# Composition of pests and predators in the early generative phase of rice cultivation in two different conditions

# Composition of pests and predators in the early generative phase of rice cultivation in two different conditions

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**Abstract.** The early phase of growth is the most vulnerable for the survival of rice plants. However, this is influenced by many factors, such as the presence of pests and predators as natural enemies. This study aimed to determine the composition of pests and predators in the vegetative phase of rice plants in rice fields close to forests, and rice fields close to urban areas. The research location was determined by purposive random sampling method. Arthropod species and populations were observed directly from 8 am to 11 am. Data on safety results were processed and calculated. Based on the results of the observations in initial generative phase, there were 687 Arthropods. At the species level, the most abundant main pest was *Nilaparvata lugens* (11.76%) and *Gesonula mundata* (10.07%). The most abundant predator was *Lycosa pseudoannulata* (25.89%). Based on the overall calculation, predatory Arthropods have largest composition (72.36%), while pests were 27.04%. Based on the type of rice field conditions, Arthropods in the rice fields bordering the mountains have higher composition in both pests (15.99%) and predators (41.18%) compared to rice fields that are near settlement/urban areas, namely 11.25% pests and predators 31.18%.

## 1. Introduction

There are many factors can determine the diversity and abundance insect pests and natural enemies, i.e. landscape, the condition cultural practice of the season and the territory crops pattern. In general, the number of species will be influenced by factor temporal and spatial [1]. Temporal factors relate to geological history, succession, season and climate variations. While spatial factors relate to habitat, plants dispersal and geography. Spatial factors relate to the amount of resources availability. The fluctuation of food availability will be the restricting factors for the existence of insect population.

Shifting natural habitats caused by monocultures to artificial habitats will reduce the quality of habitat, loss of species, and genetic erosion resources [2]. In addition, the treatment of pesticides and herbicides in the management of pest are not appropriate, could reduce insect diversity including the Family Odonata or dragonflies which is natural enemies for pests.

Dragonfly is one of predator which often be found in rice field. Previous study shows that one individual of the dragonfly able to prey 20 individual leafhoppers. The dragonfly known has 25 family [3]. The nymph and adult dragonfly have role as predators in invertebrates other or fish or vertebrate. They lay eggs in or near fresh waters, so that the abundance in an area relate to quality of waters, including a primary substrate and water vegetation [4]. Habitat election by the imago of the dragonfly is highly dependent on the structure of vegetation, including degrees of shade. As a consequence, dragonfly can respond strongly on changes in habitats as logging and the increase in erosion [5]. Therefore, the existence of dragonfly can be used as bioindicator of terrestrial condition and aquatic ecosystem [6]. The change of habitats occurs in Banyumas regency will possibly affect the abundance and diversity of the dragonfly species. Hence, the research to know the abundance and the diversity of the dragonfly species in the Banyumas regency at the vegetative stadium of rice in a whole range of different conditions of farming land is needed.

## 2. Methods

Research was carried out on March 2020 to September 2020 in Banyumas regency. The survey locations to observe the abundance and diversity of the dragonfly were chosen on some habitats, i.e., 1) rice fields close to populated areas (urban) which the irrigation pass over the residential area and 2) rice fields away from residential area or are adjacent to forest, which irrigation derived from forest.

