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DIVERSITY OF GRASSHOPPER IN LINGSAR VEGETABLE FIELD, WEST LOMBOK

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Abstract: Vegetables are one of the commodities that support the economic sector. Many factors affect the success rate of vegetable production, including pests. Grasshoppers are herbivorous insects that have the potential as pests that will affect crop yields, especially vegetables. This study aims to determine the diversity of grasshoppers in the vegetable field of Bug-Bug Village, Lingsar District, West Lombok. Sampling was carried out on vegetables with differences in plant age, namely 1, 2, and 3 months using the sweeping net method in the morning (07.00-10.30) around the edge and middle of the vegetable field. It is found that there are eight types of grasshoppers in 2 sub-orders and three families (*Acrididae* (6 species), *Pyrgomorphidae* (1 species), *Tettigoniidae* (1 species)). *Atractomorpha crenulata* and *Oxya japonica* were grasshopper species with the highest relative abundances of 42% and 29%, respectively. The analysis showed that the diversity index (H') of grasshoppers found in the research location was 1.5445.

Keywords: *Vegetables, Grasshopper, Diversity*

INTRODUCTION

West Lombok Regency is one of the regencies in West Nusa Tenggara Province, with an area of 1,053.92 Km^2. It has fertile soil and abundant water reserves that have the potential to be utilized properly. Vegetable crops are one of the many potentials of West Lombok Regency in agriculture, with a harvest area of 507 ha in 2021. One type of vegetable crop that has become the main commodity is kale. Lingsar sub-district is the highest producer of kale, with a kale production of 6381 quintals in 2021 compared to other sub-districts in the West Lombok region [1].

Vegetables are agricultural commodities that are very important in supporting the economy and the nutritional needs of families. Many factors, including pests, influence the growth and development of vegetables. Pests found in agricultural land, especially vegetable crops, generally come from the *Orthoptera*, the largest insect order with more than 20,000 species spread throughout the world. Most of the *Orthoptera* are fairly large insects, with enlarged hind legs used for jumping and many species have stridulatory apparatus for song production [2]. An example of the order *Orthoptera*, which is most commonly found as an agricultural pest, is the grasshopper group (locusts and grasshoppers).

Grasshoppers play an important role in ecosystems by triggering plant growth, and being involved in nutrient cycles and food chains [3]. Most species of grasshoppers act as herbivores and are a good source of protein for other animals such as amphibians, small reptiles, birds, and small mammals [4]. Not only for animals, some species of grasshoppers, such as *Valanga nigricornis Burm* and *Nomadacris succincta L.* are consumed by the community, as in Java (Indonesia). Communities living in and around forests use grasshoppers as an alternative protein source to fight malnutrition and increase the consumption of nutritious food [5].

Grasshoppers are very different from other pests because their populations can grow quickly and, in some species, can form large swarms that can cause damage in a fairly short time [6]. If the population density of grasshoppers increases, it will certainly affect crop yields which has an impact on reducing and even failing to harvest a certain agricultural commodity, so controlling the locust population becomes very important. In Lombok, studies on the diversity of grasshopper species in the vegetable area have not been carried out. Therefore, the availability of initial data is needed for the management of preventing damage to vegetable fields in the future that certain types of grasshoppers may cause.

RESEARCH METHODS

A sampling of grasshoppers was carried out in the vegetable field of Bug-Bug Village, Lingsar District, West Lombok, based on the vegetable age category, namely 1 to 3 months. Grasshopper samples were caught using the sweeping net in the morning (07.00-10.30) by surrounding the edges of the vegetable fields and in the center of the vegetable beds (Figure 1). Identification of the samples obtained was carried out by the Biology Laboratory, FKIP Mataram University, concerning identification books from Triplehorn & Johnson, (2004), Bailey (2007), Tan (2012, 2017), Iorio et al., (2019), and studies from Leksono et al. al., (2022) and confirmed at the Global Biodiversity Information Facility (https://www.gbif.org/) [2,4] [7-10].

