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THE EFFECT OF TRAP CROP MARIGOLD TREATMENT ON SOIL ARTHROPOD POPULATION DYNAMICS IN CHILI CULTIVATION

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ABSTRACT

This study aims to: (1) find out the soil arthropod family found in red chili (*Capsicum annum* L.) cultivation with trap crop treatment of marigold plants (*Tagetes erecta* L.). (2) to determine the effect of trap crop treatment of marigold plants (*Tagetes erecta* L.) on red chili (*Capsicum annum* L.) cultivation on soil arthropod population dynamics. Data collection was carried out using the pitfall trap method. The population in this study is all soil arthropods found in red chili plantation areas, then the sample from this study is soil arthropods that are trapped in the pitfall trap. This research took place during August 2021-December 2021 with 5 data collections. The data taken included climatic and edapic data on each observation as well as all types of soil arthropods on red chili plantations. The data obtained were analyzed using descriptive analysis which included the diversity index, equality index, and dominance index. The results of the study showed that 17 families of soil arthropods were obtained. The population dynamics of soil arthropods in red chili cultivation have changed over time by showing ups and downs in yields. Habitat modification with trap crop of marigold plants as a treatment did not have a significant effect on the population dynamics of soil arthropods in chili cultivation

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1. INTRODUCTION

Red chili pepper (*Capsicum annum* L.) is included in the agricultural crop that is strategic to cultivate because of the huge demand for chili peppers. Chili plants have a high tolerance to environmental changes, therefore chili plants can be planted in lowlands to highlands, in rice fields and moorlands, and can grow and produce in rainy and dry seasons (Sumarni & Muharam, 2005). Soil organisms that are often found in soil organisms are one of them in soil arthropods. Arthropods are a group of animals that can be found in almost all habitats, such as in water, in the soil, soil surface, air, trees, litter, under rocks, on weathered wood, on plants as pests and even on animals and humans. Arthropods include insects that are part of biodiversity. Arthropods are the most dominant animal species among other animal species. Factors that support abundance in arthropods are optimal temperature, food availability, and the presence or absence of natural enemies (Syaufina et al, 2007). Over time, the number of soil arthropods in a habitat will undergo a change. There are several factors that affect population dynamics, namely fertility, temperature, humidity, light intensity, wind speed, and so on. In addition, abundant environmental resources are also one of the influences in determining population dynamics (Nurdin, 2012). Arthropods have good benefits for the soil, one of which is that it can increase soil fertility. One way to modify habitat is by using trap crop plants.

Trap crop crops are usually planted around the main crop farmland. One of the reasons for planting trap crop plants is as a form of effort to prevent the spread, migration and limit the mobility of pests to plants. This activity has been proven to overcome problems in pests and increase agricultural productivity (Septariani et al, 2019). One of the plants that can be used as a trap crop plant is the marigold plant (*Tagetes erecta* L.). The selection of the marigold plant as a trap crop is because the marigold plant has flowers with striking colors so that it can attract the attention of soil arthropods and the marigold plant is also useful in expelling pests on the land. There is habitat modification because trap crop plants can provide a shadier atmosphere to the soil, so that it can increase soil moisture. In addition, the use of trap crop plants will also increase the availability of litter in the soil. The availability of litter in the soil is one of the supporting factors for the abundance of soil arthropod life, so the application of trap crop plants is likely to affect the existence of soil arthropods (Suhardjono, 2005). The purpose of this study is to find out the family of soil arthropods found in red chili (*Capsicum annum* L.) cultivation with trap crop treatment of marigold plants (*Tagetes erecta* L.) and to find out the effect of trap crop treatment of marigold plants (*Tagetes erecta* L.) on red chili (*Capsicum annum* L.) on the population dynamics of soil arthropods.

Based on the literature above, the application of marigold (*Tagetes erecta* L.) as a trap crop in red chili (*Capsicum annuum* L.) cultivation is expected to influence the diversity and population dynamics of soil arthropods. Habitat modification created by marigold plants, including increased shade, higher soil moisture, and greater litter availability, is anticipated to enhance the abundance and family richness of soil arthropods compared to chili cultivation without trap crop application.

1. RESEARCH METHOD (11 Pt)

2.1. Types of Research

This study was conducted as an experimental research using a Completely Randomized Design (CRD). The experiment consisted of three treatments: P0 (control treatment, chili plants without trap crops), TC (chili plants with trap crop treatment), and TC–Marigold (chili plants with Tagetes erecta L. as the trap crop). Each treatment was replicated five times to observe and compare the types and abundance of soil arthropods present under each treatment condition.

