Utilization of javanese ginseng and citronella for insect diversity in Pace village, Jember regency

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Abstract. This study aims to identify the diversity of insects in two species of herbal plants, namely Javanese ginseng and citronella in an attempt to initiate herbal plants which function as refugia which will be applied to agricultural plant cultivation. This research was conducted from May to June 2020 in Dusun Curah Wungkal, Pace Village, Silo District, Jember Regency. Sampling was done by purposive sampling, namely by taking insects on herbal plants using a sweep net. Sampling was carried out 4 times with intervals of 2 weeks. Insect diversity was analyzed using the Shannon Weiner diversity index and Dominance index. The differences between the observed parameters were analyzed using non-parametric statistics using SPSS version 15.0 software. The results showed that the number of insect abundance based on the Shannon-Wiener Index (H ') in Javanese ginseng was higher than that of citronella plants (2.124 ± 0.102> 1.163 ± 0.282). For the species dominance level (C) it is classified as a medium category and the value of Javanese ginseng is higher than that of citronella plants (0.141 ± 0.014> 0.432 ± 0.124). This condition indicates that the ecosystem of Javanese ginseng and lemongrass herbal plants, the diversity of insects, is in a fairly balanced condition.

1. Introduction

Jember Regency is one of the regencies located in the east of East Java Province with an area of 3293.34 km. Land use in Jember Regency until 2012 was still dominated by the agricultural sector so that the economy was still focused on this sector [1]. This determination is based on the number of productive workers, road conditions, telecommunications networks, clean water networks, rivers, electricity networks, and land-use patterns [2]. Also, in several areas in Silo District, there are quite a several industries. This shows that Silo District has great potential to be developed into a center for agriculture and processing, especially in Pace Village [3]. Pace Village in carrying out agricultural activities. The main agricultural commodity planted by the community in Pace Village is coffee, while other commodities are herbal plants including Javanese ginseng and lemongrass.

The Javanese ginseng plant is one of the plants known as *som Java or Javanese ginseng*. Javanese ginseng plants have functioned as ornamental plants, medicinal plants, or wild plants [4]. The parts of the Javanese ginseng plant that can be used as medicine are the roots and leaves. Lemongrass is a plant in the form of upright grasses, strong roots, upright stems, and forming clumps [5].

Currently, the cultivation of Javanese ginseng and lemongrass has been widely practiced. Along with plant cultivation, there are insects. The presence of insects in a community will affect the community structure of the area. A community is stated to have high insect diversity if it is composed of various types of insects with almost the same abundance. In cultivated land, each type of plant will

be visited by insects of different roles. The role of insects determines their trophic level in an ecosystem. Herbivorous insects or plant eaters occupy the second trophy as the first consumers [6].

The presence of herbivores in large numbers and with the potential to damage is classified as a pest. The pest problem is a problem that is oriented to human interests, not an ecological term [7]. Apart from herbivores, carnivorous or pest-eating insects occupy the third trophy as predators or parasitoids [8]. Research on the diversity of insects in Javanese ginseng and lemongrass in herbal plant centers in Pace Village, Silo District, Jember District has never been carried out. Therefore, research on the diversity of insects in Javanese ginseng and citronella plants will be carried out to know the diversity of insects in these plants to initiate herbal plants into refugia plants in agricultural cultivation.

2. Material and methods

This research was conducted on a herbal plant field in Dusun Curah Wungkal, Pace Village, Silo District, Jember Regency, from May 2020 to June 2020. This research is a descriptive study conducted directly to obtain primary data in the form of samples of insect species and insect populations. by purposive sampling, namely by taking insects on herbal plants using the sweep net. Samples were taken for each plant, amounting to 50 plants per bed. The observed parameters for the identification of insects found were separated according to their type. Pest samples were collected in 70% alcohol for identification. Insect identification was carried out at the Jember State Polytechnic Plant Protection Laboratory using a reference to the insect identification book [9] [10].