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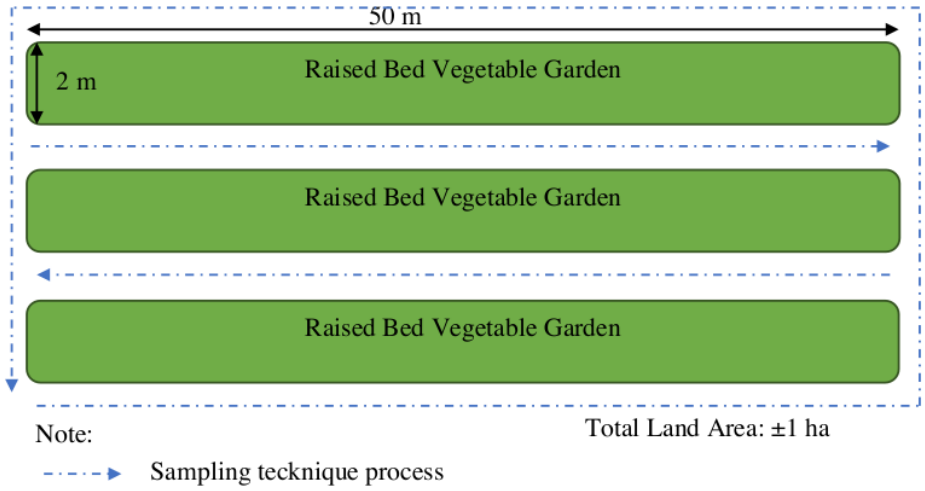

Figure 1. Grasshopper sampling scheme at the research site

The samples obtained were sorted and preserved. Large-sized grasshoppers were preserved by injecting a preservative of 5% formalin, while small grasshoppers were put into bottles or jars containing a mixture of 5% formalin and detergent. Diversity data were analyzed using the Shannon-Wienner Begon et al., (2006) index [11]:

$$H'=-\sum_{i=1}^{s} \quad Pi\ Ln\ Pi$$

Where, H'= Diversity Index; Pi= Proportional abundance Calculation of relative abundance refers to Krebs (2014):

$$KR= (ni/N)\ X\ 100\%$$

Where, ni= the number of individuals of the i-th type; N=total number of individuals

Results and Discussion

Species Composition and Diversity Index The grasshopper is a dominant herbivore, which has diversified into grassland, desert, semi-aquatic, alpine, and tropical forest habitats and exhibits diverse morphological, ecological, and behavioral diversity [12]. The grasshoppers found in the vegetable fields of Bug Bug Village consisted of 8 species belonging to 2 sub-orders, namely *Caelifera* (two families: *Acrididae*; *Pyrgomorphidae*) and *Ensifera* (*Tettigoniidae*) (Table 1). They have rather short antennae with a maximum of 30 segments. Sound or sound is produced by rubbing the hind legs against the wings. Meanwhile, *Ensifera* has antennae that are longer than its body and are divided into many segments (up to 500). Species that can sing or produce sounds produce sound by rubbing their wings forward [2]. The number of grasshoppers found in this study was more than those found in the rice field ecosystem, namely three species [13], four species in the Prakoso & Kurniawan corn agroecosystem (2021), and seven species in the plantation forest ecosystem. species [14]. However, the number of this species is much lower [15], who studied the diversity of grasshoppers in several agricultural areas including ecoton areas, post-harvest rice farming, post-harvest maize farming, mixed farming, vegetable farming and savanna, which is as much as 26 species belonging to 4 families.

