

## THE IMPACT OF USE CONVENTIONAL AGRICULTURE ON SOIL ARTHROPODA COMMUNITY IN STARFRUIT (*AVERRHOACARAMBOLA L.*) NGRINGINREJO VILLAGE BOJONEGORO, INDONESIA

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### Abstract

Bojonegoro is one of cities in East Java that has tourism potential. Agriculture-based tourism object, namely starfruit garden. Starfruit garden applying conventional farming systems namely the use of pesticides and synthetic fertilizer in order to increase the number of starfruit garden production. Soil arthropods is a arthropods that have an important role in decomposing organic materials and soil nutrients. On the farmland there is organic content and soil nutrients that abundants enough, because the addition of manure of energy in the ground. The research was conducted in June 2018 - April 2019 took place in the Belimbing Garden (*Averrhoacarambola L.*) Ngringinrejo Village, Kalitidu District, Bojonegoro Regency. This study to examine the soil arthropods community structure in organic and inorganic farmland as well as the effect of chemical and physical environmental factors to community structure of soil arthropods and farmers' perceptions of organic and conventional farming systems. The study was conducted with samples of soil sampling using *Pitfall Trap* method, measuring abiotic factors of temperature, soil pH, air humidity, light intensity and soil organic matter. The data obtained were analyzed with Ms. Excel and the PAST program to search Taxa Richness for arthropod, abundance, frequency, Shannon – Wiener diversity index and Import Value Index for Arthropod. Then they were analyzed regression, cluster, and biplot to determine the relationship between the two. The results showed impact use conventional agriculture, taxa richness and arthropod diversity index from station one to station five. The value of indicates the dominance of *Formicidae* family. The Shannon Wiener diversity index ( $H'$ ) was 4.68 in the category of moderate species diversity and moderate community stability. The evenness ( $E$ ) population value tends to be even. Soil arthropod diversity index shows that the diversity in the starfruit garden with the system organic ( $H' = 4.68$ ) is higher than on conventional land ( $H' = 4.64$ ) and the category of species diversity is moderate and community stability is moderate.

Keywords: Arthropods, Organic and Conventional System

### Introduction

Bojonegoro is one of the cities in East Java which has quite a lot of tourism potential. Bojonegoro can attract tourists from natural tourism and historical tourism. In addition, Bojonegoro also has an agricultural-based tourism object, namely star fruit plantation. In an effort to increase the existing tourism potential, the Bojonegoro Regency government has made the starfruit plantation a Belimbing Agro tourism destination. Agro-tourism has large and sweet star fruit. This is what makes star fruit one of the mainstay products and an icon of Bojonegoro Regency [1].

According to information through interviews with farmers, starfruit gardens are still classified as using conventional farming systems, namely the use of pesticides and synthetic fertilizers in order to increase the amount of starfruit garden production. This agricultural system is carried out without any restrictions, so that it can cause soil damage. In addition, there are differences in the production of star fruit in each garden. The continuous use of inorganic fertilizers has a negative effect on the soil, such as a decrease in the content of organic matter and the activity of soil microorganisms, the soil becomes solid and environmental pollution occurs. This means that the result of excessive fertilizer

application in addition to reducing fertilizer efficiency, can have a negative impact on the environment. The negative impact of using excessive and unbalanced fertilizers can cause an imbalance of nutrients in the soil, damage to soil structure, decrease the diversity and population of soil biota and environmental pollution [2].

The continuous use of inorganic fertilizers has a negative effect on the soil, such as a decrease in the content of organic matter and the activity of soil microorganisms, the soil becomes solid and environmental pollution occurs. This means that the result of excessive fertilizer application in addition to reducing fertilizer efficiency, can have a negative impact on the environment. The negative impact of using excessive and unbalanced fertilizers can cause an imbalance of nutrients in the soil, damage to soil structure, decrease the diversity and population of soil biota and environmental pollution. Therefore it is necessary to analyze the negative effects of conventional farming systems on soil arthropod communities in the landscape and landuse of starfruit garden [2].

Data which includes aspects of soil nutrient content, abiotic factors, biotic factors and social aspects of farmers obtained from researchers can be used as reports and information data regarding the impact of the use of conventional agricultural systems on the Arthropod Community in the Garden of Carambola (*Averrhoacarambola* L.) Ngringinrejo Village Bojonegoro.

