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Types of Insects in Organic and Semi-Organic Citrus Plantation

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Abstract

Using pesticide within semi-organic plantation system results in declining number and type of insects. Within the ecosystem, insect functions as herbivore, carnivore, detrivore and pollinator. The purpose of the study is to describe the structure and function of insect composition in organic and semi-organic orange plantation. The study used the blue and yellow trap pan method. The trap pan is installed one meter above the ground. 10 settlers are needed for 5 times of replication. The findings show that there are 1910 insects that belong to 5 orders and 24 families; formicidae family from hymenopetra is the most frequently found insect in the plantation. The Shannon Diversity Index showed difference between the organic and semi-organic plantation. The findings suggested that type of insects in the organic and semi-organic plantation is related to type of technology in each of the orange plantation.

Keywords: Citrus Plantation, Insect

INTRODUCTION

The use of synthetic pesticide causes various problems such as economic, environmental, social and health issues. Pesticide helps controlling harmful organisms. However, it may have several negative impacts on organisms, namely [1] the use of synthetic pesticides makes insects more resistant to the certain chemical substance; as the consequence, plantation needs to use new pesticide and it can increase cost of production. When consumers and farmers are able to understand the negative impacts of using pesticide, farmers will shift from conventional farming system to organic farming system [2].

Insect is bio-indicators of how healthy an ecosystem is. Insects play a role in the process of herbivore, predation, pollination and support material transformation cycle in the ecosystem. Balance ecosystem maintains soil fertility which increases the productivity of plants cultivation. The performance of a healthy community is supported by the preservation of insects [3].

Insects on plantations serve as indicators for the quality of agricultural ecosystems. Based on previous studies [4], the number and type of insects in organic land is higher than those in conventional farms. The levels of insect species have implications towards stability in the ecosystem. Stability of the ecosystem affects the quantity and quality of plant being produced by the plantation.

Balance ecosystem in plantations can be achieved when farmers apply sustainable farming. Farmer's attitude and behavior lead to farmer's efforts. It will affect the quality of land and biodiversity. Quality of land and biodiversity affect the production and productivity of crops [5].

The citrus plantation has two benefits; it serves as both economic and ecological services. Ecological service means the citrus plantation absorbs carbon dioxide and carbon monoxide and becomes habitat for animals, especially insects. Insects play role as herbivores (pests), carnivores, and pollinators (pollination). In terms of economic services, citrus plantation can improve economic condition of the

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society; citrus plantation productivity results in sustainable system.

The studies about insects have been conducted in several regions in Indonesia, for example [6] it was reported that the types of bugs found on the surface of soil organic horticulture soil are those belong to the order of Hymenoptera, Orthoptera, Collembola, Coleoptera, Hemiptera, Homoptera and Diptera. However, the research about insects in organic and semi-organic farming has yet been conducted. Therefore, the researchers are interested in conducting a study of which aim is to describe the numbers and types of insects in organic and semi-organic citrus plantation.

RESEARCH METHOD

The study was conducted between December 2015 and August 2016. The setting of the study was organic and semi-organic citrus plantations located in Dadaprejo, Batu, East Java. The research method used was observational method with design blocks study. The samples (insects) were taken using insect traps vessel water yellow and blue. The samples were taken every four days, and there were five times of the sampling. The environmental factors (temperature, humidity and light) are evaluated in every insect sampling. Observations were conducted using a microscope. The insect samples were identified based on their family level. 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 with SPSS.

