The performance of the brown planthopper (*Nilaparvata lugens*) population and predators on endemic lowland rice areas of Banten Province

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Abstract. Brown planthopper (BPH) are one of the main pests of rice plants, their abundance is influenced by biotic and abiotic factors such as the presence of predators (natural enemies). The aim of the study was to determine the relationship between the natural enemies' performance and the BPH performance. The study was conducted in BPH endemic areas in Serang and Lebak Regencies from March to July 2017. Sampling was carried out directly through visual observations based on four replications, where each replication consisted of 10 observation units. Data were analyzed descriptively in the form of tables and graphs. BPH performance was calculated based on existing population and corrected population. While predators are calculated based on the existing population that at the time of observation. Observations were made for five weeks, from 21 days after planting (DAP) to 56 DAP. The BPH population performance in Serang Regency was highest at 42 DAP (8.05 individual/clump) and in Lebak Regency at 35 DAP (25.05 individual/clump). Paederus is a predator with the highest abundance in Serang District, while the highest abundance of predators in Lebak Regency is spiders.

Key words: Endemic, natural enemies, population

1. Introduction

There are two types of rice planthopper pests develop in Indonesia, namely the brown planthopper (BPH) and the white back pest (WBP-*Sogatella furcifera Horvath*). The BPH is one of the important pests in Indonesia, especially after the BPH outbreak in 1986 in Indonesia [1]. Plant damage due to BPH attacks can occur in all phases of rice cultivation with minor, heavy damage and crop failure. Also, BPH pests have r-strategic properties characterized by the ability to exploit the temporary environment to eat and reproduce in large numbers in a short time [2,3,4].

The BPH pests directly damage plants by sucking the plant cell fluids [5], namely by sucking the phloem "phloem-sap-sucking"[6] which results in stunted growth, decreased plant vigor and the number of tillers [7]. A visual characteristic of plants attacked by BPH is a change in the color of the leaves and stems to brownish yellow, especially when the population is high [8]. The impact of BPH attacks is not only directly inhibiting the absorption of nutrients for plants (so that dry plants) are also indirectly as a vector for carrying rice grassy stunt virus (RGSV) and rice ragged stunt virus (RRSV) and cause the rice yellowing syndrome [9,3].

The level of population development can also be seen from the adaptation to the environment, genetically BPH has high genetic plasticity so that it is easy to develop into new biotypes and easy to develop in new habitats [1]. This condition allows BPH to develop faster than other pests with high
adaptability to the environment in which it lives. The development of BPH in Indonesia itself has identified 4 biotypes, namely biotypes 1, 2, 3 and 4. In some rice center areas, BPH biotypes have been identified, such as in West Java (Cianjur), Central Java (Pati, Kudus, Klaten), Yogyakarta. (Bantul, Kulon Progo) and East Java (Ngawi), showing BPH biotype 4 [10].

The development of BPH depends on biotic (natural enemies) and abiotic (temperature, rainfall) and farmer cultivation (pesticide application, fertilization) which can suppress or trigger the population in the field. The interaction between various biotic and abiotic factors will greatly affect mortality, birthrate and the spread of insects in an ecosystem [11,12]. Biotic factors such as the presence of predators, parasitoid or pathogenic natural enemies can suppress the BPH population. Natural enemies that are predatory and contribute to suppressing the BPH population are spiders, coccinella sp., Paederus sp., Ophionea sp. And Cyrtorhinus, while the parasitoids that contribute to lowering BPH are Anagrus sp. and Oligosita sp [1,13,14].

The use of natural enemies in controlling BPH is biological control, which is a major component in Integrated Pest Management (IPM). Biological control will reduce pollution due to the use of pesticides. Besides, natural control like this is considered more efficient, sustainable, conserves biodiversity, and is ecologically compatible [15,16]. Based on this, the research was conducted to know the relationship between the performance of natural enemies and the performance of BPH in endemic areas.

2. Materials and Method
The research was conducted in two BPH endemic sub-districts, namely Panggarangan District (Lebak Regency) and Pontang District (Serang Regency). The research was conducted during one planting season from February to June 2017. The location of the research was farmers’ land planted with the Inpari 19 variety. From each district, one village was selected which was the village with the largest area of BPH infested in the last three years. Information regarding data on villages affected by BPH was obtained from subdistrict pest observers.