2.2. Research Time and Place

The research was carried out at the Tridharma Banguntapan Plantation, Faculty of Agriculture UGM in August-December 2021.

2.3. Tools and Materials

The tools used in this study were tripods, mobile phones, cameras, stationery, hygrometer, anemometer, lux meter, thermometer, plot board, brush, *styrofoam*, skewers, shrapnel, plastic bottles, 1 kg plastic. The materials used are chili plant seedlings (*Capsicum annum* L.), marigold plant seedlings (*Tagetes erecta* L.), manure, urea fertilizer, water, detergent.

2.4. Implementation Procedure

Preparation

Planting and growing chili seeds in a greenhouse, to keep disturbances from the outside before planting in the field. Making plot boards with code P0 for control plant treatment, PK for marigold plant treatment according to treatment and preparation of soil cultivation.

Lay Out Arrangement

A plot of 2x2 m^2 with a distance between the plots of 2 m, because each treatment consists of 5 repeats, there are a total of 10 experimental plots. Chili plants are planted at a distance of approximately 30x30 cm on each plot. Trap crop plants of marigold flowers (*Tagetes erecta* L.) are planted around the chili plant plot, with a distance between the plants of 30 cm and the distance from the chili plant plot is 50 cm. The arrangement of treatment plots was carried out randomly. The installation of a well trap or pit fall trap to take soil arthropod samples in the control treatment was as many as 4 pieces and placed in each corner of the planting plot, while in the trap treatment of the pineapple crop there were 8 pieces (4 pieces in the corners of the chili plant plot and 4 pieces in the corners of the trap crop crop of the pineapple flower (*Tagetes erecta* L.). The arrangement of treatment plots was carried out randomly. The researcher only collected data on the control plot and treatment of trap crop with marigold flower plants.

The number of pitfall traps differed between the control (P0) and trap crop (TC) treatments due to differences in plot structure and habitat complexity. In the control treatment (P0), which consisted solely of chili plants without surrounding trap crops, four pitfall traps were sufficient and were placed at each corner of the 2 × 2 m plot to represent soil arthropod activity within the chili cultivation area. In contrast, the trap crop treatment included an additional habitat zone created by marigold *(Tagetes erecta* L.) plants planted around the chili plot. Therefore, eight pitfall traps were installed in this treatment: four at the corners of the chili plot and four at the corners of the marigold trap crop area. This arrangement was designed to adequately capture soil arthropod populations associated with both the main crop and the trap crop habitats, ensuring representative and comparable sampling across treatments.

Maintaining the plant (fertilization, watering, and weeding)

Provide basic fertilizer in the form of manure 7 days before planting the seedlings given to each plot. Follow-up fertilization is carried out 1 and 2 months after the application of the first fertilizer or basic fertilizer. Watering is done daily to maintain moisture and aeration, while weeding is done every 2 weeks. Pest control is carried out mechanically (picking by hand) and letting the mechanism work naturally.

2.5. Data Collection Techniques

Field data collection is carried out every 3 weeks and starts at 3 weeks after planting. Data collection was carried out on all plots of red chili (*Capsicum annum* L.) and *trap crop* plants of marigold flowers (*Tagetes erecta* L.). *Pitfall traps* are carried out for 24 hours. Data collection was carried out on all plant plots with a time range of 11.00 – 13.00 WIB. Installation of *4 pit fall traps* each on the plot of red chili plants and marigold plants to take soil arthropod samples. The installation of this trap is carried out for 1 day and 1 night. Soil arthropods obtained in *pit fall traps* are then taken and observed directly. The soil arthropods that have been obtained are then identified to the family level and the number of individuals who come is counted. The identified arthropod data is then entered into a table and processed using *Microsoft Excel* software. The data from the identification results were calculated using the Shannon-Wienner diversity index and the population dynamics index. The identification data were analyzed using SPSS to determine the influence of *trap crop* plants on soil arthropod population dynamics. Data collection ended at the age of red chili plants when they were 15 MST (Sunday After Planting).

Measurement of edapic and climatic factors was carried out on each plot before the installation of *the pit fall trap*. Soil edapic factors include the measurement of soil temperature, soil moisture, and soil pH. Soil sampling on each plot to test the content of KTK, P, K, N, PH and BO. Soil content testing was carried out at the laboratories of LPPT UGM, Lapitaya, and PT Riset Perkebunan Nusantara.