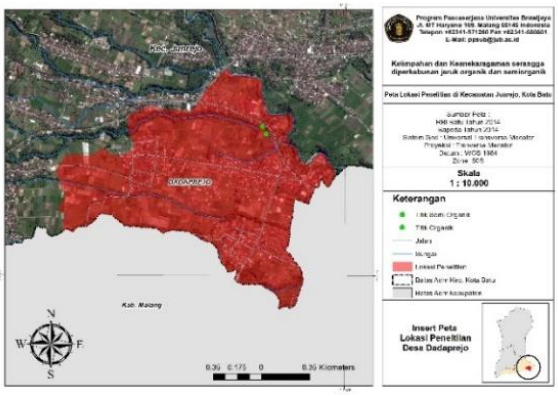

Figure 1. Map of research sites

RESULT AND DISCUSSION

Based on the findings of the research conducted in the organic and semi-organic citrus plantations, the number of individual insects that were found and collected was approximately 1,910 insects which belongs to 5 orders and 24 families. The types of insect found in the plantation are Diptera (782 insects), Hymenoptera (525 insects), Homoptera (455 insects), Coleoptera (68 insects) and Psocoptera (68 insects). The number of insects between the two locations was indicated by the number of different type of insects. In the organic plantation, there are 1,104 insects from 22 families, and semi-organic there are 765 insects from 17 families in the semi-organic plantation.

The differences of the individual number in the organic and semi-organic plantation are influenced by the plantation system. According to [7], the factors that determine the different types of insects are the patterns of land use and land surrounding the habitat. Semi-organic plantation (conventional) is a plantation system that relies on chemical inputs and synthetic pesticides to support the growth of plant. Besides that, according to [8], the use of synthetic pesticides in conventional farming does not cause only health problems, but also lead to social and environmental costs.

Organic farming is considered as solution to problems associated with the conservation of biodiversity in agriculture. According to [9], it showed that there is different level in types of insects and butterflies in organic farming, when it is compared to conventional farming. The use of synthetic chemical pesticides is prohibited in organic farming systems. As the consequence, the role and use of botanical pesticides are very strategic. The negative impact of using synthetic pesticides is environmental pollution for instance contamination of soil, water and air, resistant insect pests become resistant, resurgence and pesticide tolerance [10].

The dominating insect types belong to Formicidae, Drosophilidae, Mycetophilidae and Psyllidae Family (Figure 2). The insects caught in the organic and semi-organic fields using yellow and blue trap pan is different. In the yellow vessel, the individual number of insects is higher than the blue pan traps because the color affects the number and type of insects.

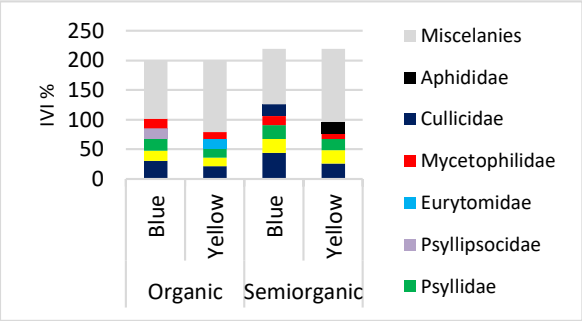

Figure 2. Index value of important insects in organic and semi-organic plantations

The difference is due to the wavelength pan trap captured by insects. According to [11], the study about color preferences mentioned that some groups of herbivores and predators have similarities in the selection of colors; they prefer yellow. Generally, insects respond yelow more positively because the color is related to the insect which stays on leaves.

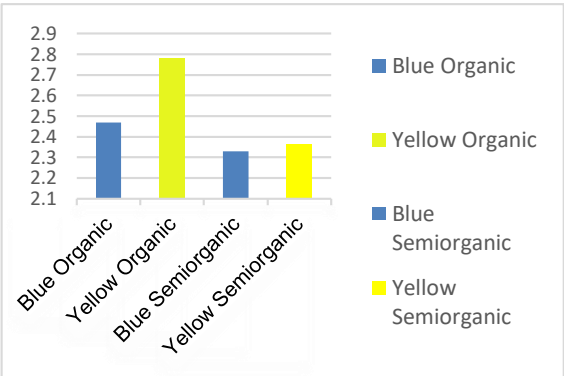

Figure 3. The Type of Insects in the Organic and Semi-Organic Farming (Pan Trap)

Based on the calculations of Shannon-Wiener diversity index (H '), the range between 2 and 3 is considered as stable environment. The insects caught in the organic plantations was more varied than the insects caught in the semi-organic plantations. According to [12], the different type of species is used to illustrate how complex a community is. High of interaction in a community showed more diversified species of insects. The ecosystems that have high biodiversity value has longer and more complex the food chain such as predator interactions, parasitism, competition, commensalismand mutualism.