## RESEARCH METHODS

### Sampling Methods

This research was conducted at Ngringinrejo village Bojonegoro. This research was conducted from June 2018 to April 2019. Sampling was conducted at five stations (Fig. 1), the location of sampling in the conventional farming system of Starfruit (*Averrhoacarambola* L.) based on the difference between Landscape and Landuse: 1.SWH

:(The northern part is bordered by rice fields), II JLN: (East side by road), III PMK: (Southern part is bordered by settlement), IV SNG: (West side is bordered by river), V (BSO): The location for sampling as a control is the Starfruit Farm (*Averrhoacarambola* L.) with an organic system (without processing).



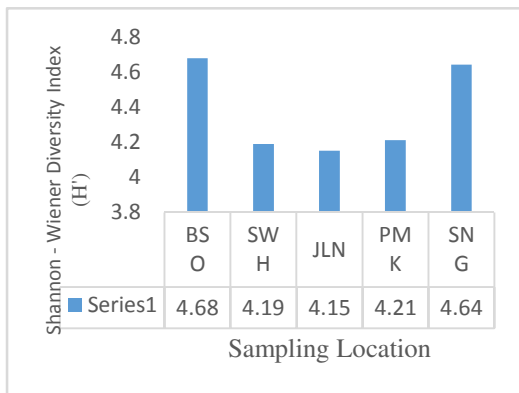
**Figure 1.** Four Sampling Location in Starfruit (*Averrhoacarambola* L.) Ngringinrejo Village Bojonegoro, Indonesia

The method applied is *selected sampling* which is based on the diversity and community structure of arthropods and variations in the types of borders in the surrounding area. The sample was taken using *Pitfall Trap* method. Sampling was given a break of 3 days with each location installed 10 pitfall traps with a depth of 10 cm and a distance between 10m pitfall traps. The *Pitfall Trap* was 7 cm diameter glass jar filled with 50ml of 70% alcohol (functioning as a preservative arthropod). At each location there are 10 *Pitfall Trap* performed. *Pitfall Trap* for 24 hours. Observation and identification of soil arthropods were done based morphological characteristics [3].

Data Analyze identification arthropods data was analyzed by Ms. Excel 2013 to found its taxa richness. Arthropods data was analyzed for abundance, frequency, relative abundance, relative frequency, Important Value Index (IVI) and Shanon – Wiener Diversity Index ( $H'$ ) which is also analyzed using Ms. Excel 2013. PAST Program was used for analyzing its regression, cluster, and biplot.

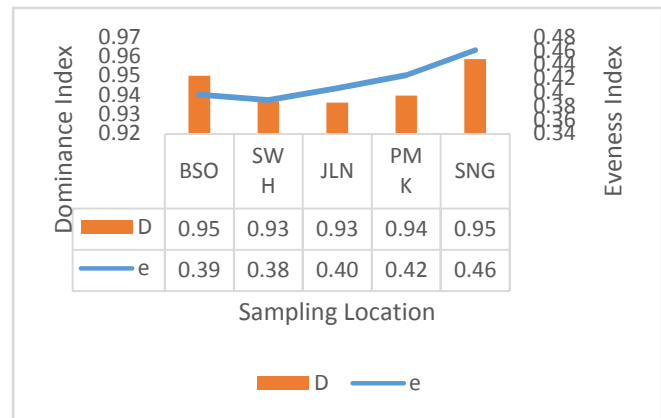
## RESULT AND DISCUSSION

The results showed a positive relationship Shannon - Wiener Diversity Index and between Dominance Index and Evenness Index (Fig.1 and Fig 2). Based on the analysis of the diversity index ( $H'$ ), dominance index (D) and evenness (E), information can be obtained that the results of the calculation of the diversity index of soil arthropods show that the diversity of star fruit gardens with a system without tillage (organic) higher than conventional land ( $H'=4.64$ ).



**Figure 1.** Shannon - Wiener Diversity Index of each species that found in in Starfruit (*Averrhoacarambola* L.) Ngringinrejo Village Bojonegoro

Likewise, the dominance and evenness index values of each location do not dominate, meaning that each location of the distribution of soil arthropods between families is evenly distributed, this is supported by a statement by Trewavas (2007), namely the addition of organic matter in the form of compost / manure to the organic farming system. , can improve soil physical, chemical and biological properties [4]. The high carbon and nitrogen content of organic matter is a source of energy for soil microorganisms. Land rich in organic matter is very supportive of the growth and development of various types of soil microorganisms and arthropods.