2.6. Data Analysis Techniques

The diversity of soil arthropods was calculated using the Shannon–Wiener diversity index (H′), while the Evenness Index (E) and the Dominance Index were also determined. Data analysis was conducted using One Way ANOVA with the SPSS program to evaluate the effect of trap crop treatment on soil arthropod population dynamics in chili plants and trap crops. One Way ANOVA was selected because the study involved comparing the mean values of diversity and population parameters among different treatment groups under a single experimental factor, namely the presence or absence of marigold trap crops.

2. RESULTS AND ANALYSIS

3.1. Result

The result of this research about soil arthropod diversity in red chili pepper (*Capsicum annum* L.) and Trap Crop (*Tagetes erecta* L.) presented in detail at Table 1, composition of obtained soil arthropods and their role in the ecosystem presented at Table 2, and average environmental factor measurement results at Table 3.

Table 1. Soil Arthropod Diversity in Red Chili Pepper (*Capsicum annum L.)* and Trap Crop (*Tagetes erecta L.)*

Family	Types of soil arthropods found in observations																	
	P0 Treatment (Control)					∑	TC (Chili) Treatment					∑	TC Treatment (Marigold)					∑
	I	II	III	IV	V		I	II	III	IV	V		I	II	III	IV	V	
Formicidae	432	453	125	231	60	1301	104	109	54	84	56	407	88	238	96	120	58	600
Agelenidae	7	24	7	5	0	43	22	14	8	3	1	48	7	10	3	6	5	31
Lycosidae	1	2	1	0	0	4	1	9	2	0	0	12	1	4	2	0	0	7
Acrididae	3	0	0	0	0	3	1	0	0	0	0	1	3	0	2	0	0	5
Tenebrionidae	4	1	0	46	0	51	2	0	0	22	0	24	4	0	9	10	3	26
Scarabaeidae	0	1	7	0	15	23	0	2	8	0	6	16	0	3	0	0	1	4
6Gryllidae	0	1	4	1	0	6	0	1	2	2	2	7	1	1	3	1	1	7
Mantidae	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Muscidae	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Pamphagidae	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Carabidae	0	0	0	0	3	3	0	1	0	0	0	1	0	0	0	1	0	1
Anthribidae	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Pentatomidae	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Pyrgomorphidae	0	0	0	0	0	0	1	0	0	0	1	2	0	0	0	0	0	0
Scolopendridae	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
Oxyopidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Alydidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Number of Arthropods	448	484	144	285	80	1440	131	136	75	111	66	519	104	256	117	138	69	684
Number of Families	6	8	5	5	5		6	6	6	4	5		6	5	7	5	6	

Table 2. Composition of Obtained Soil Arthropods and Their Role in the Ecosystem

No.	Family	Role in the ecosystem	Sum	∑ (Total amount)
1	Formicidae	Predator	2308	2557
2	Agelenidae		122	
3	Lycosidae		23	
4	Tenebrionidae		101	
5	Mantidae		1	
6	Oxyopidae		2	
7	Acrididae	Herbivore	9	35
8	Gryllidae		21	
9	Anthribidae		1	
10	Pentatomidae		1	
11	Pyrgomorphidae		2	
12	Alydidae		1	
13	Muscidae	Parasitoid	1	3
14	Pamphagidae		2	
15	Carabidae	Detritivor	5	49
16	Scolopendridae		1	
17	Scarabaeidae		43	

Table 3. Average Environmental Factor Measurement Results

Environmental factors	Plot of treatment	
	Control	Squirt
Climatic factor		
Light Intensity (Lux)	4123	5053
Air Temperature (°C)	31	33
Air Humidity (%)	69	62
Wind Speed (m/s)	0.3	0.4
Factor edafik		
Soil pH	5.7	5.6
Soil Moisture (%)	36	35

Table 4. Results of Analysis of Fisk and Chemical Properties from Soil Samples in Chili Cultivation

No.	Parameter		Treatment	
			Control (P0)	Marigold (PK)
Soil sample test results at the beginning of the study				
1	Tekstur	Pasir (%)	70,88	74,22
2		Debu (%)	20,04	16,23
3		Lempung (%)	9,08	9,55
4	Texture Class		Clayy sand	Clayy sand
5	Organic matter (%)		2,27	2,28
6	Soil pH		7,28	6,68
7	CCP (cmol (+)/kg)		32,42	33,21
8	Structure		Granular	Granular
9	Phosphorus (mg/kg)		317,50	268,69
10	Potassium (mg/kg)		684,23	671,52
Soil sample test results at the end of the study				
11	Tekstur	Pasir (%)	84,49	86,40
12		Debu (%)	12,82	10,77
13		Lempung (%)	2,69	2,83
14	Texture Class		Clayy sand	Clayy sand
15	Organic matter (%)		1,34	1,34
16	Soil pH		7,48	7,47
17	CCP (cmol (+)/kg)		4	4,87
18	Structure		Granular	Granular
19	Phosphorus (mg/kg)		166,15	164,09
20	Potassium (mg/kg)		0,77	0,78
21	Nitrogen (%)		0,07	0,07

