Diversity of arthropods on coffee arabica plantation sidegrafting robusta variety in South of Sulawesi

by Sulaeha Thamrin

Submission date: 30-Aug-2022 03:55PM (UTC+0700)
Submission ID: 1889317989
File name: Diversity_of_arthropods_on_coffee_arabica.pdf (1.31M)
Word count: 5151
Character count: 27246

Diversity of arthropods on coffee arabica plantation side-grafting robusta variety in South of Sulawesi

To cite this article: S Sulaeha *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **807** 022098

Diversity of arthropods on coffee arabica plantation side-grafting robusta variety in South of Sulawesi

S Sulaeha[1*], N Agus[1], S Fatima[1], Reta[2], S. Sjam[1] and M Melina[1]

[1]Pest and Plant Diseases, Faculty of Agriculture, Hasanuddin University, Makassar 90245, South Sulawesi, Indonesia.
[2]Pangkep State Polytechnic of Agriculture, Pangkep 90761South Sulawesi, Indonesia

E-mail: sulaeha_t@yahoo.com

Abstract. The world market demand for Arabica coffee is relatively high at this time, South of Sulawesi had the opportunity to return to its glory in the 19th century as the largest exporter of Arabica coffee from the Dutch East Indies outside Java island in Indonesian to several countries. One factor to consider is the presence of production inhibitors, which is the threat potential of pests. So far, there are no precise data on the distribution and intensity of the major pest attack in each area of coffee in South Sulawesi. This makes decision-making for pest management and crop management challenging under different climatic and geographic conditions. Thus, this study aims to identify and analyze the main types of pest that attack coffee plants according to their location, climate and geographic conditions. The exploration of arthropod abundance in the field involves four methods: direct observation, sweep net, light trap, and direct observation techniques. Observations for 5 weeks of observation. The diversity of arthropods was observed in the coffee culture using Sweep Net, Pitt Fall, Light Trap and direct observation traps. The value of the Shannon Index Diversity Index (H') was 2.9490 or moderate ecosystem. This shows that environmental conditions, productivity, ecosystem conditions, and ecological pressures in the coffee plantation area in Bontotenga Village are still quite balanced. According to their role in nature, the density of populations revealed the composition of pest insects 59%, natural enemies (predators and parasitoids) 38% and pathogenic vectors 3% of individuals found 586 individuals.

Introduction

Coffee is one of the plantation commodities which has a high economic value among other plantation crops and plays an important role as a source of foreign exchange. Coffee not only plays an important role as a source of foreign exchange but is also a source of income for no less than one and a half million coffee farmers in Indonesia [1]. The success of the coffee agribusiness requires the support of all parties involved in the coffee production process, processing, and marketing the coffee commodity. Efforts to increase coffee productivity and quality are continuously being made so that coffee competitiveness in Indonesia can compete in world markets. The cultivation and processing technology of coffee includes selecting superior coffee planting materials, maintenance, pruning of plants and providing shade, controlling pests and weeds, balanced fertilization, harvesting, and post-harvest coffee processing. Coffee processing plays an important role in determining the quality and taste of coffee [1,2].

Currently, the increase in coffee production in Indonesia is still hampered by the low quality of the coffee beans produced, which affects the development of final coffee production. One of the problems

in increasing the productivity and quality of coffee is the attack by plant pests (OPT). One of the causes of yield loss in coffee plants is damage caused by the coffee fruit borer (CPB) Hypothenemus hampei (Coleoptera: Scolytidae), which reduces production by 40-50% and shrinkage 30-40% from coffee beans. In addition, there are also several pests, such as stem borer, (*Zeuzera* sp.,), Branch borer (*Xyleborus* spp.), Green tick (*Cocus viridis*), and mealybug (*Ferrisia virgata*) [2].

Based on the above considerations, it is necessary to conduct research to identify several types of pests that exist in coffee plantations and the abundance of their population by using several trapping methods and direct observation.

2. Materials and methods

The materials used in this study were scissors, labels, collection bottles, plastic samples measuring 30x40 cm, basins, lamps, bowls, insect nets, labels, thermometers, multipurpose containers, GPS, microscopes and writing instruments, 2% formalin and 70% alcohol.

Exploration of the abundance of arthropods in the field uses four methods, namely direct observation, fit pall traps, sweep nets, light traps, and direct observation techniques. Observations were made for 5 weeks of observation.

