency is one of the main rice production centers in South Sulawesi Province, with a relatively large rice field area, reaching 118,646 hectares, and has the potential to be further developed to support economic growth in the agricultural sector (Atira *et al*., 2021). Rice stem borers are one of the constraints to rice production in Bone Regency. These pests have been found attacking rice plants in every growing season and have been shown to cause yield losses.

To address the problem of rice stem borers, the implementation of Integrated Pest Management (IPM) needs to be supported by a comprehensive understanding of the biology, ecology, population dynamics, and economic aspects of the pests as a basis for determining appropriate management strategies (January *et al*., 2020). Therefore, information on the species composition of rice stem borers in a region is needed to determine the presence and dominance of species as a basis for appropriate pest management.

Information regarding the species composition and dominant species of rice stem borers in the region remains limited. Therefore, this study was conducted to determine the species composition of rice stem borer pests collected from rice fields in Bone Regency, South Sulawesi.

2. Methodology

Study Area

The study was conducted in rice fields in Sibulue Subdistrict, Bone Regency, at elevations ranging from 0 to 30 meters above sea level, and the identification of rice stem borers was carried out at the Pest Laboratory, Faculty of Agriculture, Hasanuddin University, Makassar, South Sulawesi. The study took place from February through May 2026.

Materials and Tools

The materials used in this study were 70% alcohol, water, and liquid detergent. The tools used included a light trap, a trap container, a containment net, tweezers, sample bottles, a stereo microscope, a camera, and writing utensils.

Sampling methods

The identification of adult stem borer species and their population dynamics were determined using light trap treatments, as well as enclosures made of mosquito netting, to directly assess species composition based on crop symptoms. Three experimental units were set up for each treatment. The research procedures were as follows:

Installation of Light Traps

Light traps were installed when the plants were 10 days after sowing (DAS), with a spacing of approximately 100 meters between traps. The light traps were installed at a height of 1.5 m above ground level. Each light trap was equipped with a collection container holding approximately 750 mL of water to which 2 drops of liquid detergent had been added. The distance between the light trap and the trap container is about 10 cm. The light traps are turned on at 6:00 p.m. WITA and turned off in the morning at 6:00 a.m. WITA. Observations are conducted from when the rice is 13 days after sowing (DAS) until harvest, with observations taken every 3 days.

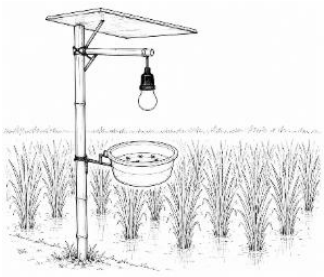


Figure 1: Installation of a Light Trap

Installation of the Enclosure

Enclosure was carried out using a 60 × 60 × 130 cm net installed over rice plants in the vegetative phase after most clumps showed deadheart symptoms. The confinement lasted for approximately 15 days. Observations were made on the number and types of adult rice stem borers emerging from the rice stands enclosed with the net.

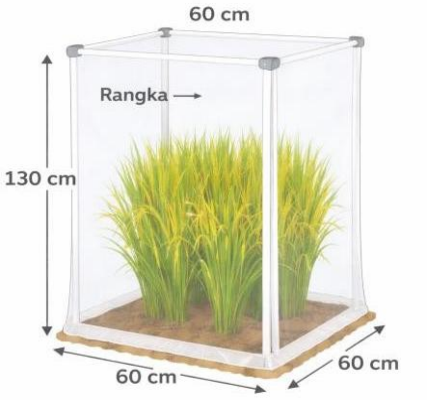


Figure 2: Installation of the Enclosure

Larvae Sampling

Larvae sampling was conducted directly on rice plants exhibiting symptoms of infestation, such as sunken leaves and leaf blight. The larvae found were collected for identification and comparison with adult specimens obtained through light traps and enclosure.

Identification of Rice Stem Borers

Samples of rice stem borer larvae and adults collected during field observations were morphologically identified in the laboratory using a stereo microscope to determine the species of rice stem borers present at the study site.

Data Analysis

The species composition of rice stem borers in light trap and enclosure catches was calculated based on the proportion of individuals of each species relative to the total number of individuals of all species, using the following formula, as cited in (Jawuoro *et al*., 2017).

$$\mathbf{SCi} = \frac{ni}{N} \times 100\ \%$$

Where:

Sci represents the composition of species-i (%), ni represents the number of individuals of species-i, and N represents the total number of individuals of all species.