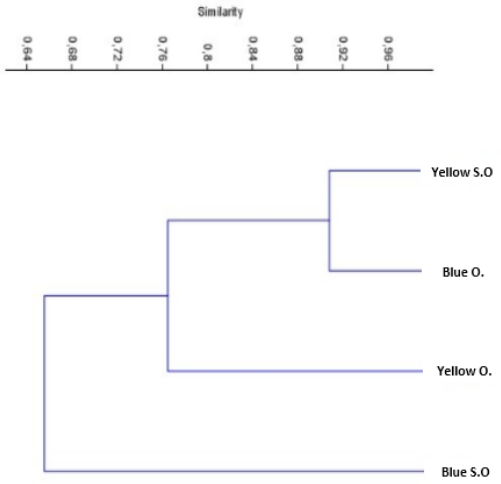

Figure 4. Similar Dendogram between the Types of Plantations

The results of Bray-Curtis Index calculation showed the similarities between the two composition; the Bray-Curtis Index of the organic plantation is about 0.74 and that of the semi-organic plantationis about 0.62. Based on the index, the composition of insects between the two locations, the organic and semi-organic plantation is about 1.0. [13], the distance coefficient calculation refers to the calculation of dissimilarity or similarity. The distance that occurs in the calculation of the Bray-Curtis Index (inequality) is between 0 (equal) and 1 (different); it make the similarity index is the complement of the calculation of Bray-Curtis.

The role of insect communities in organic and semi-organic citrus plantations

The role of insects in the ecosystem is pivotal and varied. Based on its role in the ecosystem of organic and semi-organic citrus plantations, the insects can be grouped into herbivores, detrivor, pollinators and predators (Figure 5). In the semi-organic plantations, it was obtained there were 1 family of insects that act as pollinators, 5 families of insects that act as carnivore, 6 families of insects that act as herbivores, and 5 families of insects that act as detrivor. In the organic citrus plantation, there was 1 family of insects that act as pollinators, 7 families of insects that act as carnivores, 9 families

of insects that act as herbivores, and 6 families of insects that act as detrivor.

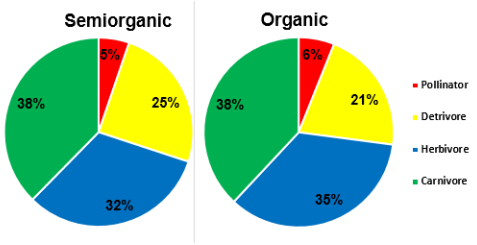

Figure 5. The Role of Insects in Citrus Plantation

Based on the findings, the farmers have a full authority in implementing which type of plantation system they prefer [14], said that there is a difference in attitude, behavior and knowledge between organic and conventional farmers. Conventional farmers need knowledge such as knowledge of environmental conservation to increase biodiversity. The farmers, who apply principles of organic farming, have a more positive attitude and more information about the environmental conservation; it can increase the benefits of diversity.

The roles of insects in organic and semi-organic plantations are herbivores, detrivor, pollinators and predators. The farmer's knowledge of the role of insects is still lacking. They should have some information about and understand economic value of the role of insects in the plantations. According to (15), the role of insects is still poorly understood by farmers and as the result using pesticide to kill insects has become the common practice. The training program gives awareness for farmers about the insects so that they will reduce the use of insecticides and understand the benefit of land conservation which is effective and more harmonious to increase production.