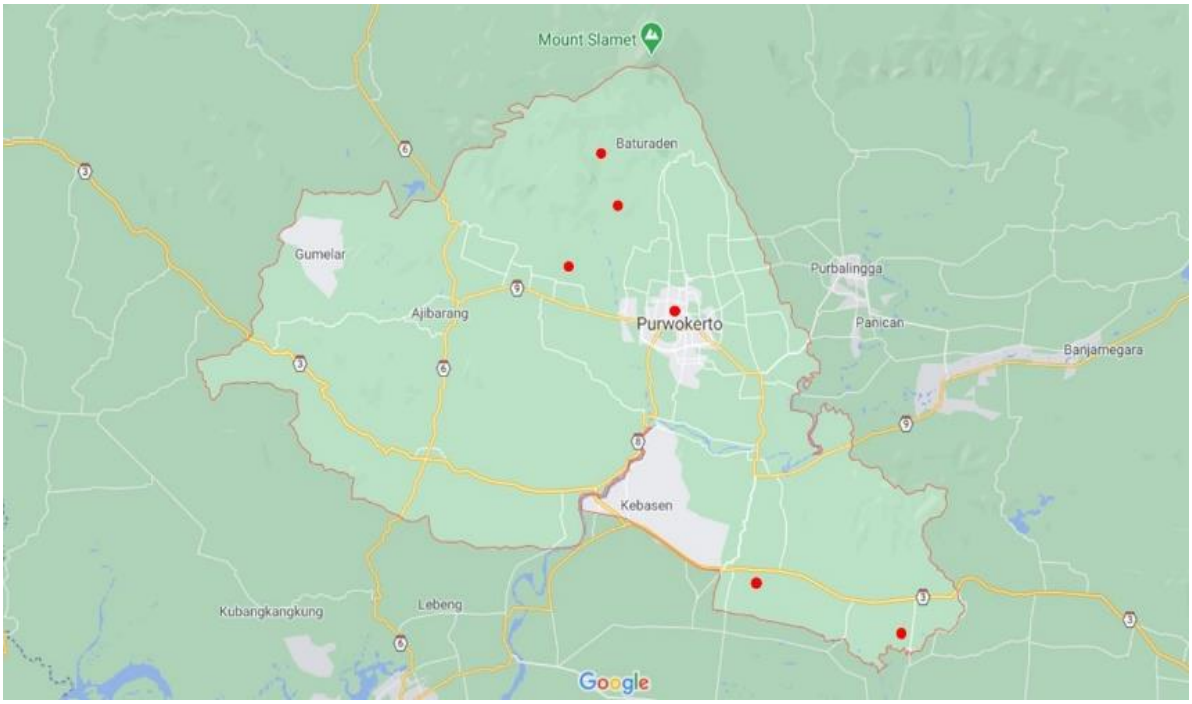


**Figure 1.** Map of the locations of dragonflies and pest's observation on rice fields in Banyumas regency.

Each observation plot size is 1000 $m^2$. The observation of dragonflies and pest was conducted over the growing season, since plant was 1 weeks after planting (wap) to 12 wap by 1-week intervals. The data was tabulated based on the phenology of rice in order to obtain the type of dragonflies and pest on every phase of rice development.

Observation of the dragonfly was conducted directly with the composite (5 plots taken in every rice field (plot size was 10 x 10 $m^2$). Observation aerials were 5 meters radius to monitor insect that flies. The unknown species captured by net and were identified directly. A conical fishnet size was 60 x 300-380 cm and the stick was 1 meter long. The observation was conducted from 9am to 11am daytime.

The pest's collection was conducted by direct observation of 40 each sample of rice fields which observations were drawn from the center, located at systematic random and determined by following

the diagonal line. The observation was made by noting all insects were found in one large sample of rice clump inside the plot.

## 3. Results and discussion

Based on the observation, the data of pests and predator's abundance in two different were shown in Table 1. There were 687 totals of insects consisting of 28 species belong to 22 family and 8 order.

**Table 1.** Number of insects were found in the rice fields adjacent to forest and rice fields near residential area (urban).