Table 5. Equality Index and Dominance Index Data

Types of Treatment	**Equality Index**	**Dominance Index**
Control Chili	0.187	0.818
***Trap crop* cabai**	0.375	0.627
***Trap crop* marigold**	0.250	0.773

Table 6. Anova's One Way Test Results from the Effect of Plant Feeding *Trap Crop* on Soil Arthropod Population Dynamics.

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	28438.392	2	14219.196	.331	.720
Within Groups	2062926.353	48	42977.632		
Total	2091364.745	50			

3.2. Analysis

Diversity of Soil Arthropod Types in Red Chili Cultivation with *Marigold* Crop Trap Treatment

Arthropods are one of the biotic components that have an important role in soil ecosystems. Arthropods can be found in a variety of places including on the surface or in the ground. The diversity of ground-surface arthropods in each place varies. According to Resosoedarmo et al. (1984), low diversity is found in communities with extreme environments, such as dry areas, poor soils, and high mountains, while high diversity is found in areas with optimal environmental communities, for example in fertile areas, rich soils, and mountainous areas. Soil surface arthropods as a biotic component of soil ecosystems are highly dependent on environmental factors. Environmental changes will affect the presence and density of arthropod populations. One of the habitat modifications is by using *trap crop plants*. *Trap crop* is a technique used to attract insects with potential pests so that they do not attack the main crop. The use of *trap crop* plants not only serves as a pest barrier, but *trap crop* plants can be a habitat modification in order to increase soil arthropods. This is because modifying the habitat of *trap crop* plants can provide shaded conditions to the soil, so that it can increase soil moisture.

In Table 1, arthropods were obtained as many as 1440 individuals with a total of 13 families, namely Formicidae, Agelenidae, Lycosidae, Acrididae, Tenebrionidae, Scarabaeidae, Gryllidae, Mantidae, Muscidae, Pamphagidae, Carabidae, Anthribidae, Pentatomidae. In the chili *crop trap* treatment, 519 individuals were obtained with a total of 10 families, namely Formicidae, Agelenidae, Lycosidae, Acrididae, Tenebrionidae, Scarabaeidae, Gryllidae, Carabidae, Pyrgomorphidae, Scolopendridae. In the treatment in *trap crop*, 684 individuals were obtained with a total of 10 families, namely Formicidae, Agelenidae, Lycosidae, Acrididae, Tenebrionidae, Scarabaeidae, Gryllidae, Carabidae, Oxyopidae, Alydidae. The family that is most found in each treatment is the formicidae and has the most number. In the control treatment the family Formicidae has the most number found compared to other families. There are differences in environmental conditions and treatment in each plot that can cause and affect the high and low population of soil arthropods.

One of the biotic components that plays an important role in soil ecosystems is arthropods. Arthropods are the largest phylum in the animal world including insects, spiders, fleas, centipedes which have an important role in food webs, especially on the ground and as decomposers, predators, and bioindicators for an ecosystem (Rahmat, 2013). The role of insects is very diverse, including as plant eaters, natural enemies, carrion eaters, pollinators, ectoparasites and disease vectors (Borror et al., 1992).

In Table 2, the most abundant soil arthropods are groups that act as predators. Predators are organisms that eat other organisms (prey) that are weaker and have a larger body size than their prey (Sembel, 2011). Predatory arthropods are often found in the form of insects, mites, and spiders (Purnomo, 2009). Then the second soil arthropod that was found was a detritivore. Detritivores are organisms that obtain energy by eating the remains of living things. With the presence of detritivores, decomposers can contribute to the nutrient cycle. The third most abundant soil arthropods are herbivores. Herbivores themselves are a group that eats plants and the existence of their population causes damage to plants, referred to as pests. Herbivorous arthropods include predators, parasitoids and act as natural enemies of herbivorous arthropods. Parasitoids are the four most common ground arthropods. Parasitoids are insects whose premature stadia parasitize on or in the bodies of other insects, while the imago lives freely looking for nectar or honeydew as food (Purnomo, 2009). In general, according to Sembel (2011), there are 4 natural enemies, namely: pathogens, parasites, parasitoids and predators. Meanwhile, according to Jumar (2000), natural enemies are generally parasitoids or predators.