The Environmental Factor Influencing the Insect

The existence of the insect community with all of their interaction cannot be separated from the existence of some abiotic factors. In the context of the study, abiotic factors refers to air temperature (®C), humidity (%) and the intensity of light (lux). The temperature and humidity are abiotic factors which influences the interaction of organisms with its abiotic. The following diagram (Figure 6-8) shows the analysis of temperature, humidity and light intensity

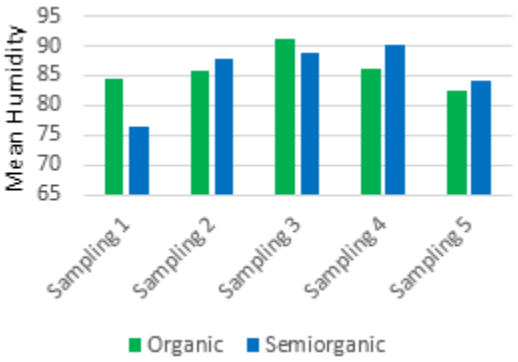

Figure 6. The Comparison of average humidity in the Organic and Semi-Organic Citrus Plantations

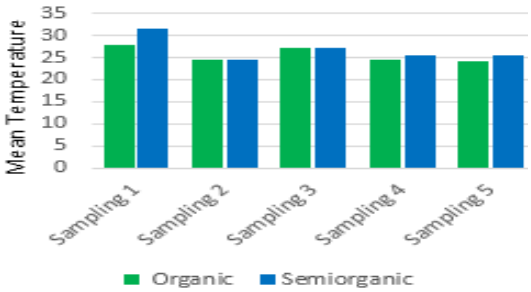

Figure 7. The Comparison of Average Temperatures in Organicand Semi-Organic Plantations

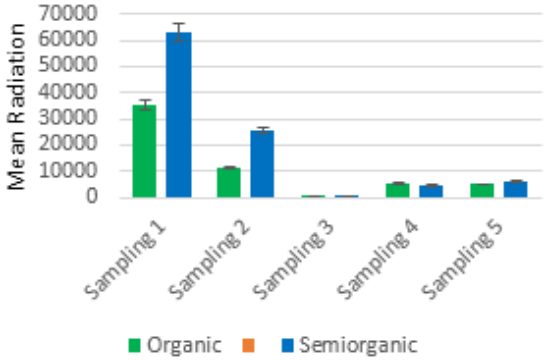

Figure 8. The Comparison of Average Light Intensity in Organicand Semi-Organic Plantations

One of the abiotic factors that can determine how low or high diversity is in citrus plantation is the temperature. Some of the measurement results of abiotic was carried out systematically to obtain correlation between abiotic factors and the types of insects. The air humidity describes the content of moisture in the air.The insects need moisture in the air (humidity) for a certain activity.The humidity can

affect the distribution of activity and insect development. Air humidity is important to understand because understanding the air moisture allows farmers to find out the amount or the existing water content [16].

The dominant types of insects in the organic citrus orchard are Formicidae and Psyllidae family, while the dominating types of insects in the semi-organic citrus plantations are Drosophilae and Formicidae. It happens because of some factors attracting the insects namely aroma, and color vessel meanwhile the abiotic factors that gives contribution to the different types of insects in the plantations is the temperature. The temperature influences activities of insects in the mornings; the most suitable temperature for the growth of insects is 27 C. The temperature enables the insects to go out looking for food; it can increase the diversity of insects [17].

CONCLUSION

Based on the analysis, it can be concluded that:

The citrus plantation system selected by the farmers influences number and types of insects in the plantation. There are 1,104 insects that belong to 22 families in the organic plantation systems and there are 765 insects from 17 insect families in the semi-organic plantation. for the blue vessel and 2.78 for yellow vessel.

RECOMMENDATION

The agriculture system selected by the farmers depends upon the level of the farmer's knowledge. The farmer's knowledge affects perceptions and eventually behavior. Careful agriculture system will result in sustainable plantations.

There is a need for a facilitator of which role is giving explanation about the effect of using pesticide and the management of organic plantations to improve the standard of life as well as to reduce health and social issues caused by synthetic pesticide.

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