2.1 The observed variables cover

2.1.1 Arthropod diversity. Observations were carried out using insect nets on areas over conventional chili plants and organic transitions. These observations were made to classify the arthropods present in the treatment field. Identification based on [11]. This identification is useful for knowing the group and its role in chili plants.

2.1.2 Shannon-Weiner diversity index (H '). Diversity is a combination of the various component and the equality component as an overall diversity index [11]. Therefore, the greater the number of individuals per species, the higher the diversity index value will be. The diversity index value is calculated based on the Shannon Wiener index. This index value is related to the environmental conditions of the community. The diversity index is physically controlled ecosystems has a low value while in natural ecosystems it has a high value. Knowing the diversity of insect species in both treatments, namely organic and conventional transitional chili plants.

2.1.3 Dominance index (C). The dominance of the species in the observed insect community was calculated based on the Simpson dominance index [11]. If the value of the dominance index <1 then the insect species are diverse, on the contrary, if the value of the dominance index = 1, the insect species are not diverse. Besides, according to Simpson's calculation, if the Simpson index value (C) ranges from 0.7 - 0.8, it is a state that has not experienced disturbance or pollution, whereas if C <0.7 indicates a condition that has experienced disturbance or contamination. The diversity index provides an excellent way to identify and assess pollution.

The dominant species in the two treatments, namely the organic and conventional transitions, had a high index of importance so that the most dominant species naturally had the greatest index of importance.

2.2 Data analysis

Data were analyzed using non-parametric analysis with SPSS version 15.0 Shannon-Wiener diversity index (H ') using the formula:

$$H' = -\sum_{i=1}^{s} \left[\left(\frac{ni}{N}\right) ln\ ln\ \left(\frac{ni}{N}\right)\right]$$

Note: H 'is the Shannon diversity index, ni is the total individual species i, N is the total individuals of all species. Shannon-Wiener diversity index criteria.

Table 1. Value and description of the Shannon-Wiener diversity index (H ')

H' < 1.0	1.0 < H' < 3.22	H' > 3.22
-Low Diversity	- Moderate Diversity	- High Diversity
- Low Productivity	- Medium Productivity	- High Productivity
- Unstable Ecosystems	- Balanced Ecosystem	- Stable Ecosystem

The Dominance Index uses the formula:
C = ∑ pi ^ 2
Note: C is the Dominance Index, pi is the number of individuals in a species divided by the total number of individuals found in the species.

3. Result and discussion

3.1 Insect Diversity

In the research that has been carried out using Javanese ginseng and lemongrass herbal plants as objects by looking at the abundance and diversity of the types of insects that exist, so that various types of insects have been identified from their types and trophic structures in Javanese ginseng and lemongrass plants. 12 insect species have been identified in the Javan ginseng plant, including *Dichcrosis puntifera, Chrysodeixis chlalcites, Agrotis ipsilon, Minegrala coerulenfrons, Nezara viridula, Coccinellidae sp, Anisoptera sp, Ischnura spp, Appias libyhea, Ochetellus spora, and Aphisica mellifera*.

Some of the dominant insects in the order Lepidoptera with their tropical status or role as pests or phytophages, namely insects that attack plants. Meanwhile, those that act as pollinators or insects that can pollinate plants are the species Appias libyhea. The second trophic structure is an insect that acts as a natural enemy of pests, namely predators where there are four species of predators with the order Hymenoptera and the order Odonata and each of these two insect species. For the third trophic structure, some insects act as pollinators or insects that can help plants to pollinate, namely insects of the order Hymenoptera and order Lepidoptera.

Citronella plants have identified several insects from their trophic structures, including *Dichcrosis puntifera, Nezara viridula, Coccinellidae sp, Anisoptera sp, Ischnura spp, and Ochetellus sp*. Some insects act as herbivores or insects that act as plant pests, namely *Dichcrosis puntifera* and *Nezara viridula* species. While insects that act as natural enemies of pests are four species of insects and have the first trophic structure in citronella herbal plants.