| Habitat | Order | Family | *Species* | Number | Role |
|---|---|---|---|---|---|
| **Urban 2** | Orthoptera | Tettigoniidae | *Conocephalus longipenis* | 2 | Pest |
| **Urban 2** | Araneae | Lycosidae | *Lycosa pseudoannulata* | 7 | Predator |
| **Urban 2** | Diptera | Chironomidae | *Chironomidae* | 58 | Neutral |
| **Urban 2** | Odonata | Libellulidae | *Orthetrum sabina* | 1 | Predator |
| **Urban 2** | Araneae | Tetragnathidae | *Tetragnatha sp.* | 1 | Predator |
| **Urban 2** | Araneae | Araneidae | *Argiope catenulata* | 1 | Predator |
| **Urban 2** | Orthoptera | Acrididae | *Gesonula mundata* | 1 | Pest |
| **Urban 2** | Hemiptera | Delphacidae | *Nilaparvata lugens* | 1 | Pest |
| **Forest 1** | Hemiptera | Delphacidae | *Nilaparvata lugens* | 2 | Pest |
| **Forest 1** | Araneae | Lyniipidae | *Atypena formosana* | 14 | Predator |
| **Forest 1** | Odonata | Libellulidae | *Othetrum sabina* | 3 | Predator |
| **Forest 1** | Diptera | Calliphoridae | *Calliphoridales* sp. | 1 | Neutral |
| **Forest 1** | Diptera | Chironomidae | *Chironomidae* | 366 | Neutral |
| **Forest 1** | Orthoptera | Acrididae | *Gesonula mundata* | 3 | Pest |
| **Forest 1** | Araneae | Oxyopidae | *Oxyopes javanus* | 1 | Predator |
| **Forest 1** | Odonata | Coenagrionidae | *Agriocnemis femina* | 1 | Predator |
| **Forest 1** | Hymenoptera | Syrpidae | *Platyceirus* sp. | 1 | Pollinator/ Predator |
| **Forest 1** | Hymenoptera | Formicidae | *Oecophylla smaragdina* | 1 | Predator |
| **Forest 1** | Orthoptera | Acrididae | *Oxya hyla intricata* | 1 | Pest |
| **Forest 1** | Lepidoptera | Crambidae | *Scirpophaga innotata* | 2 | Pest |
| **Forest 1** | Araneae | Lycosidae | *Lycosa pseudoannulata* | 2 | Predator |
| **Forest 1** | Hymenoptera | Formicidae | *Iridomyrmex anceps* | 1 | Predator |
| **Forest 1** | Diptera | Dolichopodidae | *Condylostylus* sp. | 1 | Neutral |
| **Forest 1** | Araneae | Araneidae | *Argiope catenulata* | 1 | Predator |
| **Forest 1** | Orthoptera | Phyrgomorphidae | *Atractomorpha crenulata* | 1 | Pest |
| **Urban 1** | Araneae | Lycosidae | *Lycosa pseudoannulata* | 24 | Predator |
| **Urban 1** | Diptera | Chironomidae | *Chironomidae* | 5 | Neutral |
| **Urban 1** | Orthoptera | Gryllidae | *Gryllus campestris* | 1 | Predator |
| **Urban 1** | Hymenoptera | Formicidae | *Odontoponera denticulat* | 1 | Predator |
| **Urban 1** | Orthoptera | Acrididae | *Gesonula mundata* | 7 | Pest |
| **Urban 1** | Odonata | Libellulidae | *Orthetrum sabina* | 1 | Predator |
| **Urban 1** | Hemiptera | Delphacidae | *Nilaparvata lugens* | 8 | Pest |
| **Urban 1** | Hymenoptera | Formicidae | *Solenopsis geminat* | 8 | Predator |
| **Urban 1** | Odonata | Coenagrionidae | *Agriocnemis femina* | 1 | Predator |