Figure 1. Family Formicidae (Personal Documentation)

In the observations made by the soil arthropods that are widely found come from the Formicidae family which always dominates the number of results from the first observation to the fifth observation. The Formicidae family is the most common family. Ants are the most dominant group of insects in terrestrial areas related to diverse eating habits (Setiani et al., 2010). Ants are insects with high diversity. The diversity that ants have includes the diversity of species and the diversity of ecological roles. The important role of the existence of ants is in the ecosystem, including as *an ecosystem engineer* or *soil engineer* during the process of making nests. This helps to increase soil fertility.

Soil arthropods in the family Agelenidae are also found in the first to fifth observations in each treatment, but not as much in the family Formicidae. According to Platnick (2003), it is mentioned that the cobwebs of the family Agelenidae are built on low vegetation and shrubs, however some species can be found in tree branching holes and rocky caves. Spiders from the agelenidae family are web-making spiders that generally have the characteristic of a long spineret so that they can be seen if this spider is observed from the dorsal.

The order Coleoptera is an order of the family tenebrionidae and scarabaeidae with the role of predators and detritivores. The two families were found to be suspected because the activities of the family were mostly carried out in or above the surface of the land related to their roles. Shahabuddin et al. (2005) stated that the order Coleoptera mostly acts as detritivores, one of which is the Scarabeidae family known as fecal beetles. Referring to Kevan (1955), the order Coleoptera found belongs to the transient group, namely insects whose entire life cycle takes place on the ground.

In the first and second observations, there was a high number of soil arthropods because at that time the environmental conditions were favorable for arthropod life because they received watering and fertilization treatments carried out during land preparation using fertilizers. The addition of biomass to agricultural land is one way of efforts to modify habitat, to improve the performance of soil arthropods as part of the pest management system, including by providing suitable habitats for their development (Mudjiono, 1993; Nurindah, 2013).

The results of the data measurement in Table 3 have an average climatic factor of light intensity with the control treatment obtained data of 4123 Lux and the treatment of the marigold plant of 5053 lux. The intensity of light has a huge influence on animal life. Light affects insect activity (diurnal, nocturnal, crepuscular) and insect behavior (attracted to light waves, dodging light waves) (Alim, E. S. & H. Ramza. 2010). Light intensity is an environmental factor that can affect the increase in air temperature and is used as a marker for certain activities such as in foraging, molting, or reproduction, flight activities, affecting insect metabolism, in addition to that it can affect the local distribution of arthropods so that the animal can act according to the response of signals coming from sunlight.

The air temperature obtained from the measurement results was obtained on average 31-33°C. The temperature difference in each treatment plot that is not too far away will still affect the abundance and presence of soil arthropods because each type of arthropod has a tolerance to different temperature changes. According to Jumar (2000:92), the effective temperature range for soil insects is a minimum temperature of 15ºC, an optimum temperature of 25ºC and a maximum temperature of 45ºC. According to Rizali (2002:41), temperature is one of the factors that directly affects the foraging activities of arthropods on the ground surface.

In the measurement of air humidity, the control treatment obtained a result of 69%, while in the treatment of the trap crop marigold plant*,* a result of 62% was obtained. From the results of these measurements, it can be seen that the air humidity obtained is less than optimal, which is in accordance with the opinion of Riostone (2010) that the air humidity is good in the range of 85-95%, thus supporting insects in their survival. Purwanti (2003) stated that the increase in air humidity greatly interferes with the process of oxygen uptake (respiration) of soil arthropods.

In the results of the measurement of wind speed data carried out with control treatment, it was obtained as 0.3 m/s while the treatment of trap *crop* plants was 0.4 m/s. Wind speed affects the metabolism of insects, then small insects their mobility is affected by the wind, such insects can be carried as far as possible by wind movements. The wind speed on the observation is very low.

In the measurement of edapic factors, it consists of soil pH and soil moisture. Soil pH was obtained from the control treatment of 5.7 and the *treatment of trap crop* of 5.6. According to Fitrianti (2015:5) soil pH is very important in terrestrial ecology because the life of soil organisms is highly determined by soil pH. The height and low of a species are not only influenced by food factors, but also environmental factors that support survival.

The soil moisture in the observations obtained data of 36% in the control treatment, while in the treatment of *trap crop* crops it was around 35%. Humidity exerts an influence that can reduce soil arthropod species. If soil moisture conditions are very high, then soil arthropods will die or migrate elsewhere, with a decrease in soil arthropod species resulting in a dominant species.