Based on the results in Table 2, which states the functional diversity of insects in Javanese ginseng and lemongrass with the symbol (+) indicates that there are insects in herbal plants. Meanwhile, the symbol (-) states that there are no insects in herbal plants.

Based on the research (Table 2), the total number of Arthropods on Serai Wangi and Java Gingseng plants has been carried out from the average number of species of the two treatments, which are different in Javanese ginseng, there are 12 species, including 6 species of pests, 4 species of predators, pollinators 2 species, while for citronella plants itself, namely 2 species for pests and 4 species for predators.

At the order level, 6 orders were found, including Lepidoptera, Diptera, Hemiptera, Coleoptera, Odonata, and Hymenoptera. Whereas at the level of insect families, there are 11 insect families found, so Table 2 shows the abundant diversity of arthropods in the herbal plant ecosystem, both Javanese ginseng and citronella plants.

Arthropods are generally grouped into insect pests, useful insects, and neutral insects. As useful organisms, some insects act as natural enemies both as parasitoids and predators, insect pollinators, and decomposers. Meanwhile, neutral insects often fall prey to predators, so that they play a very large role in maintaining the balance of the ecosystem.

Table 2. Insect Diversity in Citronella and Javanese Ginseng

Number	Insect Name / Species	Order	Family	Role	Number of Individuals	
					GJ	SW
1.	*Dichcrosis puntifera*	Lepidoptera	Crambidae	Pest	+	+
2.	*Chrysodeixis chlalcites*	Lepidoptera	Noctuidae	Pest	+	-
3.	*Agrotis ipsilon*	Lepidoptera	Noctuidae	Pest	+	-
4.	*Minegrala coerulenfrons*	Diptera	Micropezidae	Pest	+	-
5.	*Nezara viridula*	Hemiptera	Pentatomoidea	Pest	+	+
6.	*Coccinellidae sp*	Coleoptera	Coccinellidae	Predators	+	+
7.	*Anisoptera sp*	Odonata	Anisoptera	Predators	+	+
8.	*Ischnura spp*	Odonata	Amphipterygidae	Predators	+	+
9.	*Appias libyhea*	Lepidoptera	Nymphalidae	Pollinator	+	-
10.	*Ochetellus sp*	Hymenoptera	Formicidae	Predators	+	+
11.	*Aphis mellifera*	Hymenoptera	Apidae	Pollinator	+	-
12.	*Aulacophora indica*	Coleoptera	Chrysomelidae	Pest	+	-
Total	12 Species	6 Order	11 Family			

Description:
GJ: Javanese Ginseng; SW: Serai Wangi/Citronella; +: there are insects; - : no insects

Table 3. Insect Populations in Javanese Ginseng and Serai Wangi Plants.

Number	**Name of Insect**	**Javanese Ginseng (MST)**				**Serai Wangi/Citronella (MST)**			
		1	**3**	**5**	**7**	**1**	**3**	**5**	**7**
1.	*Dichcrosis puntifera*	12	7	3	1	2	2	1	0
2.	*Chrysodeixis chlalcites*	8	3	4	3	0	0	0	0
3.	*Agrotis ipsilon*	5	4	3	4	0	0	0	0
4.	*Minegrala coerulenfrons*	5	3	2	5	0	0	0	0
5.	*Nezara viridula*	7	2	1	1	2	1	0	0
6.	*Coccinellidae sp*	22	24	27	24	15	9	13	10
7.	*Anisoptera sp*	15	17	18	13	3	2	1	1
8.	*Ischnura spp*	13	14	12	16	1	1	1	1
9.	*Appias libyhea*	31	25	22	38	0	0	0	0
10.	*Ochetellus sp*	22	27	12	21	5	3	2	2
11.	*Aphis mellifera*	22	29	27	22	0	0	0	0
12.	*Aulacophora indica*	2	1	1	1	0	0	0	0
	Total	164	156	132	149	28	18	18	14