3. Results and Discussion

The results of the study indicate that four species of rice stem borers were found in Bone Regency, South Sulawesi: *Scirpophaga innotata*, *Scirpophaga incertulas*, *Chilo suppressalis*, and *Sesamia inferens*. These four species were identified based on observations of larvae collected from infested rice plants and adults captured using enclosure and light trap methods (Tables 1 and 2; Figure 5). These findings indicate that the rice stem borer community at the study site consists of several species with varying compositions.

Table 1: Species composition of rice stem borers based on enclosure results

Species	Number of Adults	Species Composition (%)
Scirpophaga incertulas	3	30
Scirpophaga innotata	7	70

Based on the plant enclosure results, the composition of adult moths showed that *Scirpophaga innotata* was the most dominant species, with a proportion of 70%, while *Scirpophaga incertulas* accounted for 30%.

Table 2: Species composition of rice stem borers based on light trap results

Species	Number of Adults	Species Composition (%)
Scirpophaga incertulas	503	36.45
Scirpophaga innotata	792	57.39
Chilo suppressalis	85	6.16

The results of the light-trap captures showed that *Scirpophaga innotata* had the highest capture proportion, at 57.39%, followed by *Scirpophaga incertulas* at 36.45% and *Chilo suppressalis* at 6.16%. The higher proportion of *Scirpophaga innotata* compared with the other species indicates that this species was the most dominant rice stem borer based on the adult captures obtained during one growing season. Meanwhile, the relatively low proportion of *Chilo suppressalis* indicates that the presence of this species at the study site was lower than that of *Scirpophaga innotata* and *Scirpophaga incertulas*. The dominance of *Scirpophaga innotata* in the light traps also supports the results of the plant enclosure method (Table 1), which showed that this species had the highest proportion in the rice stem borer community at the study site.

The dominance of *Scirpophaga innotata* in both observation methods indicates that this species has a higher relative abundance and prevalence compared to other rice stem borer species at the study site. These results are consistent with those of Tjandrakirana *et al*. (2007), who reported that *Scirpophaga innotata* is one of the dominant rice stem borer species in South Sulawesi. This contrasts with the Java region, where the dominant species is *Scirpophaga incertulas* (Iqbal *et al*., 2023). According to Sriningsih *et al*. (2020), the white rice stem borer exhibits a clustered population distribution pattern, and the intensity of its attacks spreads throughout the rice crop, potentially causing higher yield losses compared to other rice stem borers.

Based on the adult capture results in Tables 1 and 2, *Scirpophaga incertulas* is the species with the second-highest abundance after *Scirpophaga innotata*. This finding indicates a difference in the species composition of rice stem borers compared to that reported by Tjandrakirana *et al*. (2007) in South Sulawesi. That report stated that S. innotata was the dominant species, followed by *Chilo suppressalis*, *Sesamia inferens*, and *Chilo polychrysus*, while *Scirpophaga incertulas* was not listed among those species. The presence of *S. inferens* in this study was also supported by the identification of larvae found on symptomatic rice plants (Figure 5d), although this species was not obtained as an adult through either the light-trap or plant-enclosure methods.

These differences in species composition are thought to be related to changes in agroecosystem conditions over time, including changes in environmental conditions, cropping patterns, and rice cultivation practices that can influence the composition and dominance of each rice stem borer species. Horgan *et al*., (2021) state that changes in rice production practices can affect the composition of rice stem borer communities at the regional level, including shifts in interspecies dominance. Furthermore, Horgan (2023) explains that the dominance of rice stem borer species can vary regionally and is influenced by environmental conditions as well as the rice production systems employed. Thus, the emergence of *Scirpophaga incertulas* as the species with the second-highest abundance in this study may indicate temporal and regional variations in the composition of rice stem borer communities in South Sulawesi.

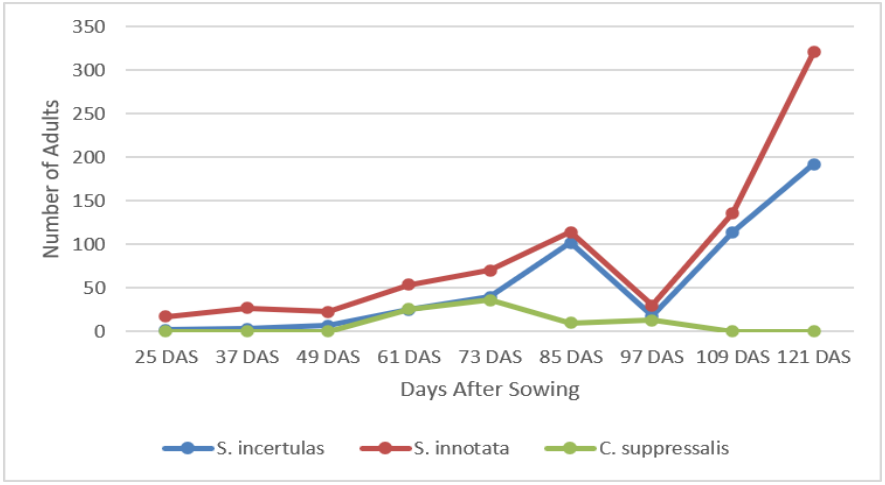


Figure 3: Population dynamics of each rice stem borer species based on light trap catches over the course of one growing season.

