

The Difference of Arthropods Diversity in Semi-Organic and Conventional Citrus Orchard in Dau, Malang

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Abstract

The purpose of this research is found diversity of arthropods in citrus orchard to describe effect of pesticide. Therefore, the researchers are interested in conducting a study of which is to describe and compare the numbers and types of insects in organic and semi-organic citrus orchard. This study has been done on 4 conventional and 2 semi-organic orchard in Dau, Malang, in February 2019. Arthropod observation using pitfalltraps and visual encounter method. Pitfall trap were performed on 5 point in each orchard. The visual encounter method was conducted for 1 hour in on each orchard. The findings show that there are 1,365 insects which belongs to 10 orders and 21 families. The number of arthropod between the two locations was indicated by the number of different type of arthropods. In the semi-organic orchard, there are 960 Species from 13 families, and conventional there are 405 species from 13 families. The dominant family from Drosophilidae, Formicidae, Chrysomelidae, Lycisidae, Anisobabidae and Aphididae. Conventional orchard system considered as stable environment which is an average of 2.8 of diversity index. The highest number of species belonging to pests reaches 61%.

Keyword: Arthropod, Citrus orchard, Conventional, Diversity, Semi-organic

INTRODUCTION

The green revolution in 1960 cause impact of the ecosystem has begun. Green revolution is to increase agricultural productivity. The way is using inorganic ingredients such as pesticide and fertilizer. The impact in ecosystem of the use of inorganic materials is pollution of the environment both soil, water and air as well as pest explosions so that inevitably farmers must continue to use pesticides.

Conventional systems are implemented to prioritize crop production. So that in processing it Chemical are used from industrial products such as chemical fertilizers with high active ingredients, herbicides, and pesticides. The main purpose is to produce higher yields or crops because of the loss of plant pest organisms [1]. Conventional systems certainly have a negative impact, for the change in ecosystem stability because it uses synthetic chemicals. The most obvious impact is on the health aspect such as product health and ecosystem health [1]

Government have been make serious effort to replace organic fertilizers and pesticides and implement the Integrated Management of

Healthy Citrus orchards. These efforts have not been maximally implemented by farmers because the prices of organic agricultural products on the market are competitive. The encouragement from the farmers and the government is considered to be not optimal to truly implement organic farming in Indonesia.

Insect soil have a vital role in the food chain, especially as decomposers. Without the insect, natural organisms will not be able to recycle organic materials. Arthropods also play a role as prey for other smaller predators, so it will sustain other arthropods. As a consequence of arthropod community structure will reflect the environmental factors that affect the soil, including on human activity. The identification of the abundance and diversity of birds and arthropods species is important, so we can know the role of the organism to the environment [2].

This research purpose is to determine diversity of insects in citrus orchard to describe the effect of pesticide. Arthropod diversity describes the level of damage in the orchard. The level of damage is a reference to improve land and for determining strategy for the conversion process of organic

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cultivation. Therefore, the researcher interest in conducting a study of which aim is to describe and compare the numbers and types of insects in organic and semi-organic citrus orchard.

RESEARCH METHOD

The study was conducted between February and March 2019. The setting of the study was semi-organic and conventional citrus orchard located in Dau, Malang, East Java. Semi-organic orchard are cultivation using minimum non-organic pesticide. Conventional orchard are cultivation using non-organic pesticide with once a week spraying intensity. The research method used was observational method with design blocks study. The samples (arthropod) were taken using Pitfall trap and visual encounter. The insect samples were identified based on their family level.

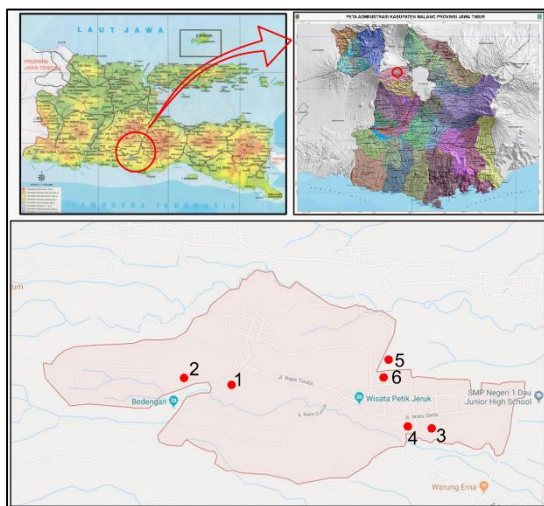


Figure 1. The Location point of the study in Selorejo Village, Dau, Malang

Data analysis was done by abundance, frequency, and diversity. The data analysis of community structure comparison is obtained from the importance and diversity index (Shannon-Wiener). The similarity of the composition of the two locations was analyzed using Bray-Cutris similarity index and the pattern of variation was analyzed using software Microsoft Office and PAST.