Based on the results in table 3. The insect population identified in two herbal plants, namely Javanese ginseng, and lemongrass, shows an abundant diversity of insects, for example, insects that act as plant pests are not dominant in the two treatments of herbal plants, but the most dominant insects here are insects that act as natural enemies or predators of plant pests, then insect pollinators or pollinators. This is because predators or natural enemies in the food chain pyramid occupy the second level of the consumer trophy. Trophies or levels in the food chain form a food chain pyramid, where the number of

producers is more than consumer I, the number of consumers I am more than consumers II, and so on [12].

Table 3 shows the role of natural enemies in balance with insect pests. For example, in the species Coccinellidae spp, the observer shows a high number compared to other insects. Therefore, predatory insects which are the second-highest consumer are found more than the pests and pollinators which are the first consumers. Herbivore arthropods in agricultural ecosystems can affect the level of plant productivity because herbivorous arthropods will damage plants by eating plant parts [13].

3.2 Shannon-Wiener Diversity Index (H ') and Dominance Index (C)

Table 4. Diversity Index

Data Analysis	Treatment	
	Javanese Ginseng	Serai Wangi/Citronella
Shannon-Wiener (H')	2,124±0,102 a	1,163±0,282 b
Dominansi (C)	0,141±0,014 a	0,432±0,124 b

Note: Data followed by different letters stated significantly different according to the *Mann Whitney test* data
($p < 0.05$).

The diversity of insects showed significantly different results. This shows that the herbal plants used had a significant effect on the diversity of arthropods found in Javanese ginseng. Based on the Shannon-Wiener (H ') analysis using the Paired sample T-test, the diversity of insects in citronella plants is lower, this can be caused by the lower number of insect species than in Javanese ginseng. The SID (standard dominance index) of the two herbs shows significantly different, this is due to the dominance of species in each herbal plant.].

According to Saxena [16] states that it is ecologically and in a balanced manner that flowering plants are needed to attract insects using morphological and physiological characters of flowers, namely size, shape, color, fragrance, flowering period, and nectar and pollen content. Most of the insects prefer small flowers, tend to open, with a long flowering time [17] and [18].

Table 4 showed hat the number of insect abundance based on the Shannon-Wiener Index (H ') in Javanese ginseng plants is higher than in citronella plants ($2.124 \pm 0.102 > 1.163 \pm 0.282$). For the species dominance level (C) it is classified as a medium category and the value of Javanese ginseng is higher than that of citronella plants ($0.141 \pm 0.014 > 0.432 \pm 0.124$). Such conditions indicate that the ecosystem of Javanese ginseng and lemongrass herb plants is a fairly balanced diversity of insects. The color of the flower is one of the attractions of flowers for insects. Apart from color, the nectar and pollen content in flowers is also an attraction for insects. Nectar is a complex collection of chemical compounds with varying nutritional content, generally containing simple sugars (monosaccharides) which are about 15–75% by weight.

The scent of flowers is also an attraction as well as a plant identifier for insects [19]. The aroma is one of the adaptability of plants that can act as an attractive or repellent. For pollinator insects, the smell or scent of flowers is more difficult to identify than the color of a flower. Thus planting these types of plants can have positive implications in supporting biological control efforts [20].

4. Conclusion

Based on the research conducted, it can be concluded that the diversity of insects in herbal plants, namely Javanese ginseng and lemongrass produces: Arthropod populations that have been identified in the herbal plants of Javanese ginseng and lemongrass, there are 12 species of 6 orders and 11 insect families found. The Shannon-Wiener index (H ') is in the moderate category, citronella plants have a lower number of individuals than Javanese ginseng, which means that this condition indicates that the

ecosystem is in a fairly balanced condition both in citronella and Javanese ginseng. The dominance index (C) of species in Javanese ginseng plants is 0.141 ± 0.014, lower than that of citronella plants, namely 0.432 ± 0.124.

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