The sample plots were selected from the Inpari 19 variety planted by farmers in collaboration with the Banten Agricultural Technology Research Institute (Banten AIAT). The number of plots observed was 5 plots, where each plot was taken 5 samples of plants/clumps which were selected systematically along the diagonal of the plot. Data were taken every week, carried out at 21 days after planting (DAP) up to 56 DAP. Observations were made on each selected clump including the abundance of BPH population, diversity of natural enemy insects, and other dominant pests. The data were presented descriptively in the form of tables and graphs, whereas to calculate the number of corrected populations, namely the BPH population after being reduced by the presence of its natural enemies using the corrected BPH population formula was as follows from Baiha [17]:

\[
Di = \frac{Ai - (5Bi + 2Ci)}{20}
\]

Notes:
\[Di = \text{Amount of corrected BPH}\]
\[Ai = \text{Number of BPH}\]
\[Bi = \text{Number of predators: spider, Paederus, Ophionea, Coccinella}\]
\[Ci = \text{Number of predators Cyrtorhinus}\]

3. Results and Discussion
BPH attacks could occur in various phases of rice plants, from the nursery to the generative phase with the attacked rate from minor to crop failure. In addition, BPH was included in the very important global pest that must be handled properly [18,19]. The results of researched conducted in two locations showed a trend where the abundance of the BPH population in Lebak regency was higher than in Serang regency. BPH population abundance tended to increase every week. The highest abundance was during the productive tiller phase before booting (35 DAP) (table 1). Previous researched results showed the same results where the peak presence of BPH occurred in the vegetative phase, this was due to the availability of feed-in abundant planting areas [3,16,4] and plants tended to absorb nitrogen for protein formation which also became a source of nutrition for BPH [20].
BPH population when 42 DAP had decreased, this was presumably because the plant had entered the generative phase, so that nitrogen supply decreases at the same time P and K uptake increases. Besides that, generally, farmers had controlled using insecticides. The same thing was also reported by [16], that at the 7 weeks after planting observations, the BPH population had decreased, which was also thought to be due to reduced food sources and nitrogen [4,16].

| Table 1. Abundance population of BPH at 21-56 DAP in Serang and Lebak Districts |
|-----------------|--------|--------|--------|--------|--------|
| Location/DAP    | Replication | Average |
|                 | 1     | 2     | 3     | 4     |
| 21 DAP          |       |       |       |       |
| Serang          | 0.40  | 0.60  | 0.80  | 0.80  | 0.65a  |
| Lebak           | 6.60  | 3.20  | 3.60  | 4.00  | 4.35b  |
| 28 DAP          |       |       |       |       |
| Serang          | 0.60  | 0.80  | 1.20  | 3.60  | 1.55a  |
| Lebak           | 5.00  | 3.60  | 9.60  | 2.40  | 5.15b  |
| 35 DAP          |       |       |       |       |
| Serang          | 1.00  | 2.00  | 0.80  | 12.00 | 3.95a  |
| Lebak           | 10.20 | 27.60 | 31.80 | 30.60 | 25.05b |
| 42 DAP          |       |       |       |       |
| Serang          | 7.60  | 4.60  | 12.80 | 7.20  | 8.05a  |
| Lebak           | 17.00 | 18.40 | 16.30 | 19.10 | 17.70b |
| 56 DAP          |       |       |       |       |
| Serang          | 2.20  | 8.80  | 2.00  | 14.60 | 6.90a  |
| Lebak           | 25.60 | 22.00 | 10.60 | 10.60 | 17.20b |

The same trend could be seen from the corrected BPH population (the number of BPH population after being reduced by the ability of natural enemies such as spiders, paederus, coccinella and cytorhynus), where the decrease in the number of BPH was also related to preying on BPH. It was used to determine controlled measures using chemical pesticides if the corrected BPH population had exceeded the controlled threshold. The controlled threshold for plants less than 30 DAP was 3 individuals/family and if the plants were more than 30 DAP was 5 individuals [17].