2.1. Research observation

Sampling of insect pests was carried out in the coffee plantation area and direct observation of the coffee plants using several trap models, the species found from each trap were then put into bottles containing 70% alcohol for further identification. Observations on coffee plantations were carried out every week for 5 consecutive observations (5 weeks). The observation parameter in this study was the number of arthropod species found in the coffee plantations of each type of trap used. The species found were then identified based on [3], and was identified at the Insect Ecology Laboratory (E19), Faculty of Agriculture, Hasanuddin University.

2.2. Trap techniques used

2.2.1 Pitfall Trap. Pitfall traps are one of the traps to determine the abundance of ground dwelling arthropods. This trap uses a container that is brightly colored, like a yellow color, this trap is a bowl-shaped with a bright yellow color that is placed in the ground with a slightly elevated position to prevent water from flowing on the surface from falling into the trap. The trap containers are filled with 2% formalin as much as 1/3 of the volume of the container, then covered with zinc in the form of a roof to prevent rainwater from entering the trap (figure 1). Pitfall traps are placed at 20 points with a distance of 7 meters between the traps, these traps are installed for 2 days, referring to the Guide to New Zealand Soil invertebrates method. Trapped arthropods were put in a plastic containing 70% alcohol, then identified and counted in the laboratory.

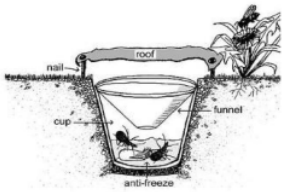

Figure 1. Pittfall trap model.

2.2.2. Sweep net. Insect net trapping is used to pick up active flying arthropods. The net method is carried out by the method of 3 swings with swing directions to the left and right at 20 planting points with the location of sample plants randomly selected with a line transect pattern with a distance of 5 trees on each row of plants. Trapped arthropods are introduced to a container containing 70% alcohol.

2.2.3. Light trap. The trap of using a lamp is by hanging a white lamp over the surface of the basin which already contains a mixture of water and 2% formalin as high as 1/3 of the volume of the container. This trap is installed in the afternoon so that the pests that are active at night will be more easily attracted to the trap. Two light traps were installed at the research location. Trapped arthropods were collected and stored in collection bottles containing 70% alcohol, then identified and counted.

2.2.4. Direct observation. Direct observation method for observing arthropods in and around plants. Direct observations were made on 20 sample plants randomly selected with a line transect pattern with a distance of 5 trees per row of plants. In a coffee tree, 4 branches are taken that point to the north, south, east and west which aim to equalize sun exposure. Arthropods found were taken and stored in a collection bottle containing 70% alcohol, then identified and counted and observed for symptoms of attack.

2.3. Arthopod identification
The arthropods obtained were identified to the family level using the insect identification reference book of Australia (1992), the sixth edition of Introduction to Insect Lessons, Identification Key to the Families in Diptera (Insecta) by [3], anual of Nearctic Diptera Volume 1 by [5], and the website www.bugguide.net run by the Iowa State University Department of Entomology. Arthropods are grouped based on their role as predators, herbivores, detrivors, parasitoids, and others. Species abundance analysis using the Shannon Index.

$$H = \sum pi \ln pi \quad (1)$$

Where :
= Diversity Index
pi = ni / N (n: number of individuals of tree species it-I; N = number of all species)

The diversity index (H) is classified as follows: H <1 = low, H > = medium, H > = high. The criteria for the diversity value of Shannon H 'use criteria that have been modified [6] as follows: Diversity value (diversity level); H < 1 (very low), 1 < H < 2 (low) , 2 > H < 3 (moderate), 3 > H < 4 (high), H > 4 (very high).

3. Results and discussion

The results of research conducted in the village of Bontotanga, Sinjai Borong, Sinjai Regency on coffee plantation, found insect arthropods consisting of 9 orders, with the highest number of population found in the Order Coleoptera (figure 1). The types of orders found were the order Hymenoptera, Lepidoptera, Diptera, Odonata, Celeoptera, Orthoptera, Hemiptera, Neuroptera, Blattodea, with a total number of taxa family levels of 45 families, namely Cetoniidae, Curculionida, Pentatomidae, Melocinidae, Chrysomelidae, Carabidae, Cercodidae, Scarabaedidae, Elatirida, Mysmelectrido, Staphylinidae, Tenebrionidae, Staphylinidae, Miridae, Melyridae, Anthocoridae, Rhopalidae, geocoridae, Gerridae, Asilidae, Stratiomydae, Syrphidae, Ichneumonidae, Formicidae, Aptidae, Culicidae, Hymespiriidae, Aptidae, Culicidae, Hymespalidae Acrididae, Trigonidiidae, Grylidae, Libellulidae, Myrmeleontidae, Chrysopidae, Archotermopsidae, Blaberidae, Blattelidae, Sclerosomatidae, Agelenidae, Paradoxomatidae, Henicopidae and Scathopagidae. The highest population was found in Family Formicidae, as many as 120 individuals during the observation (table 1).