MATERIAL AND SAMPLING METHOD

Pick out of soil arthropods using pitfall trap. Pitfall trap made from a jam jar with 70mm diameter and 150mm height. The trap is filled with a mixture of water, detergent and alcohol as much as a third of the bottle jam. Pitfall fitted with a buried high ground and then covered with a

plastic pole spikes. Pitfall mounted of 5 pieces at different point in 2 semi-organic and 4 conventional orchards. Installation of the trap is determined at random (Random sampling). Traps were installed wait for 24 hours. Collection data of arboreal arthropods using observation with visual encounter method. Observation take about 30 minutes. Arthropods are caught in a trap directly identified by using insect determination guide books [3].

RESULT AND DISCUSSION

Based on the findings of the research conducted in the semi-organic and conventional citrus orchards, the number of individual insects found and collected was 1,365 insects which belongs to 10 orders and 21 families. The types of insect found in the orchard are Coleoptera (404 specimen), Diptera (313 specimen), Hymenoptera (304 specimen), Hemiptera (195 specimen) Araenae (60 specimen), Dermaptera (24 specimen), Lepidoptera (9 specimen), Orthoptera (28 specimen), Odonata (24 specimen), and Isoptera (4 specimen). The number of arthropod between the two locations was indicated by the number of different type of arthropods. In the semi-organic orchard, there are 960 individuals from 13 families, and 405 species from 13 families in conventional orchard.

Semi-organic and conventional orchard system influencing the number of arthropods. According to [4] land use pattern and habitat are factor of determine type of arthropod. Semi-organic system was farmed with low inputs synthetic pesticides. Using inorganic pesticides in orchard cause health, social, and environmental problem [5]. Organic farming is the best solution to decrease environmental problem and associate with biodiversity conservation. According to [6] conventional and organic farming showed the different level of insects type and butterflies. Synthetic pesticides was prohibited in organic farming. So, the consequence is using chemical pesticide with good strategic. The impact of using inorganic pesticides cause environmental pollution in air, soil and water [7] [8].

Conventional orchards system are indicated by 1, 2, 3 and 4, while 5 and 6 are semi-organic orchard system. It is said to be semi-organic because it still uses inorganic materials in the process. In addition, the location of organic orchard was among conventional orchard. The dominant arthropod is insect.

Tabel 1. Abundance of Arthropods in citrus orchard

Ordo	Family	Point						Total
		1	2	3	4	5	6	
Araenae	Lycosidae	-	-	-	1	53	2	56
	Sicariidae	-	-		-	-	-	1
	Sicariidae 2	-	-	1	-	-	-	3
Coleoptera	Chrysomelidae	61	125	3	11	-	-	201
	Chrysomelidae 2	36	27	4	31	-	-	120
	Staphylinidae	-	56	26	13	-	7	78
	Coccinelidae	-	-	2	-	3	-	3
	Cerambicidae	1	1	-	-	-	-	2
Dermaptera	Anisolabididae	2	-	-	1	19	2	24
Diptera	Drosophilidae	88	34	-	69	-	-	223
	Culicidae	14	17	32	36	1	-	81
	Mydidae	-	-	13	-	2	-	2
	Muscidae	3	4	-	-	-	-	7
Hemiptera	Aphididae	-	-	-	-	100	95	195
Hymenoptera	Formicidae 1	23	14	-	20	14	-	82
	Formicidae 2	1	3	11	4	1	-	13
	Formicidae 3	4	1	4	-	17	-	22
	Eulophidae 4	16	46	-	29	-	-	94
	Formicidae 5	22	12	3	22	8	18	89
	Formicidae 6	-	-	7	1	1	-	2
	Formicidae 7	-	-	-	1	1	-	2
Lepidoptera	Lycaenidae	-	-	-	-	1	-	1
	Erebidae	-	-	-	-	1	-	1
	Erebidae	-	-	-	-	3	3	6
	Pieridae	-	-	-	-	1	-	1
Odonata	Libellulidae	-	-	-	-	10	14	24
Ortoptera	Acrididae	-	-	-	-	4	2	6
	acrididae	-	-	-	-	8	9	17
	Pyrgomorphidae	-	-	-	-	5	-	5
isoptera	Rhinotermitidae	1	3	-	-	-	-	4
Total		272	343	106	239	253	152	1365

Chrysomelidae. The Drosophilidae family dominates conventional orchards (figure 2) and have important value index (IVI) 54.9 (orchard 1), 29.4 (orchard 2), 50.9 (orchard 3), 53.1 (orchard 4). The Drosophilidae family in citrus orchards is considered to be a pest by farmers because its makes fruits unsuitable for harvest.