| | | | | | |
|---|---|---|---|---|---|
| **Urban 1** | Araneae | Lyniipidae | *Atypena formosana* | 3 | Predator |
| **Urban 1** | Hymenoptera | Formicidae | Monomorium minimum | 2 | Predator |
| **Urban 1** | Odonata | Coenagrionidae | *Pseudagrion pruinosum* | 1 | Predator |
| **Urban 1** | Odonata | Libellulidae | *Crocothemis servilia* | 1 | Predator |
| **Forest 2** | Araneae | Lyniipidae | *Atypena formosana* | 24 | Predator |
| **Forest 2** | Araneae | Lycosidae | *Lycosa pseudoannulata* | 13 | Predator |
| **Forest 2** | Orthoptera | Acrididae | *Criotettix cf robustus* | 1 | Pest |
| **Forest 2** | Hemiptera | Delphacidae | *Nilaparvata lugens* | 8 | Pest |
| **Forest 2** | Diptera | Chironomidae | *Chironomidae* | 14 | Neutral |
| **Forest 2** | Orthoptera | Acrididae | *Gesonula mundata* | 6 | Pest |
| **Forest 2** | Hemiptera | Miridae | *Cytorhinus lividipennis* | 1 | Predator |
| **Forest 2** | Odonata | Libellulidae | *Orthetrum sabina* | 2 | Predator |
| **Forest 2** | Orthoptera | Phyrgomorphidae | *Atractomorpha crenulata* | 2 | Pest |
| **Forest 2** | Lepidoptera | Crambidae | *Scirpophaga innotata* | 1 | Pest |
| **Forest 2** | Araneae | Tetragnathidae | *Tetragnatha sp.* | 1 | Predator |
| **Forest 2** | Hymenoptera | Formicidae | *Solenopsis geminat* | 1 | Predator |
| **Forest 2** | Coleoptera | Staphylinidae | *Paederus dermatitis* | 1 | Predator |
| **Forest 2** | Coleoptera | Dysticidae | *Dytiscus verticollis* | 2 | Predator |
| **Forest 2** | Odonata | Coenagrionidae | *Agriocnemis femina* | 1 | Predator |
| | | **TOTAL** | | **687** | |

There was a difference of pest and the predator species on both habitats. From the data, 7 were known as pest species and 19 most predatory species were found (Table 2). From 7 pest species, *Gesonula mundata* and *Nilaparvata lugens* were dominant on two habitats 10.07 and 11.25% respectively. *G. mundata* which belong to the Acrididae is the common pest in rice fields and has role as herbivores [7]. While the abundance of *N. lugens* or brown planthopper deeply affected by climatic conditions, the growing season and the abundance of nitrogen in the soil. High temperatures predicted favored by brown planthoppers. Thus, the abundance possibility of rice fields adjacent to forest due to the temperature has turned higher. The abundance of nitrogen can also improve health brown planthoppers and increase the percentage of fecundity [8].

*Lycosa pseudoannulata* become the most commonly predators found on both habitats, with number of 25.89%. Factors affect the predator's abundance such as warm temperatures about 28°C. Rice which 1 months after planting is the right time to laying their eggs, while feeding will occur in the next phase to generative stadium [9]. Based on observations, the number of the Odonata (dragonfly) were found be considered in a small number. Restricting factors in abundance directly such as the availability of oxygen in water and temperatures around 25°C [10].

Overall, the number of predators that found in two different habitats was higher than the number of pests which was 72.36 and 27.04%. As for comparison, the abundance of pest and predators in the rice fields adjacent to forest were 15.99 and 41.18% respectively. While comparison pest and predators in the rice fields near residential area (urban) were 11.25 and 31.18%. Therefore, it can be concluded that the number of predatory in nature are still abundant relative to the number of pests though the changing of environmental conditions.

**Table 2.** Abundance of pests and predators in the rice fields adjacent to forest and rice fields near residential area (urban).