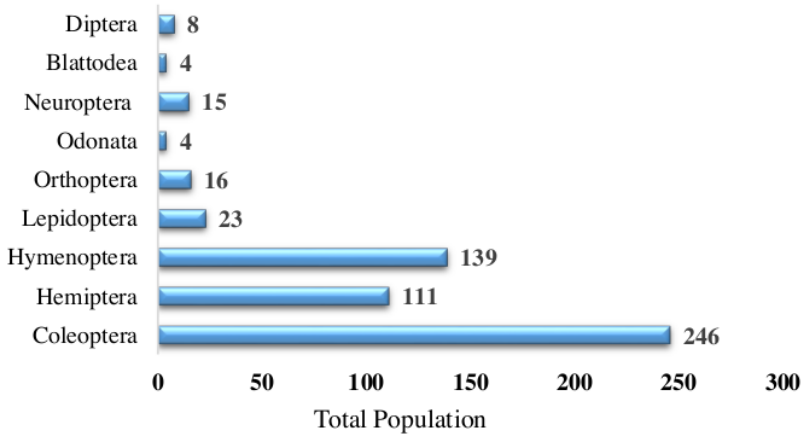

Figure 2. The composition of the abundance of insect arthropods in the coffee planting area of the Arabica side-grafting Robusta variety in the Sinjai district.

Table 1. Arthropods abundance for 6 (six) weeks of observation on robusta side grafting Arabica Coffee Plantation in Bontotangga Village, Sinjai District.

No	Order	Family	Total	Ni/N (Pi)	Ln Ni/N (Pi)
1	Coleoptera	Cetoniidae	39	0.066552901	-2.709758143
		Curculionidae	70	0.119453925	-2.124824548
		Meloidae	1	0.001706485	-6.37331979
		Chrysomelidae	14	0.023890785	-3.73426246
		Carabidae	50	0.085324232	-2.461296784
		Coccinellidae	3	0.005119454	-5.274707501
		Cantharidae	6	0.006825939	-4.987025428
		Scarabaidae	15	0.02559727	-3.665269588
		Elateiridae	9	0.015358362	-4.176095212
		Mysmelectrido	6	0.010238908	-4.58156032
		Staphylinidae	4	0.006825939	-4.987025428
		Tenebrionidae	1	0.001706485	-6.37331979
2	Hemiptera	Miridae	5	0.008532423	-4.763881877
		Melyridae	29	0.049488055	-3.00602396
		Anthocoridae	17	0.029010239	-3.540106446
		Rhopalidae	1	0.001706485	-6.37331979
		Geocoridae	4	0.006825939	-4.987025428
		Gerridae	1	0.001706485	-6.37331979
		Flatidae	54	0.092150171	-2.384335743
		Pentatomidae	29	0.049488055	-3.00602396

3	Diptera	Asilidae	2	0.003412969	-5.680172609
		Stratiomydae	3	0.005119454	-5.274707501
		Syrphidae	2	0.003412969	-5.680172609
		Scathopagidae	1	0.001706485	-6.37331979
4	Hymenoptera	Ichneumonidae	2	0.003412969	-5.680172609
		Formicidae	120	0.204778157	-1.585828047
		Apidae	4	0.006825939	-4.987025428
		Culicidae	13	0.0221843	-3.808370432
5	Lepidoptera	Nympalidae	4	0.006825939	-4.987025428
		Pieridae	7	0.011945392	-4.427409641
		Hespiriidae	10	0.017064846	-4.070734697
		Arctiidae	2	0.003412969	-5.680172609
		Cossidae	46	0.011945354	-4.427409771
6	Orthoptera	Acrididae	2	0.003412969	-5.680172609
		Trigonidiidae	3	0.005119454	-5.274707501
		Grylidae	11	0.018771331	-3.975424517
7	Odonata	Libellulidae	4	0.006825939	-4.987025428
8	Neuroptera	Myrmeleontidae	13	0.0221843	-3.808370432
		Chrysopidae	2	0.003412969	-5.680172609
9	Blattodea	Archotermopsidae	1	0.001706485	-6.37331979
		Blattellidae	1	0.001706485	-6.37331979
		Blaberidae	2	0.003412969	-5.680172609
10	Opiliones	Sclerosomatidae	12	0.020477816	-3.88841314
11	Araneae	Agelenidae	3	0.005119454	-5.274707501
12	Polydesmida	Paradoxomatidae	4	0.006825939	-4.987025428
13	Lithcciomorpha	Henicopidae	1	0.001706485	-6.37331979
			586		
				Index Shanon :	**H' = 2.949**