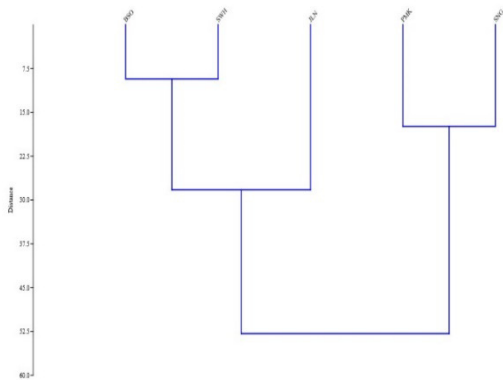
**Figure 2.** Correlation graph between Dominance Index and Evenness Index of each species that found in Starfruit (*Averrhoacarambola* L.) Ngringinrejo Village Bojonegoro

This can be seen from the abundance and diversity of soil arthropods which are quite high on tillage or organic. In ecosystems that have a high abundance and diversity of organisms, there are complex interactions in terms of food webs that can support ecosystem stability (Price, 1997) [5]. This is also consistent with what has been stated by Odum (1971), that in stable ecosystems, there are generally complex organisms with high diversity [6]. According to (Ponce et al, 2011) showing that organic systems contribute to diversity which can minimize the negative effects of agricultural intensification, as well as to improve the quality of arthropod habitat[7].

The Importance Value Index (IVI) is used to analyze the dominance (control) of a species in a particular community and can also be about the role of an individual type in the ecosystem. Based on the data from the Pitfalltrap method, it shows that the dominant family is the Formicidae family, meaning that the Formicidae family arthropods have a role in agricultural land.

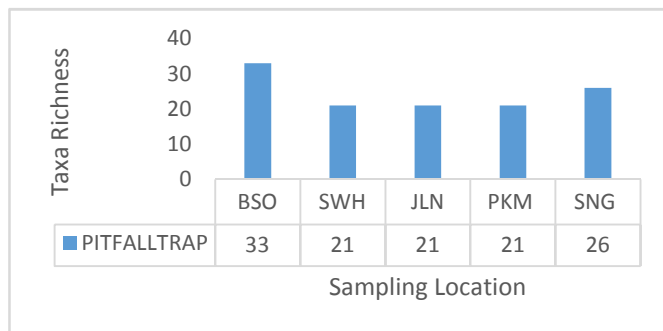
The location of tourist area is dominated by *Formicidae*. This is indicated by the high value of the Importance Value Index (IVI) in the tourist area (Fig.3). The high abundance of the family Formicidae is due to the fact that it is one of the most common and widespread groups. This is indicated by several research results from Patang (2011)

[8].andKartikasari, et al., (2015) which found the Formicidae family in large numbers [9].



**Figure 3.** Importance Value Index (IVI) of each species that found in in Starfruit (*Averrhoacarambola L.*) Ngringinrejo Village Bojonegoro. (S) indicate secondary data.

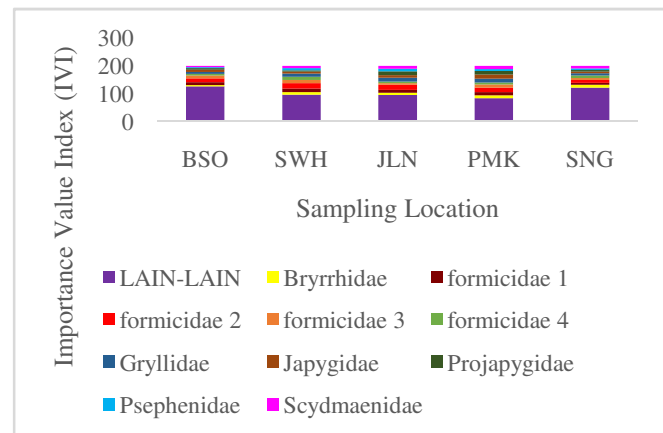
The results showed a Taxa Richness use pitfalltrap method. The location of the Starfruit Farm (*Averrhoacarambola L.*) with the system without tillage (organic) has a wealth index with a value of 33 families while at the location of the Starfruit Farm (*Averrhoacarambola L.*) with a conventional agricultural system bordering rice fields, roads, settlements and rivers have wealth index values in sequence, among others: 21; 21; 21 and 26 families.