Figure 3 shows that the number of captures for each species fluctuates over time, indicating that adult activity does not occur at a constant rate throughout the plant's growth. Based on the graph, *Scirpophaga innotata* was found throughout all phases of rice plant growth. This is consistent with Horgan (2023), who stated that *Scirpophaga innotata* infestations can occur from the early tillering stage through the end of plant growth and that this species is able to survive prolonged periods of drought through a diapause mechanism. *Scirpophaga incertulas* was found from the early tillering stage through the end of rice plant

growth. This is consistent with Horgan *et al*., (2021), who stated that *Scirpophaga incertulas* infestations occur from the early tillering stage through the end of plant growth and that this species prefers plants with a large number of tillers. Meanwhile, *Chilo suppressalis* was found in the highest numbers during the middle to late tillering stage. This is consistent with Horgan *et al*., (2021), who stated that *Chilo suppressalis* infestation generally occurs during the middle to late tillering stage, with poorer development in mature plants, and is more commonly found in plants with thick stems.

The species composition pattern in Bone Regency indicates the coexistence of *Scirpophaga innotata* and *Scirpophaga incertulas*, which differs from the situation in Koronadal, South Cotabato, Philippines, where a shift in dominance from *S. incertulas* to *S. innotata* has been reported (Litsinger *et al*., 2006). In Bone Regency, *Scirpophaga innotata* remained the more dominant species, while *Scirpophaga incertulas* still accounted for a relatively high proportion, indicating that a complete shift in dominance had not occurred. Litsinger *et al*., (2006) [11] attributed the dominance of *Scirpophaga innotata* in South Cotabato to its ability to survive dry periods through diapause. This difference in species dominance patterns suggests that the agroecosystem conditions in Bone Regency still support the coexistence of *Scirpophaga innotata* and *Scirpophaga incertulas*.



(a) (b) (c)

Figure 4: Documentation of adult rice stem borer species: (a) *S. incertulas*, (b) *S. innotata*, and (c) *C. suppressalis*.

The morphology of the adult moths of each rice stem borer species obtained from the light-trap captures is presented in Figure 4. The forewings of *Scirpophaga incertulas* moths are light brown to yellowish in color, with a distinct black spot in the middle (Figure 4a). *Scirpophaga innotata* moths are pure white in color and have fringed wings (Figure 4b). Each wing of *Chilo suppressalis* has a series of spots and is light brown in color (Figure 4c).



(a) (b) (c) (d)

Figure 5: Documentation of rice stem borer larvae: (a) *S. incertulas*, (b) *S. innotata*, (c) *C. suppressalis*, and (d) *S. inferens*.

The larval observations showed that four species of rice stem borers were collected directly from symptomatic plants, namely *Scirpophaga innotata*, *Scirpophaga incertulas*, *Chilo suppressalis*, and *Sesamia inferens*. The body of *Scirpophaga incertulas* larvae is yellowish-green, and the head is brown (Figure 5a). The body of *Scirpophaga innotata* larvae is white or yellowish-white, and the head is brown (Figure 5b). The body of *Chilo suppressalis* larvae is slightly grayish-cream, with five brown stripes on the body, while the head is brown (Figure 5c). The dorsal side of *Sesamia inferens* larvae is light pink, while the lateral side is light pink to white, and the head is brownish-pink (Figure 5d).

The absence of *Sesamia inferens* in light traps, even though its larvae were found on plants in the field (Figure 5d), indicates the limitations of light traps in detecting this species. This is consistent with Singh & Kular (2015), who reported that *Sesamia inferens* adults are not strongly attracted to light traps, so adult captures do not always reflect the level of infestation in the field.44.

4. Conclusion

The rice stem borer species found at the study site were *Scirpophaga innotata*, *Scirpophaga incertulas*, *Chilo suppressalis*, and *Sesamia inferens*. These four species were identified based on the presence of larvae on symptomatic plants, while the adult stage included *Scirpophaga innotata*, *Scirpophaga incertulas*, and *Chilo suppressalis*. The plant enclosure and light-trap results showed that *Scirpophaga. innotata* was the dominant species. The consistent dominance of *Scirpophaga innotata* in both methods indicates that this species had the highest relative abundance in Bone Regency, South Sulawesi.

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