The results of the analysis in table 1 show that in the coffee planting area, the arabica grafted robusta variety was found as many as 13 taxa classes of phylum arthropods with a total number of species of 586 individuals. These specimens were obtained for 6 weeks of observation using several methods, namely pitfall traps, light traps, sweep nets, and direct observation.

From the observation and data analysis, it can be seen that the insect species with the highest number are Family Formicidae, 120 species of Selonopsis and Dolichoderus bituberculatus, both types of ants are insects which generally have high dominance in the planting area. The Arabica coffee planting area along with robusta in Tajjuru Hamlet, Bontotenga Village, shows the presence of Selenopsis and D.bituberculatus ants which have a role as predators or entomophageal insects that will be able to control and reduce insect pest populations. The results of the Diversity Index (H ') calculation indicate that the arthropod diversity index in the robusta side-grafted arabica coffee varieties as a whole is 2,949 which is categorized in a moderate level of diversity based on the diversity of the Shannon Index H' which is 2 <H <3. This illustrates that the condition of the ecosystem and the ecological pressure in the coffee plantation area in Bontotenga Village is still quite balanced, namely that natural control factors are still working in suppressing pest populations.

This diversity is closely related to insect activity patterns related to environmental factors. This is in line with [7], which states that the presence of insects in nature is influenced by the presence of abiotic factors or climatic elements as components of an ecosystem, including temperature, light intensity, and air humidity.

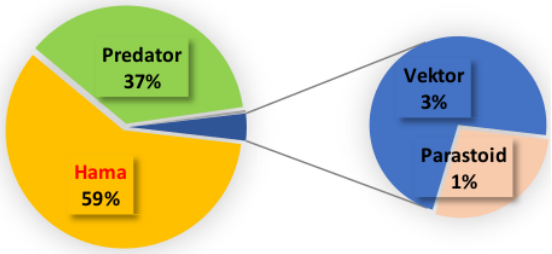

Figure 3. The proportion of abundance of arthropods based on their role in nature.

Based on the ecological role of the arthropod community in the observation area, it was found that the highest proportion of insect pests was 59%, the predatory group was 37%, the vector of disease transmission was 3%, and the smallest group was found to be 1% of the parasitoid group (figure 3 and table 1). The existence of natural enemies of predators and parastoids will be able to suppress the development of the pest population, this can be seen from the attack of the Zeusera coffea twig borer which commonly attacks coffee plants in the Sinjai Borong district does not show heavy attacks, with an average attack rate of only ± 37% - 45%. The population of Z.coffea stem borer which is found in the coffee plantation area, its existence is always found in several farmers' lands, this is influenced by the conditions of the offee cultivation where there are cocoa plants in between. The cocoa plant is known to be an alternative host of the Z. coffea stem borer [8,9].

The results of the identification of arthropods based on morphological characteristics to the family level found in side-grafted Arabica coffee plants Robusta for six weeks of observation were 586 populations with 45 families from the insect taxa and arachnid groups.

Table 2. The existence status of Arthropods on the coffee plantation for 6 weeks of observation.