Dominant species is family Drosophilidae. Based on the value (figure 2) suggests that the Dominance of Drosophilidae happened because of each spraying then unfit for fruit harvested will

fall. So the Drosophilidae from other areas to come. Interest In Drosophilidae towards ripe fruits this because behavior affected by chemicals [9]. Insect population less predators can't tackle and balance the amount herbivorous insects can be damaged orchard due to lack of space shelter and hide for insect's predator [10]. One of them found in the phenylpropanoid plants have essential oils. In addition, the female Drosophilidae also lay their eggs on the fruit [11].

At the moment, Drosophilidae have spread almost throughout in Sumatra, Java, Madura, and Riau islands. In that climate cool, high humidity and wind that is not too tight intensity attack and the fruit fly population will increase. Climate factor is very influential against the distribution and development of Drosophilidae [12]. The codominant family in conventional orchard is Chrysomelidae. There are two types of Chrysomelid species identified. The species is also classified as a pest by eating stems, leaves or shoots [13].

Semi-organic orchards (orchard 5) show the dominance of the Aphididae family, Anisolabididae and Lycosidae. Of the several dominant families identified, they have different roles. Aphididae are pests, Anisolabididae are predators and detritivores and Lycosidae are predators as a biological control [14]. Aphids caused direct damage to the leaves due to suctioning of fluids and transmission of viruses. Aphids usually suck the lower surface of leaves, young stem tissue, flower buds and growing pods. Plants that have been attacked will be stunted, leaf distortion and yield loss up to 40% [15]

Differences in cultivation techniques affect the population and the level of diversity of species of insects and spiders. Organic farming systems have a diversity of insects and spiders are better than conventional agriculture because in organic land the cultivation system is applied in accordance with environmental rules [16].

Different from previous semi-organic orchard, semiorganic orchard (orchard 6) dominated by the family Formicidae. There are 2 identified species namely *Dolichoderus thoracicus* and *Oecophyllini* sp. Formicidae family reported in habitats variety such as citrus orchard. [16]. In the ecosystem, Formicidae has several function roles as scavenger, detritivore, predator, and seed feeder [17]. Formicidae can be used as bioindicator of soil condition, environmental changes, maintaining soil structures and maintaining nutrient cycles [17].

Based on cluster with Shannon-wiener diversity index calculation, conventional orchard system considered as stable environment. Arthropods in conventional orchard system more varied than semi-organic system. The variety of arthropods illustrated complexity of community, complex food chain, high interaction, and related to environmental stability.

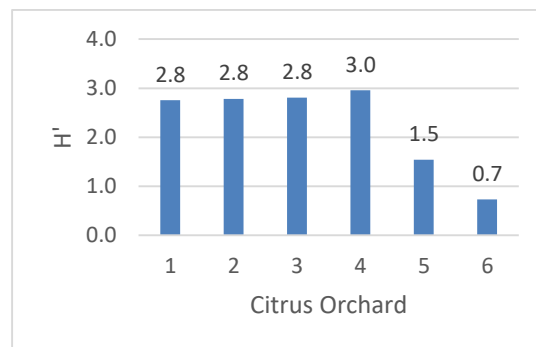


Figure 3. Arthropods diversity with Shannon-Wiener index

The diversity of each orchard calculated by the Shannon Wiener index. Generally, citrus orchard with conventional system have a high diversity than semi-organic orchards. Conventional orchard have almost the same diversity, which is an average of 2.8 with a relatively high environmental stability. High diversity can be caused by species that are resistant to pesticides. The increase in species diversity has a positive correlation with increased species viability [18]

Semi-organic orchard have a low diversity, which is an average of 1. Showing low environmental stability. This is understandable because the semi-organic orchard has only been running for 1.5 years or in the conversion phase. The conversion phase will eliminate several species that are often encountered and produced only a few dominant species because they are resistant and bring new species. The decrease in the arthropod diversity caused by impact of chemicals element. Side effect of using chemical pest control is target pest being resistant to pesticides, loss of several type of arthropods, secondary pest explosions [8]. Taxa richness influenced by the state of a homogeneous agricultural ecosystem. agricultural practices have a very influence on insect diversity [16]

Species diversity tends to be low or moderate in ecosystems that have strong limiting factors and physically controlled environments and will increase in an ecosystem that is not regulated or takes place naturally. Arthropod diversity is low to moderate influenced by several things and related communities are built communities whose existence managed by humans, Land use change cause change in living space for an organism, micro-climates in the ecosystem area, and occur competition between related ecosystem inhabitant [19].

