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RICE BROWN PLANTHOPPER INCIDENCE AND DIVERSITY OF NATURAL ENEMIES IN INDONESIA

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ABSTRACT

Rice brown planthopper *Nilaparvata lugens* Stål (BPH) infestations reduce rice yield. This study assessed the BPH incidence and natural enemies in Mekongga rice, Tatah Belayung, South Banjarmasin District, Banjarmasin City, from August to October 2023. This study revealed that BPH density was 0.11 individuals/plant, below the economic threshold. The natural of Hymenoptera enemy community comprised 8 orders and 37 families, dominated by Anthocoridae (Hymenoptera). Shannon-Wiener diversity index of 2.8457 and low dominance index of 0.0881 indicated moderate natural enemy diversity.

Key words: *Nilaparvata lugens*, Aranea, Coleoptera, Hymenoptera, Shannon-Wiener index, dominance index, peatland, predator, parasitoid, abundance, rice, incidence, density, economic threshold

Brown planthopper *Nilaparvata lugens* Stål is a significant pest in rice cultivation. This pest is a vector insect of Rice Ragged Stunt Virus (RRSV) and Rice Grassy Stunt Virus (RGSV). Symptoms of infested rice plants will turn dwarf, brownish-yellow leaves (hopper burn), and hollow rice grains due to the plant being unable to carry out the photosynthesis process due to a decrease in chlorophyll and protein content in the leaves (Darmadi and Alawiyah, 2018; Ramli et al., 2018). Incidence of *N. lugens* is strongly influenced by abiotic factors such as temperature, humidity, and rainfall. Temperature plays an essential role in insect distribution, development, survival, and reproduction (Bale, 2002). In addition, biotic factors such as the presence of natural enemies and plant varieties can affect the presence of *N. lugens* in the field (Sianipar et al., 2017). Natural enemies such as predators and parasitoids help suppress *N. lugens* and are environmentally friendly. The advantages of natural enemies are that they do not cause new pest explosions, are available in the field, do not cause resistance to host insects, and are environmentally friendly (Sanda and Sunusi, 2013).

In a study by Soedijo and Pramudi (2015), several predators such as *Coccinella* sp., *Paederus fuscipes*, *Atypena* sp., *Lycosa pseudoannulatea*, *Tetragnatha maxillosa*, *Oxyopes javanus*, and *Carrhotus sannio* were found effective in controlling *N. lugens*. Parasitoid insects that commonly attack eggs and nymphs of *N. lugens* include *Aprostocetus* sp., *Gonatocerus* sp., *Anagrus nilaparvatae*, *Oligosita* sp., *Tetrastichus formosanus*, and *Cyrtogaster vulgaris* (Haryati et al., 2016; Abdilah and Susilo, 2020). This study aims to determine the incidence of *N. lugens* and natural enemies in Tatah Belayung, South Kalimantan.

MATERIALS AND METHODS

This study was conducted in Tatah Belayung, Banjarmasin City, South Kalimantan (3°22'13.8 "S 114°36'28.5 "E) from August to October 2023. The population density was determined by observing 10% of the total number of rice clumps (Sembiring and Mendes, 2022). The incidence was calculated manually at the base of the rice plant stem that has been selected previously. Pests were collected using a small brush and transferred into a collection bottle containing 70% alcohol. Natural enemy samples were taken using sweep nets and yellow sticky traps (Ikhsan et al., 2021). Natural enemy insects were taken from the research field area by determining the experimental subplots, placing five yellow traps scattered in each subplot/plot for 10 hours, and using a sweep net for five double swings at 07.00-10.00 AM. Samples of natural enemies that were successfully obtained were then identified and categorized into predatory and parasitoid insects based on references from Shepard et al. (1987), Goulet and Huber (1994), and Barrion and Litsinger (1995). The diversity of natural enemies was analyzed using the Shannon-Wiener (H') diversity index (Krebs, 1998) and the Simpson (D) dominance index (Simpson, 1949) calculated using Microsoft Excel.

RESULTS AND DISCUSSION

Young rice stalks are a food source for *N. lugens*, increasing the population in the third observation. This study, in line with Hasan et al. (2021), observed that of *N. lugens* counts increased at 4 week of planting (WAP), known as the first generation (G-1), and increased again at 8 WAP (G-2). The fourth increase can be influenced by environmental conditions, namely the migration of adults to a new land to find food because the local rice variety has previously entered the generative phase. Based on observations, the incidence of *N. lugens* is below the economic threshold with 0.11 individuals/plant. Romadhon et al. (2017) stated that the jajar legowo system has a tight spacing between rows, which benefits natural enemies and makes it difficult for *N. lugens* to attack the rice plants; increase in the second growing season was observed due to the breakdown of the plant's resistance (Pilanto et al., 2021). In addition, rice plants that enter the generative phase need more phosphorus (P) and potassium for panicle formation. Ferdyansyah (2022) reported that the element potassium plays a role in increasing sclerenchyma levels, resulting in the thickening of the stem tissue. This makes it difficult for *N. lugens* to get food because its style makes it difficult to penetrate the rice stem. The population of *N. lugens* usually increases during the vegetative growth stage (Verma et al., 2021).