Status	Family	Total of species	Total of population
Pest	Scolytidae	1	21
	Cossidae	1	46 (larva)
	Carabidae	8	50
	Curculionidae	1	70
	Pentatomidae	1	29
	Chrysomellidae	1	14
	Cantharidae	1	6
	Cetoniidae	1	39
	Tenebrionidae	1	1
	Acrididae	1	2
	Trigonidiidae	1	3
	Grylidae	1	11
	Myridae	1	1
		Total of species	**287**

Predator	Agelenidae	1	3
	Asilidae	1	2
	Carabidae	1	50
	Stratiomydae	3	3
	Syrphidae	2	3
	Libellulidae	1	3
	Myrmelontidae	1	12
	Chrysopidae	1	2
	Staphylinidae	1	4
	Formicidae	2	120
	Staphylinidae	1	4
	Libellulidae	1	4
	Myrmeleontidae	1	13
	Coccinellidae	1	3
	Chrysopidae	1	2
Total of species			**178**
Blattodea	Blattellidae	1	1
	Blaberidae	1	1
total			**2**
Parasitoid	Ichneumonidae	1	2
	Apidae	2	3
		Total of species	**5**
Vektor	Culicidae	1	13
		Total of species	13

Chrysolopus specstabilis (Coleoptera: Curculionidae) is known as Botany bay diamond weevil, this insect is found in sweep net traps, with the characteristic morphology seen to have metallic blue glossy black spots, 1 pair of capitate type antenna with 2 cm long, the tip of the head is like a snout (figure 4). The activity of the larvae and imago of these insects generally attacks the branches or trunks of trees. According to [10] this insect uses its long snout to make a hole in the stem for laying space.

Figure 4. *Chrysolopus specstabil*is (Coleoptera: Curculionidae).

Scelida nigricornis (Coleoptera: Chrysomelidae) is known as flea beetles, these insects are found in sweep net traps, with the characteristic morphology seen to have a metallic blue body color on the elitra (wings). The abdomen looks longer backward. It has 1 pair of antenae with a length of 3 cm and 3 pairs of brown limbs. These herbivorous insects are leaf-eaters (figure 5).

Figure 5. *Scelida nigricornis* (Coleoptera:Chrysomelidae).

Ophionea sp. (Coleoptera: Carabidae were found in sweep net traps, characterized by the morphology seen to have a dark brown color with an elongated and flattened body shape, the more the head will shrink or have a long prothorax, the middle part of the elytra are black. The antenna consists of 11 segments. , The 3 basal segments are brown, while the other part is black. The elytra is shorter than the hind wings so that it does not completely cover the abdomen. It has the formula tarsus 4-4-4 (figure 6). According to [11], a ground beetle belonging to the Carabidae family acts as a predator that actively scatters prey during the day. The types of insects that prey on are brown fleas, caterpillars, caterpillars.

Figure 6. *Ophionea* sp. (Coleoptera: Carabidae).

Menochilus sp. (Coleoptera: Carabidae, these insects are found in sweep net traps, with the characteristic morphology seen to have a striped brown color with a tiger-like skin pattern, the tip of the abdomen is shiny green. wider than the pronotum. The forewings have a black and brown hue, the three pairs of limbs are slightly longer (figure 7). According to [13] the carabidae *Menochilus* sp. known as the Common tiger beetle is a predatory beetle. These beetles catch prey by waiting for the prey in the burrow. After catching the prey, the prey is brought into the burrow to be devoured. In addition, these beetles can prey on various insects that are found on the ground. These beetle larvae live in wood crevices in dry soil [13].

Figure 7. *Menochilus* sp. (Coleoptera: Carabidae).

Monteithiella humeralis (Coleoptera: Pentatomidae) is known as the pittosporum shield bug, these insects are found in sweep net traps, with the characteristic morphology seen to have yellowish-green patches with black patches in three rows right on the back of the abdomen, 1 pair of antennae with a length of 2 cm and visible 3 segments green-brown. Three pairs of legs with green and yellow tips (figure 8).

Figure 8. *Monteithiella humeralis* (Hemiptera: Pentatomidae).

Adelphocoris linolatus (Hemiptera: Miridae) is known as the Alfalfa plant bug. These insects were found in the sweep net traps and were characterized by a pale green morphology. Has 1 pair of antenna with a length of 1.3 cm, 3 pairs of green limbs and a spiny tibia. The body is slightly elongated, the spines on the back of the tibia are equal to or larger than the width of the tibia. These insects are common in cloves and other legume crops (figure 9).

Figure 9. Family Miridae.

This specimen has not been identified until the taxa species, only up to the Family level (Hemiptera: Cantharidae). The Cantharidae family was found through sweep net traps, with the morphological characteristics of having a brown orange body color, and very thin pale brown wings, long elytra and 1 pair of antennae with a length of 2 cm, brown and smooth hair (figure 10).

Figure 10. Spesimen *un identify species* (Coleoptera : Cantharidae).