In general, the abundance of the population of BPH was corrected to still below the controlled threshold, except for 35 DAP in Lebak which reached 5.8 individuals/family. This value indicates that controlled must be carried out so that BPH attacks are not caused economic harm. The BPH population declined again and was below the controlled threshold in the 42 DAP observations, this indicates that the controlled carried out by the farmers was right.

| Table 2. The population of BPH corrected at 21-56 DAP in Serang and Lebak Districts |
|-----------------|--------|--------|--------|--------|
| Location/DAP    | Replication | Average |
|                 | 1     | 2     | 3     | 4     |
| 21 DAP          |       |       |       |       |
| Serang          | -6.6  | -5.4  | -11.7 | -5.2  | -7.225 |
| Lebak           | -7.4  | -15.8 | -1.4  | -7    | -7.9   |
| 28 DAP          |       |       |       |       |
| Serang          | -25.4 | -20.2 | -10.8 | -14.4 | -17.7b |
| Lebak           | -7    | -6.4  | -4.4  | -2.6  | -5.1a  |
| 35 DAP          |       |       |       |       |
| Serang          | -15   | -5    | -12.2 | -23   | -13.8b |
| Lebak           | -22.8 | 20.6  | 17.8  | 7.6   | 5.8a   |
Natural enemies are organisms found in nature that could kill, weakened and reduce the reproductive phase of insects, natural enemies could be predators, parasitoids or pathogens. Natural predatory enemies usually reduce the number of insect populations, hosts or predators, by eating individual insects. For some species, natural enemies are the main force that regulates insect population dynamics, so it is important to know how natural enemies affect insect populations in order to estimate their effects. The results of the study of [21] showed that natural predators such as spiders were able to prey on BPH with a mortality rate of 78-91% at the ratio leveled between predator: BPH was 1: 3 to 1: 11, and on the 15th days after that death reached 100 percent with a ratio of 1: 5 to 1:14. However, at a ratio of 1:18, some BPH will survive and will become a large population.

**Figure 1.** Abundance population of predators at 21-56 DAP in Serang District

In general, the abundance of predator populations in Pontang district, Serang regency and Panggarangan district, Lebak regency, was quite high. The existence of predators was able to exercise natural controlled to suppress the development of the BPH population. This proves that predators could be used as biological controls in regulating natural balance. The dominant predator in the area of Pontang district, Serang regency was paederus, with a population ranging from 1-3 individuals per plant. Meanwhile, the dominant natural enemy in Panggarangan district, Lebak regency was spiders with a population ranging from 1-3 individuals/family.
**Figure 2.** Abundance population of predators at 21-56 DAP in Lebak Regency

**Figure 3.** Relationship between BPH population abundance and predators at 21-56 DAP in Serang District

**Figure 4.** The relationship between BPH abundance population and predators at 21-56 DAP in Lebak Regency
The relationship between the BPH population and the predator population was moderate, in serang regency the correlation with \( r = 0.483 \) and in lebak regency \( r = 0.693 \). According to taylor [22], if the range of \( r <0.35 \) indicate a weak relationship; \( r = 0.36-0.67 \) indicates a moderate relationship, and \( r = 0.36-0.67 \) indicates a strong relationship. Thus, there was a relationship between the presence of the BPH population and its predators. In this case, predators contribute to the decrease in BPH in a location. This was reinforced by the results of researched by [16] on ciherang rice varieties in Indramayu regency, showing that predatory species that had the potential to reduce BPH population density were *Tetragnatha maxillosa* (jaw spiders), *Micraspis inops* (dome beetles), *Coccinella repanda* (coccinella beetles), *Paederus fuscipes* (tomcat), *Microvelia douglasi* (waterbugs), and *Lycosa pseudoanulata* (wolf spider).

4. Conclusion

The dominant predator in the area of Pontang district, Serang regency was paederus, with a population ranging from 1-3 individuals per plant. Meanwhile, the dominant natural enemy in Panggarangan subdistrict, Lebak regency was spiders with a population ranging from 1-3 individuals/family. The relationship between the BPH population and the predator population was moderate (in serang \( r = 0.483 \) and in lebak \( r = 0.693 \)), in this case, predators contribute to the decrease in BPH in a location.

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