Soil arthropods will abound in habitats that are able to provide factors that can support the life of soil arthropods such as food availability, optimal temperature, and the presence or absence of natural enemies (Syaufina et al., 2007). The type of habitat affects the condition of the floor (thick, damp) and the diversity of litter, which can directly affect the diversity of the arthropods that inhabit it. Striking environmental changes have led to population shrinkage and arthropod diversity (Suhardjono, 2005). Soil arthropods are highly dependent on the availability of organic matter in the form of litter or others found on the surface of the soil (Ruslan 2009).

Based on Table 4, the results of the analysis of soil chemical content of organic matter (BO), the results of soil tests at the beginning and end show the same data in the control treatment and the arthropods, but in the control treatment plot there is a greater number of soil arthropods than the arthropods, which is possible that the research land has several debris from foliage that is rather difficult to decompose by soil arthropods so that many soil arthropods in particular which acts as a detritivore is present in the plot of control treatment to eat the remains of leaf litter.

The value of the land KTK is very diverse and depends on the nature and characteristics of the land itself. According to Hakim et al. (1986), the size of the soil KTK is influenced by pH, texture, type of clay minerals, organic matter, and fertilization. At the beginning of the study, KTK obtained high results, while at the end of the study, the content of KTK was very low. The highest KTK score obtained was in the treatment of the final research. The higher the KTK value, the faster the rate of nutrient transfer (Kemas, 2005:142).

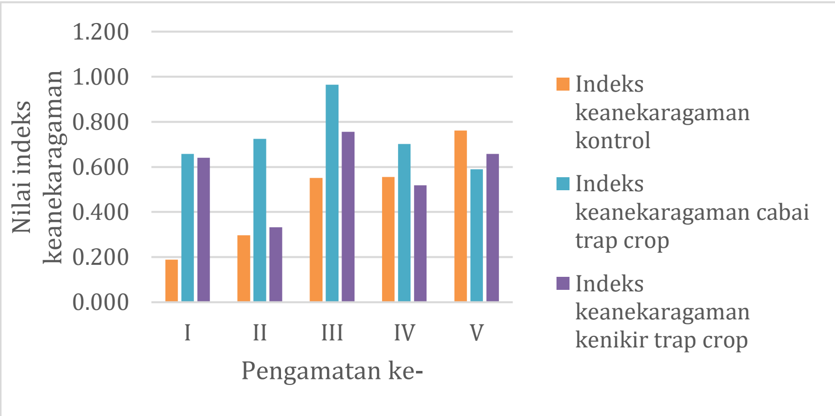

Figure 2. Soil Shannon-Wiener Arthropoda Diversity Index Chart

The soil arthropod diversity index (H') graph shows that from observation I to V there has been fluctuations. In the first to fifth observations with control treatment, it is known that the soil arthropod diversity index value is less than 1 which means it has a low diversity index. In this study, the species that dominate is from the family formicidae. Species that dominate in a study can affect the value of diversity so that the value of diversity becomes lower. The number of families and population can affect the value of H'. The value of diversity becomes lower when there are more species in a family while other species have fewer numbers.

To find out population dynamics in addition to using the diversity index, it can also be done by calculating the evenness index and the dominance index in the soil arthropods of each treatment. The following are the results after the calculation obtained as follows:

In Table 5, the results of the equality index with the three treatments show that the equality index in the study is relatively low. Low results are known with the number of individuals in each family being different and there is one family that dominates. According to Astriyani (2014), the value of this equality index ranges from 0-1. The smaller the value of the equality index, the smaller the uniformity of the population, meaning that the distribution of the number of individuals of each type is not the same and there is a tendency for one number of individuals to dominate, and vice versa, the greater the value of the equality index, then no type of individual dominates.

Based on Table 5, it can be seen that the research field has a different dominance index of the three treatments, including the presence of the formicidae family that dominates the research. This causes individuals in a community to have an uneven distribution. All three treatments in this study had a low dominance index. This is because the individuals in the field consist of several families so that in a community there is an even distribution of individuals and has a low dominance index. According to Odum (1993) said that the dominance index ranges from 0 to 1, the smaller the dominance index value, it shows that there is no dominant species, on the contrary, the greater the dominance, it indicates that there is a certain species. The diversity index is higher if the population of a species in a community is evenly distributed, on the other hand, the diversity index is categorized as low if there is one dominant individual.

Soil Arthropod Population Dynamics in Red Chili Cultivation

Observations of soil arthropod dynamics in data collection are carried out every three weeks using the pitfall trap method, then the number of trapped soil arthropods is calculated at each observation to determine the population dynamics.