E. aestuans (Diptera: Asilidaae) was found through a sweep net trap, characterized by a brown body morphology with a slightly tapered tip of the abdomen. Antenna with a length of 0.5 mm, on the three 3 pairs of legs part of the tibia, there is a spot that is light brown and fine hairs. The abdomen is dark gray, with the tip of the abdomen widening (figure 11).

According to [14] in the Diptera of Canada report, this *E. aestuans* fly is known as the Robber Fly. This fly can prey on various insect species and can catch prey that is larger than its body size. Robber fly insects have sensory organs that are very important for their activities as predators. The habitat of robber flies is easy to find in the open, on vegetation, or the ground. The visible behavior of these flies will often move their head or body in response to the movements of their prey.

Figure 11. Spesimen *robber fly Efferia aestuans* (Diptera: Asilidaae).

E. spinigera (Diptera: Stratiomyidae) is known as the Garden Solder fly. These insects were found in the sweep net trap, with morphological characteristics having a black body with a long abdomen, a body size of 8.5-16 mm, and transparent brown wings (figure 12).

Figure 12. Spesimen *Exaireta spinigera* (Diptera: Stratiomyidae).

Statiomyidae fly as a predator, known as the Soldier Fly [14], which has a body length of 15 mm and resembles a wasp from the subfamily Sphecinae. These insects are generally found in shrubs or decaying vegetation, E. spinigera fly larvae become decomposing insects on organic materials.

The insect *S. bipunctatus* (Diptera: Stratiomydae) was found in the sweep net trap, with the morphological characteristics seen to have green on the thorax to the abdomen and blackhead. It has a very short 1 pair antenna which is almost invisible round shape. It has 3 pairs of yellowish-brown limbs. This insect acts as a predator. The existence of these flies in the field is influenced by the amount of organic waste from scattered coffee leaf leaves as a result of plant pruning, the same thing that flies that decompose organic matter E. spinigera are as shown in figure 13.

Figure 13. Spesimen *Sargus bipunctatus* (Diptera: Stratiomydae).

This specimen is known as the Twin-Spot Centurion, this fly has a body size of 10-14 mm. The mesonotum is metallic green, the abdomen is brown, with bright spots (silver). The female fly has a wider body shape than the male fly, which is slightly slender, the abdomen of segment 1 is reddish and the last segment is bluish-black. Female flies lay their eggs in fresh manure, livestock manure or near the soil where the larvae grow. Larvae are maintained from cow dung, compost, vegetation and decaying organic matter [15].

The *P. haemorrhous* specimen (Diptera: Syrphidae) was found in the sweep net trap, with the morphological characteristics of a black body with metallic brown wings, 1 pair of antennae with a length of 0.7 mm. The legs are brown and there are black spots at the base of the coxa segment and on the tip of the tibia, on all parts of the body, there are fine hairs.

The morphological characters found are the same as the characters described in Insect of Australia (2001). [3] reported the identification results *P. haemorrhous* as frst report in Pakistan shows very short frons of the head, black antennae with long flagellomeric or 3rd segment, antennae with very short arista type. The dorsal part of the thorax is black and covered with hair or seta. This fly has a habitat found on land with grass vegetation or open areas. This insect acts as a predator [12].

Specimen No. 12 (Hymenoptera: Ichneumoniidae) has not been identified until the taxa species have similar morphological characters because so many species have similar morphology. This insect known as the Ichneumon wasps was found using a sweep net trap. The morphological characteristics of the body are orange except for the black abdomen and head. This Ichneumonidae insect has a ± 13.5 cm long abdomen, long antennae with 16 segments. On the legs that look long, there are fine hairs on the tibia.

The same thing was explained [3], the parasitoids Ichnomonidae have a body length of about 25 mm with an abdomen that is longer than the other parts. Its body is brown, orange, and dark in the eyes. Its antennae and legs are very long. According to [3] Wasp Ichnomonidae is an insect that is quite easy to identify with its long body, abdomen, limbs and antennae characteristics. Most of the species members of this taxa family are parasitic in several types of insect pests. This parasitoid imago is actively attracted to light at night in rural areas.

The species of *Neptis sappho* (Lepidoptera: Nymphalidae) was found through sweep net traps, this morphological characteristic appears to have a brown color with white spots or patches on the wings, enlarged antenna tips and yellow color. Habitat where adults live like humid places. Symptoms of the attack caused by the attack of the larval stage are visible eating marks, leaving the leaves behind. Pupa *N. sappho* thrives on litter or organic waste [17].