Family *Acrididae* (Suborder *Caelifera*) is a family that has the most members found in the research location, namely six species, namely *Aiolopus thalassinus subsp*. Tamulus (Fabricius, 1798), *Gastrimargus marmoratus* (Thunberg, 1815), *Oxya japonica* (Thunberg, 1815), *Phlaeoba fumosa* (Serville, 1838), *Stenocatantops splendens* (Thunberg, 1815), *Valanga nigricornis* (Burmeister, 1838) (Table 1). Grasshoppers from the family Acrididae are one of the most diverse lineages of the order *Orthoptera* with 6,700 valid species distributed worldwide [11]. *Acrididae* are commonly known astrue grasshoppers and are pests of agricultural, forest, vegetable, garden, and fruit crops [16].

Not all types of grasshoppers obtained were found in all ages of vegetables. Two species of grasshoppers *Oxya japonica* (Thunberg, 1815) and *Atractomorpha crenulata* (Fabricius, 1793) were found in all data collections (three vegetable age categories). The species *O. japonica* is also one of the grasshoppers found abundantly in rice fields in

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Sleman Yogyakarta (Yudharta et al., 2021). It is suspected that this species is a permanent pest in vegetable fields adjacent to rice farms. It is supported by the external appearance of an appropriate color so that predators disguise it. These two types of grasshoppers have the characteristics of movement in the form of a jump that is not too active and far. Both types of grasshoppers are commonly found in green leafy vegetables. Meanwhile, two species, *Aiolopus thalassinus subsp. Tamulus* (Fabricius, 1798) and *Gastrimargus marmoratus* (Thunberg, 1815) were only found in 1 age range of vegetables (2 months of age) (Table 1). Both of these species are usually found living to camouflage themselves in open ground with little grass vegetation growing near vegetable beds or the underside of vegetables which have a slightly green and brownish color following the appearance of their body morphology.

The grasshopper diversity index (H') was 1.5445 (Table 2). This index is higher than H' in the vegetable farming area in the Dompu area, Sumbawa island, by 1.25 (Leksono et al., 2022), forest ecosystems (0.6307), and maize agroecosystems (0.5335) in Karanggayam District, Kebumen [17], and only slightly different from the diversity of grasshoppers in the three forests in Surabaya, namely 1.53 [18]. The diversity of grasshopper species was positively influenced by plant diversity, but the relationship was sometimes inconsistent [4]. For some grasshopper species, habitat appears to be influenced by the presence of shrubs and tree cover as important factors providing shelter, laying eggs, and food sources (Zografou et al., 2009). In addition, factors such as land height also have an effect. Orthopterans with the highest diversity and evenness values are found at an altitude of 150-250 meters above sea level, while the lowest diversity and evenness values are in the range of 360°. – 450 masl [19].

Table 1. Distribution and Diversity Index of Grasshoppers in Vegetable Fields Research Locations

Species	Sub-Order	Family	Vegetable Age (Months)		
			1	2	3
Aiolopus thalassinus subsp. Tamulus (Fabricius, 1798)	*Caelifera*	*Acrididae*	-	+	-
Gastrimargus marmoratus (Thunberg, 1815)	*Caelifera*	*Acrididae*	-	+	-
Oxya japonica (Thunberg, 1815)	*Caelifera*	*Acrididae*	+	+	+
Phlaeoba fumosa Serville, 1838)	*Caelifera*	*Acridantops*	(	+	+
splendenscatantops (Thunberg, 1815)	*Caelifera*	*Acrididae*	-	+	+
Valanga nigricornis (Burmeister, 1838)	*Caelifera*	*Acrididae*	+	+	-
Atractomorpha crenulata (Fabricius, 1793)	*Caelifera*	*Pyrgomorphidae*	+	+	+
maculatus (Le Guillou, 1841)	*Ensifera*	*Tettigoniidae*	+	-	+