The different type of species used to illustrate how complex a community [20]. High of

interaction in a community showed more diversified species of insects. The ecosystems have high biodiversity value has longer and complex the food chain such as predator interactions, parasitism, competition commensalism and mutualism.

The abundance and diversity of canopy insects has different activities in changing seasons. Several factors that influence changes in this activity are abiotic factors, food sources, and seasons. The families that commonly dominate plantations are Coccinellidae, Staphylinidae and Delpacidae [21]. Generally, Agroecosystems have low biotic and genetic diversity and tend to be one kind. It shows the ecosystems are unstable and prone to increasing populations of pest species [22].

Cluster analysis with a similarity value 0.80 indicated that organic and semi-organic orchards really have a difference in terms of diversity and abundance.

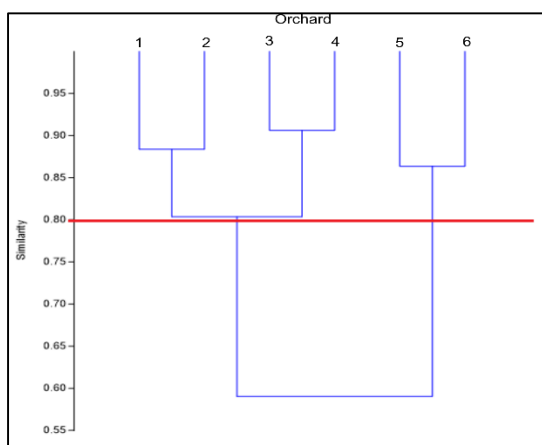


Figure 4. Similar Dendrogram between the Types of orchard

The highest number of species belonging to pests reaches 61% (figure 6). This high percentage caused by animal resistance to pesticides. Actually pests classified as herbivores but in the graph above herbivores there is a separate diagram because some of the identified herbivores are few in number and do not cause damage to the orchard area [23] the role of predators reaches 27%. The large number of predatory arthropods caused by the large number of herbivores [24]. Detritivor with a percentage of 8%. Detritivor must be exist in every habitat because the soil in the citrus orchard is not so good. So need succession proses [25]. The large number of herbivores (including pests) and the presence of predators in accordance with the level of the food chain, namely herbivores, are more abundant

than predators, indicating that there is still stability in the environment. [18]. The abundance of herbivorous insects has a good influence on the development of natural enemies, because herbivorous insects are a source of food for predator [16]

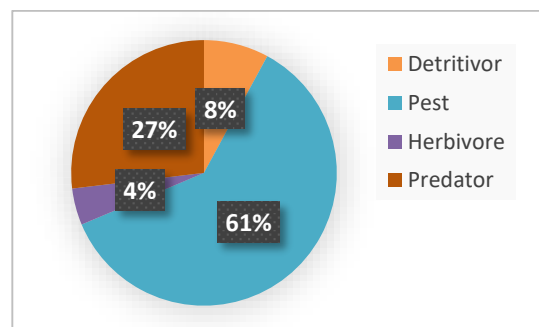


Figure 6. The Role of Insects in Citrus Plantation

CONCLUSION

This research collected approximately 1,365 insects which belongs to 10 orders and 21 families. The number of arthropod between the two locations indicated by the number of different type of arthropods. In the semi-organic orchard, there are 960 Species from 13 families, and conventional there are 405 species from 13 families. The dominant family from Drosopilidae, Formicidae, Chrysomelidae, Lycisidae, Anisolabididae and Aphididae. Conventional orchard system considered as stable environment. Arthropods in conventional orchard system more varied than semi -organic system. The highest number of species belonging to pests reaches 61%. This high percentage is caused by animal resistance to pesticides. The large number of predatory arthropods is caused by the large number of herbivores. Herbivores are more abundant than predators, indicating that there is still stability in the environment.

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