The conservation forest influences the diversity of arthropods in coffee cultivation by discovering several types of herbivores or insect pests whose hosts are not coffee plants in Tahura, which is not far from the research location. The existence of this protected forest supports the development of natural enemies of predators and parasitoids, this can be seen from the number of natural enemies found in coffee plantations as much as 38% or 184 individuals. In line with the opinion of [17], natural ecosystems (forests) have a high degree of arthropod diversity and a fairly stable natural ecosystem arrangement. It is known that the natural enemies found in coffee plantation areas are natural enemies that commonly prey on and parasitize pests on coffee plants so that they can be significant potential in biological control.

4. Conclusions

Arthropod diversity was found in coffee plantations using sweep net, pitt fall, light trap, and direct observation traps. The result in a Shannon Index (H ') diversity index was value of 2.9490 or moderate ecosystem. This shows that environmental conditions, ecosystem conditions and ecological pressures in the coffee plantation area in Bontotenga Village are still quite balanced. Population density based on its role in nature found the composition of insect pests 59%, natural enemies (predators and parasitoids) 38% and disease-causing vectors 3% of the total individuals were found 586 individuals.

References

[1] DJPEN 2012 *Coffee Opportunities and Challenges* (Jakarta: Ministry of Trade)
[2] BPPP 2020 Komoditas Tanaman Perkebunan Kopi [Kopi Komoditas Tanaman Perkebunan] (Jakarta: Kementerian Pertanian Republik Indonesia)
[3] Borror D J Triplehorn C A and Johnson F 1996 Pengenalan Pelajaran Serangga, Edisi Keenam, Penerjemah Soetiyono Partosoedjono (Yogyakarta: Gadjah Mada University Press)
[4] McAlpine B V, Peterson G E, Shewell H J, Teskey J R, Vockeroth and Wood D M 1981 *Manual*

of Neartic Diptera Volume 1 (Canada: Canadian Government Publishing Center)
[5] Shannon C E 1948 A mathematical theory of communication *Bell. Sys. Tech. J.* **27** 379–423
[6] Aditama C R and Kurniawan N 2013 Struktur komunitas serangga nokturnal areal pertanian padi organik pada musim penghujan di Kecamatan Lawang, Kabupaten Malang *J. Biotropika* **1** 186-190
[7] Puji L and Purnomo 2018 Intensitas serangan hama penggerek batang kakao di perkebunan rakyat Cipadang, Gedongtatan, Pesawaran *J. Agro Industri Perkebunan* **6** 1-8
[8] Toana M H, Mudhjiono G, Karindah S and Abadi A L 2014 Diversity of Arthropods on cocoa plantation in three strata of shade tree *Agrivita* **36** 120-127
[9] Hawkeswood T J 2007 Beetles (Coleoptera) of the Shell Picture card series: Curculionidae. *Calodema supplementary* **31** 1-2
[10] Hijmas K L, Villareal S and Catindig J 2010 Biological control ecosystem services in Tropical rice *Atlas of Biodiversity Risk* **1** 248-249
[11] Saleem M., Dilbar H,Habib A, Ghulam G, Muneer A. 2014. Predation efficacy of Menochilus sexmaculatus Fabricus (Coleoptera: Coccinelidae) agaitns *Macrosiphum rosae* under Laboratory condition. *J. Entomol. Zool.* **2** 160-163
[12] Savage J, Borkent A, Brodo F, Cumming J M, Curler G, Currie D C, deWaaard J R 2019 Diptera of Canada *Zookeys* **819** 397-450
[13] Stubbs A and Drake M 2001 *British Soldierflies and Their Allies: A Field Guide to the Larger British Brachycera* (UK: British Entomological & Natural History Society) p 512
[14] Turk J K, Memon N, Mal B, Memon S A, Shah M A and Solangi D A 2014 First record and redescription of *Paragus haemorrhous* Meigen (Diptera: Syrphidae) from Balochistan, Pakistan *J. Entomol. Zool. Stud.* **2** 267-270
[15] De Buck N 1990 Bloembezoek en bestuivingsecologie van Zweefvliegen (Diptera, Syrphidae) in het bijzonder voor België. de travail de l'Institut Royal des Sciences naturelles de Belgique, **60** 3-167
[16] Ivone W B 2012 Kontribusi artropoda kanopi dalam menjaga stabiltas ekosistem pada kebun berbasis Sengon laut (Paraserianthes falcataria (L.)) budidaya porang (Amorphophallus muelleri blumei) (schott) di Jember sebagai sumber belajar biologi *Bioeduksi* **3**
[17] Mika A M and Newman J A 2010 Climate change scenarios and models yield conflicting predictions about the future risk of an invasive species in North America *Agric. For. Entomol.* **12** 213-221