Conocephaluspresent/found; -= absent/not found

Table 2. Grasshopper Diversity Index at the study site

Species	Total	Pi	Ln Pi	PiLnPi
Oxya japonica (Thunberg, 1815)	22	0.2895	-1.2397	-0.3589
Valanga nigricornis (Burmeister, 1838)	5	0.0658	-2.7213	- 0.1790
Atractomorpha crenulata (Fabricius, 1793)	32	0.4211	-0.8650	-0.3642
Conocephalus maculatus (Le Guillou, 1841)	6	0.0789	-2.5390	-0.2004
Stenocatantops splendens (Thunberg, 1815)	3	0.0395	-3.2321	-0.1276
Phlaeoba fumosa (Serville, 1838)	6	0.0789	-2.5390	-0.2004
Gastrimargus marmoratus (Thunberg, 1815)	1	0.0132	-4.3307	-0.0570
Aiolopus thalassine subsp. Tamulus (Fabricius, 1798)	1	0.0132	-4.3307	-0.0570
			H'	1.5445

Relative Abundance of Species

The relative abundance of the types of grasshoppers found was quite varied. Variations in the abundance of grasshoppers could be influenced by many factors such as environmental factors, including altitude, temperature,and soil moisture and composition [4]. Variation Abundance and diversity of grasshopper speciesformed along with the elevation gradient of land use highest relative abundance was the *A. crenulata* (Fabricius, 1793)

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at 42%, followed by *O. japonica* (Thunberg, 1815) (29%). The high abundance of these two species is related to the distribution of species, where these two species are always found in three age categories of vegetables. *Oxya japonica* (Rice grasshopper) is one of the main pests inhabiting wild rice (*Oryza rufipogon*) and lowland rice (*Oryza sativa*) in South China which can cause a decrease in rice yields[20]. Meanwhile, the grasshopper type *Atractomorpha crenulata* has a great hidden potential to turn into a major pest if its population is not monitored and controlled below the damage threshold level [21]. A. crenulata also played a role as pathogenicity of two parasites namely *Leidyana subramanii* and *Retractocephalus dhawanii* [22]. Meanwhile, the lowest relative abundance was found in two species, namely *G. marmoratus* (Thunberg, 1815) and *A. thalassinus subsp. Tamulus* (Fabricius, 1798) of 1%, which shows the same pattern with the relationship of species distribution (Figure 2).

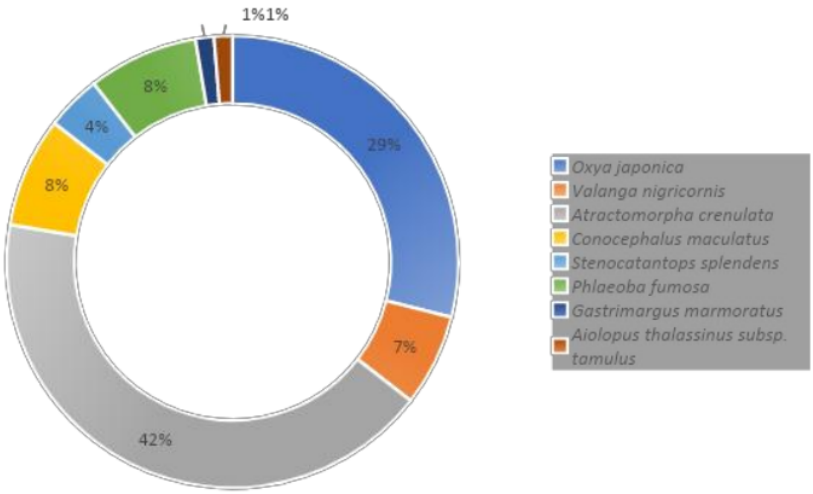

Figure 2. Relative abundance of locust species found during the study

CONCLUSION

There were eight species of grasshoppers (order *Orthoptera*) in the vegetable fields of Bug Bug Village, which were covered in two sub-orders, namely *Caelifera* and *Ensifera*, with a diversity index of 1.5445. The most abundant species in relative abundance are *A. crenulata* (family *Pyrgomorphidae*) and *O. japonica* (*Acrididae*) which are part of the suborder *Caelifera* and species that have a low abundance from the family *Acrididae* are *G. marmoratus* and *A. thalassinus subsp. guest*.

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