Abiotic and biotic factors influence *N. lugens*. According to Krishnaiah et al. (2005), the optimal development for *N. lugens* is at 25-30°C with 70-90% humidity. Based on the observation results, the temperature obtained ranged from 28.43-31.2°C and humidity between 53.33-66.67% (Fig. 1). Temperature contributes significantly to the *N. lugens* incidence, while relative humidity contributes only 21.9% (Win et al., 2011). Rainfall also indirectly affects the incidence. The observed rainfall ranged from 0-11.6 mm, which was not conducive. Low humidity can reduce fertility, increase nymphal mortality, and promote macroptera wing development (Manikandan et al., 2015). The diversity of natural enemies showed a medium Shannon-Wiener diversity level of 2.8406 and a low dominance index of 0.0883 (Table 1). This is because the study site has a monoculture farming pattern that only grows rice yearly. Polyculture systems have more abundant populations of natural enemies (Andow, 1991; Gurr et al., 2003). The natural enemies obtained consist of predators and parasitoids. Predatory insects consist of 7 orders, namely Araneae, Coleoptera, Diptera, Hemiptera, Odonata, Orthoptera, and Trichoptera, while parasitoid insects consist of Hymenoptera and Diptera.

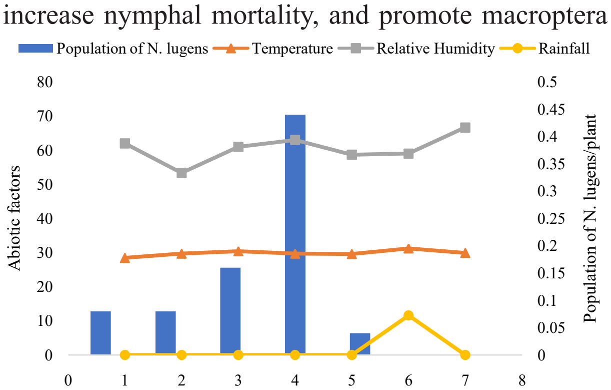

Fig. 1. *Nilaparvata lugens* incidence vs weather factors

The number of natural enemy species obtained was higher in yellow traps than in swing nets, with the dominating insects being the Anthocoridae and Scelionidae families. Insects of the Anthocoridae family prefer yellow to white (Raen et al., 2013), and parasitoids of the Scelionidae family prefer yellow to find their hosts (Ferreira Santos de Aquino et al., 2012). The Coccinellidae family dominates the population of natural enemies obtained from swing nets compared to other natural enemy families. These insects can prey on important pests such as *N. lugens*, *Nephotettix virescens*, *Scotinophara* sp, etc. *Synharmonia conglobata* (Coleoptera: Coccinellidae) can prey on *N. lugens*; as many as 1.18 individuals during the day and 0.94 individuals at night (Pustika et al., 2023). At the beginning of the observation, the population of natural enemies was still low and increased by the fifth observation. This may happen because the pests available during the vegetative phase are more numerous than in the generative phase, so the natural enemies in the field are high. The increase in insect diversity in the agroecosystem will increase the population of natural enemies (Sidauruk and Sipayung, 2018).

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Table 1. Abundance of natural enemies
(Mekongga variety Tatah Belayung, South Kalimantan)

No	Family	Ordo	Trap		Individual totals
			Sweep net	Yellow sticky trap	
1	Clubionidae	Araneae	14	-	14
2	Linyphiidae	Araneae	7	19	26
3	Lycosidae	Araneae	7	-	7
4	Salticidae	Araneae	5	-	5
5	Tetragnathidae	Araneae	14	-	14
6	Theridiidae	Araneae	12	2	14
7	Carabidae	Coleoptera	56	32	88
8	Coccinellidae	Coleoptera	289	23	312
9	Hydrophilidae	Coleoptera	9	-	9
10	Staphylinidae	Coleoptera	99	13	112
11	Chironomidae	Diptera	21	123	144
12	Dolichopodidae	Diptera	18	70	88
13	Sciomyzidea	Diptera	3	29	32
14	Stratiomyidae	Diptera	16	6	22
15	Tachinidae	Diptera	10	5	15
16	Anthocoridae	Hemiptera	14	302	316
17	Gerridae	Hemiptera	2	-	2
18	Lygaeidae	Hemiptera	5	-	5
19	Miridae	Hemiptera	4	-	4
20	Naucoridae	Hemiptera	1	-	1
21	Veliidae	Hemiptera	9	11	20
22	Braconidae	Hymenoptera	10	36	46
23	Diapriidae	Hymenoptera	-	45	45
24	Encyrtidae	Hymenoptera	-	29	29
25	Eulophidae	Hymenoptera	-	87	87
26	Eurytomidae	Hymenoptera	-	6	6
27	Formicidae	Hymenoptera	6	11	17
28	Mymaridae	Hymenoptera	-	17	17
29	Platygastridae	Hymenoptera	5	65	70
30	Pteromalidae	Hymenoptera	-	51	51
31	Scelionidae	Hymenoptera	3	148	151
32	Trichogrammatidae	Hymenoptera	-	31	31
33	Coenagrionidae	Odonata	3	-	3
34	Libellulidae	Odonata	3	-	3
35	Tettigonioidea	Orthoptera	10	-	10
36	Trigonidiidae	Orthoptera	6	-	6
37	Hydropsychidae	Trichoptera	3	-	3

Trap	Shannon-Wiener diversity (H')	Dominance (D)
Sweep net	2.2418	0.2232
Yellow sticky trap	2.5609	0.1159
Both trap	2.8406	0.883

AUTHOR CONTRIBUTION STATEMENT

All authors contributed to experimental design, assisted in data collection, provided a critical review of the manuscript, and contributed to manuscript revision.

CONFLICT OF INTEREST

No conflict of interest.

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