Diversity of arthropods on coffee arabica plantation sidegrafting robusta variety in South of Sulawesi

ORIGINALITY REPORT

13%	9%	10%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	repository.lppm.unila.ac.id Internet Source	2%
2	ijrrjournal.com Internet Source	2%
3	I D Daud, A Nurariaty, Rasmi. "Inventory of arthropoda in endophytic hybrid corn plants (Variety Mr14 x Variety Nei9008)", IOP Conference Series: Earth and Environmental Science, 2020 Publication	1%
4	backend.orbit.dtu.dk Internet Source	1%
5	ukipaulus.ac.id Internet Source	1%
6	Submitted to Top Education Institute Student Paper	1%
7	prosiding.unirow.ac.id Internet Source	1%

8	publikasi.polije.ac.id Internet Source	<1 %
9	www.researchgate.net Internet Source	<1 %
10	E Ibrahim, A Mugiasih. "Diversity of pests and natural enemies in rice field agroecosystem with ecological engineering and without ecological engineering", IOP Conference Series: Earth and Environmental Science, 2020 Publication	<1 %
11	Tiara Halidah Ratnasari, Nova Hariani, Sus Trimurti, Fatmawati Patang. "ROLE AND TYPES OF INSECTS IN SETTLEMENT AREAS OF SUNGAI PINANG VILLAGE IN SAMARINDA CITY", Jurnal Pendidikan Matematika dan IPA, 2022 Publication	<1 %
12	repository.unhas.ac.id Internet Source	<1 %
13	A Marques, N F Haneda, A P P Hartoyo. "Incidence Attacks of Coffee (Coffee arabica L.) Pest on Agroforestry System in Liquica Regency, Timor Leste", IOP Conference Series: Earth and Environmental Science, 2022 Publication	<1 %
14	Nastasia F. Margini, Wasis Wardoyo, Nadjadji Anwar. "Variability of Discharge Inflow in	<1 %

Wonorejo Reservoir, Indonesia", IOP Conference Series: Earth and Environmental Science, 2022
Publication

15	Submitted to Universitas Jenderal Soedirman Student Paper	<1 %
16	S Sulaeha, E S Ratna, Purwantiningsih, A Rauf. " Population dynamics of melon fly Coquillett (Diptera: Tephritidae) and damage level of fruits based on phenology and altitude ", IOP Conference Series: Earth and Environmental Science, 2020 Publication	<1 %
17	Chatarina Gradict Semiun, Eufrasia R. A. Lengur, Gaudensius U. U. Boli Duhan. "Insect diversity profile of mangrove ecosystem in Menipo Nature Tourism Park, East Amarasi, East Nusa Tenggara", IOP Conference Series: Materials Science and Engineering, 2020 Publication	<1 %
18	Y Daud, Y Arafat, D A Kumara, D A Fortuna, F M Yunus, H F Avicienna, Farhan. "Employing 3-D inversion of geomagnetic data to identify demagnetized rock associated with reservoir zone of Blawan-Ijen geothermal prospect area", IOP Conference Series: Earth and Environmental Science, 2020 Publication	<1 %

19	A Kurniawan, Y Daud, M A Tifani, N Latuconsina, F Maulana. "Interpretation of surface geological conditions based on Landsat-8 data, DEM and field geological data in the Tulehu geothermal prospect area, Maluku Province", IOP Conference Series: Earth and Environmental Science, 2020 Publication	<1 %
20	Arfan ., Alam Anshary, Zainuddin Basri, Hibban Toana. "Effect of Chemical Insecticides on the Arthropod Diversity in the Agroecosystem of Red Onion Crops", Asian Journal of Crop Science, 2018 Publication	<1 %
21	Submitted to University of Sri Jayewardenepura Nugegoda Sri Lanka Student Paper	<1 %
22	www.ccrjournal.com Internet Source	<1 %

Exclude quotes	On	Exclude matches	< 5 words
Exclude bibliography	On		