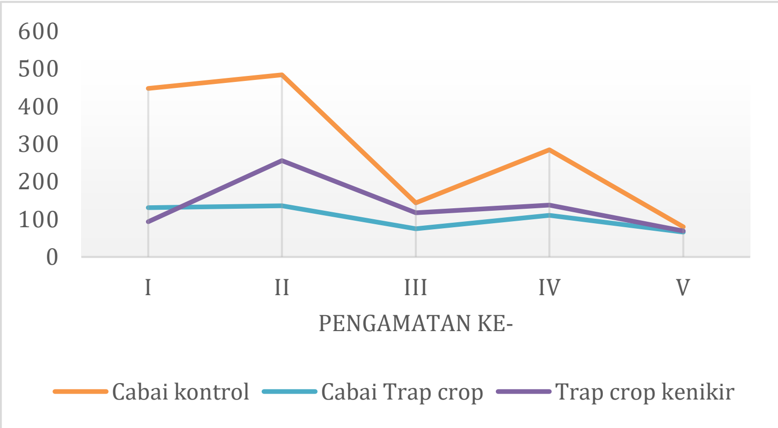

Figure 3. Graph of Soil Arthropod Population Dynamics in Red Chili Cultivation with *Trap Crop*

The number of arthropods obtained was the most in the control chili treatment. The least results were found in the trap treatment of chili crops. The formicidae family is a very common and widespread group in a variety of habitats. The graph above shows the curve that goes up and down from the first observation to the fifth. In the first and second observations with control treatment, the trap crop chili, and trap crop marigold increased. The third observation shows that the results have decreased, this is due to several things, namely the environment where the planting was done at that time was not in good condition because around the planting garden there were many grasses and wild plants that were the variables that disturbed this study, then the erratic weather and the cherry blossom plants that attracted the attention of the surrounding insects. In the fourth observation there was an increase and in the last observation there was a decrease again. The decrease in the number of soil arthropods is due to the fact that chili plants have entered the generative phase, which during this phase chili plants and trap crop plants have provided shade to the land and also provide a trail for soil arthropods so that the trap crop plants will attract the presence of soil arthropods to be around. The presence of arthropods in a place depends on both biotic and abiotic factors. The presence of soil arthropods in a habitat is greatly influenced by the condition of that habitat. Soil arthropods will abound in habitats that are able to provide factors that can support the life of soil arthropods such as food availability, optimal temperature, and the presence or absence of natural enemies (Syaufina et al., 2007).

To determine the dynamics of the soil arthropod population in red chili (*Capsicum annum* L.) cultivation, several data were taken from observation. The habitat modification used in this observation is with the marigold flower plant (*Tagetes erecta* L.) Those planted around the main plant are used to attract and provide a food source for natural enemy insects that also serve as soil arthropod microhabitats. Modification of the habitat of trap crop plants can provide a shadier atmosphere to the soil, so that it can increase soil moisture. The availability of litter in the soil with the use of trap crop will provide an increase. The availability of litter in the soil is one of the factors that support the abundant life of soil arthropods. From this statement, trap crop plants will affect the existence of soil arthropods (Suhardjono, 2005).

The marigold flower plant (*Tagetes erecta* L.) is an annual plant, it can grow in soil with a neutral pH in hot areas, enough sunlight, and good drainage. The dominant soil arthropod population from the beginning of planting to the end was on the control treatment plot compared to the other two treatments. These results are possible from environmental factors in the plots that are different from the facts in the field, so that they can affect the results obtained. In the treatment plot of trap crop chili and trap crop plants, many plants are damaged and wilted, this can be possible with the competition to get nutrients between trap crop plants and chili plants. Kurniawati Martono (2017) stated that one of the most rational strategies to optimize the function and role of natural enemies is environmental conservation in order to provide sufficient feed and a comfortable growth environment as well as development for natural enemy organisms.

Based on Table 6, the results of the one way anova test with the treatment of applying trap crop plants to red chili plants on soil arthropod population dynamics showed a Sig value of 0.720 greater than 0.05, so it can be interpreted that there is no significant difference in the application of trap crop plants on the population dynamics of soil arthropods in red chili cultivation, where in this statistical test H0 was accepted and H1 was rejected. Trap crop plants have a function that can be used as a microhabitat which is expected to be able to contribute to efforts to increase soil fertility by presenting many soil arthropods (Allifah et al., 2013).

3. CONCLUSION

Based on the results of this study, it can be concluded that red chili (Capsicum annuum L.) cultivation with marigold (Tagetes erecta L.) as a trap crop supported a diverse soil arthropod community comprising 17 families, with Formicidae consistently representing the most abundant family across all treatments. The application of marigold trap crops influenced the population dynamics of soil arthropods by modifying habitat conditions; however, statistical analysis indicated that there were no significant differences in soil arthropod populations among the control treatment, chili cultivation with trap crops, and the trap crop treatment.