| Species | Forest 1 | Forest 2 | % of abundance | Urban 1 | Urban 2 | % abundance |
|---|---|---|---|---|---|---|
| **Pest** | | | | | | |
| *Atractomorpha crenulata* | 1 | 2 | 1.78% | 0 | 0 | 0.00% |
| *Conocephalus longipenis* | 0 | 0 | 0.00% | 0 | 2 | 1.18% |
| *Criotettix cf robustus* | 0 | 1 | 0.59% | 0 | 0 | 0.00% |
| *Gesonula mundata* | 3 | 6 | 5.33% | 7 | 1 | 4.74% |
| *Nilaparvata lugens* | 2 | 8 | 5.92% | 8 | 1 | 5.33% |
| *Oxya hyla intricata* | 1 | 0 | 0.59% | 0 | 0 | 0.00% |
| *Scirpophaga innotata* | 2 | 1 | 1.78% | 0 | 0 | 0.00% |
| **Number** | **9** | **18** | 15.99% | **15** | **4** | 11.25% |
| **Predator** | | | | | | |
| *Agriocnemis femina* | 1 | 1 | 1.18% | 1 | 0 | 0.59% |
| *Argiope catenulata* | 1 | 0 | 0.59% | 0 | 1 | 0.59% |
| *Atypena formosana* | 14 | 24 | 22.35% | 3 | 0 | 1.76% |
| *Crocothemis servilia* | 0 | 0 | 0.00% | 1 | 0 | 0.59% |
| *Cytorhinus lividipennis* | 0 | 1 | 0.59% | 0 | 0 | 0.00% |
| *Dytiscus verticollis* | 0 | 2 | 1.18% | 0 | 0 | 0.00% |
| *Gryllus campestris* | 0 | 0 | 0.00% | 1 | 0 | 0.59% |
| *Iridomyrmex anceps* | 1 | 0 | 0.59% | 0 | 0 | 0.00% |
| *Lycosa pseudoannulata* | 2 | 13 | 7.65% | 24 | 7 | 18.24% |
| *Monomorium minimum* | 0 | 0 | 0.00% | 2 | 0 | 1.18% |
| *Odontoponera denticulat* | 0 | 0 | 0.00% | 1 | 0 | 0.59% |
| *Oecophylla smaragdina* | 1 | 0 | 0.59% | 0 | 0 | 0.00% |
| *Orthetrum sabina* | 3 | 2 | 2.94% | 1 | 1 | 1.18% |
| *Oxyopes javanus* | 1 | 0 | 0.59% | 0 | 0 | 0.00% |
| *Paederus dermatitis* | 0 | 1 | 0.59% | 0 | 0 | 0.00% |
| *Pseudagrion pruinosum* | 0 | 0 | 0.00% | 1 | 0 | 0.59% |
| *Solenopsis geminat* | 0 | 1 | 0.59% | 8 | 0 | 4.71% |
| *Tetragnatha sp.* | 0 | 1 | 0.59% | 0 | 1 | 0.59% |
| *Platyceirus sp.* | 1 | 0 | 0.59% | 0 | 0 | 000% |
| **Number** | **24** | **46** | 41.18% | **43** | **10** | 31.18% |

## 4. Conclusion

Based on this study it is concluded that *G. Mundata* and *N. lugens* become the dominant pests found, while *L. pseudoannulata* is the predator found on the observed habitats. The comparison of pest and predator overall by 72.36 and 27.04% with comparison of pest and predators of rice fields adjacent to forest were 15.99 and 41.18%. While comparison of the pest and predator in the rice fields in urban area were 11.25 and 31.18%.

**Acknowledgement**
The authors wish to thank the authority of Institute for Research and Community Service of Universitas Jenderal Soedirman for providing financial support to perform the research activities.

**References**
[1] Begon M, John L H and Colin R T 2006 *Ecology, Population and Communities* 2nd Edition (London: Blackwell Science Publ)
[2] Altieri M A and Clara I N 2004 *Biodiversity and Pest Management in Agroecosystems* 2nd Edition (Binghamton: Food Product Press)
[3] Watson J A L and O'Farrell A F 1996 *The Insects of Australia, a Text Book for Students and Research Workers volume 1 second edition* (Australia: Melbourne University Press)
[4] Orr A G 2004 *International Journal of Odonatol* 7 371–384
[5] Clausnitzer V, Kalkman V J, Ram M, Collen B, Bailie J E M, Bedjanic M, Darwall W R T, Dijkstra K B, Dow R, John H, Karube H, Malikova E, Paulson D, Schutte K, Suhling F, Villanueva R J and Ellenreider N V 2009 *Biological Conservation* **142** 1864–1869
[6] Corbet 1993 *Libellula* **12** 91–102
[7] Prakoso B 2017 *Biosfera* **34** 80–88
[8] Rashid M M, Islam M J K S and Latif M A 2017 *Ecological Processes* **6** 1–10
[9] Satpathi C R 2010 *Academic Journal of Entomology* **3** 65–68
[10] Fulan J A, Henry R and Davanso R C S 2011 *Acta Limnologica Brasiliensis* **23** 23–29