**Figure 4.** Taxa Richness of each species that found in in Starfruit (*Averrhoacarambola L.*) Ngringinrejo Village Bojonegoro

Cluster and biplot analysis are used to classify locations based on the factors affecting the location. The result of cluster analysis with distance 50% similarity level shows three different location groups.

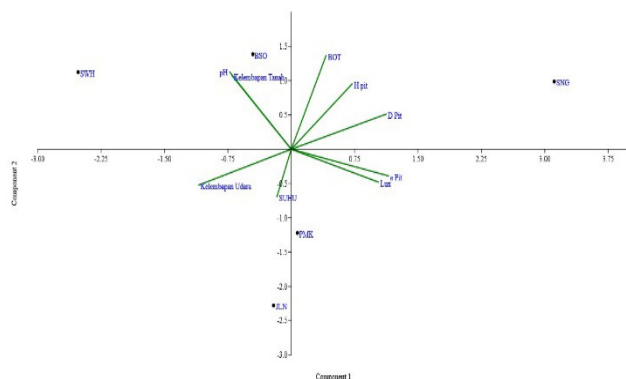
These groups are BSO and SWH, JLN, and PKM and SNG areas groups (fig.5)



**Figure 5.** Cluster analysis of each location in Starfruit (*Averrhoacarambola L.*) Ngringinrejo Village Bojonegoro

Each location is characterized by a few specific things. This is demonstrated by biplot analysis (fig.6). explained that abiotic and biotic factors work together to form a balanced ecosystem. Abiotic factors of soil moisture, soil pH, soil temperature, light intensity and BOT of Soil Organic Matter (BOT) support the survival of soil arthropods. The location of the Starfruit Farm (*Averrhoacarambola L.*) with the agricultural system without tillage (organic) has an average value of abiotic factors, namely Soil Organic Matter (BOT), as well as other indices including: Diversity index ( $H'$ ), evenness index ( $E'$ ), The dominance index ( $D$ ) tends to be high in Pithfalltrap method, while in the location of the Starfruit Plantation (*Averrhoacarambola L.*) which uses a conventional agricultural system bordering rice fields, it can be seen from the abiotic factors of soil pH, soil moisture and humidity has a high average value compared to other locations. The relative importance of the factors affecting soil arthropod diversity and abundance in the agroecosystem is the influence of abiotic, biotic and their interaction variables. One is that it varies according to climate, soil type and agricultural practices. The influence of meteorological variables can also affect, namely, rainfall and air temperature, soil moisture and soil temperature, besides the chemical and physical characteristics of the soil have been identified as

important drivers in the distribution and abundance of soil arthropods (Ghiglieno, 2020) [10]



**Figure 6.** Biplot analysis for each location in Starfruit (*Averrhoacarambola L.*) Ngringinrejo Village Bojonegoro

## CONCLUSION

This research concludes that all from Shannon - Wiener Diversity Index, Dominance Index and Evenness Index, Taxa Richness, Cluster Biplot and Biplot analysis is BSO location of higher than any other location. There is a dominance of Formicidae in five location Starfruit (*Averrhoacarambola L.*) Ngringinrejo Village Bojonegoro. There was a positive relationship between Shannon - Wiener Diversity Index, Dominance Index and Evenness Index, Taxa Richness, Cluster Biplot and Biplot analysis. The category of species diversity is moderate and community stability is moderate.

## ACKNOWLEDGEMENT

This research is supported by Ecology and Animal Diversity Laboratory of Brawijaya University, Provide information to government and related parties about the potential of soil arthropods as an easy and inexpensive means of monitoring environmental quality and scientific treasures, especially regarding

the diversity of soil arthropods in starfruit (*Averrhoacarambola L.*) Ngringinrejo Village, Bojonegoro Village. Authors would like to thank all of the author's friends, Mr. Purnomo in assisting the author identification arthropod in Laboratory and Prof. Amin SetyoLeksono, S.Si, M.Si, Ph.D and Zulfaidah Penata Gama, S.Si, M.Si, Ph.D., who has guided and supported this research until completion.

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