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REFERENCES

Ade Rahmat. (2013). *Flora & arthropod inventory and monitoring training*. Bandung, Indonesia.

Alim, E. S., & Ramza, H. (2010). Designing insect trap devices (pests) with light intensity. Retrieved from http://lemlit.ac.id/files/serangga3.pdf

Allifah, A. F., et al. (2013). Refugia as a microhabitat to increase the role of natural enemies on agricultural land. In *Proceedings of FMIPA Universitas Pattimura 2013* (ISBN 978-602-97522-0-5).

Borror, D. J., Triplehorn, C. A., & Johnson, N. F. (1992). *An introduction to the study of insects* (6th ed.; S. Partosoedjono, Trans.). Yogyakarta, Indonesia: Gadjah Mada University Press.

Fitrianti, D. (2015). *Composition of soil surface insects in peanut cultivation areas in Kejorongan Langgam, Kenagarian Kinali, West Pasaman Regency* (Undergraduate thesis). STKIP PGRI West Sumatra, Indonesia.

Hakim, N., Nyakpa, M. Y., Lubis, A. M., Nugroho, S. G., Diha, M. A., Hong, G. B., & Bailey, H. H. (1986). *Fundamentals of soil science*. Bandar Lampung, Indonesia: University of Lampung.

Hanafiah, K. A. (2005). *Fundamentals of soil science*. Jakarta, Indonesia: RajaGrafindo Persada.
Jumar. (2000). *Agricultural entomology*. Jakarta, Indonesia: PT Rineka Cipta.
Kurniawati, N., & Martono, E. (2018). The role of flowering plants as a conservation media for natural enemy arthropods. *Journal of Plant Protection Indonesia*, 19(2), 53–59.
Nurdin, S. (2012). *Population dynamics*. Pekanbaru, Indonesia: University of Riau.
Nurindah, & Indrayani, I. G. A. A. (2013). *Natural enemies of cotton insect pests*. Malang, Indonesia: Indonesian Tobacco and Fiber Crops Research Institute.
Odum, E. P. (1993). *Fundamentals of ecology* (T. Samingan, Trans.). Yogyakarta, Indonesia: Gadjah Mada University Press.
Platnick, N. I. (2003). *The world spider catalog* (Version 4.3). New York, NY: American Museum of Natural History.
Purnomo, et al. (2009). *Biology*. Jakarta, Indonesia: Book Center, Ministry of National Education.
Purwanti. (2003). *Soil macrofauna diversity in various types and combinations of intercropping under sengon stands (Paraserianthes falcataria (L.) Nielsen) at RPH Jatirejo, Kediri, East Java*. Surakarta, Indonesia: Department of Biology, FMIPA Universitas Sebelas Maret.
Resosoedarmo, S., Kuswata, K., & Aprilani, S. (1984). *Introduction to ecology*. Bandung, Indonesia: CV Remadja Karya.
Riostone. (2010). *Insect ecology: An ecosystem approach*. New York, NY: Academic Press.
Rizali, A., et al. (2002). Insect diversity in forest-edge rice fields as indicators of environmental health. *Biological Journal*, 9(2).
Ruslan, H. (2009). Composition and diversity of soil surface insects in homogeneous and heterogeneous forest habitats at the Conservation Education Center (PPKA). *Vis Vitalis*, 2(1), 43–53.
Septariani, D. N., Herawati, A., & Mujiyo, M. (2019). Utilization of various refugia plants as natural pest control in chili plants (*Capsicum annuum* L.). *PRIMA: Journal of Community Empowering and Services*, 3(1).
Shahabuddin, Hidayat, P., Noerdjito, W. A., & Manuwoto, S. (2005). Research on insect biodiversity in Indonesia: Dung beetles (Coleoptera: Scarabaeidae) and their role in ecosystems. *Biodiversity Journal*, 6, 141–146.
Suhardjono, Y. (2005). *Colembola of mixed dipterocarp forest, Wanarise Samboja, East Kalimantan after three fires over 25 years*. Bogor, Indonesia: Research Center for Biology, Indonesian Institute of Sciences (LIPI).
Sumarni, N. (2005). *Red chili production technology*. Bandung, Indonesia: Balitsa.
Syaufina, L., Hendra, F. N., & Buliansih, A. (2007). Diversity of land arthropods in Gunung Walat Educational Forest. *Journal of Conservation Media*, 12(2), 57–66.