Chapter 14
Arthropod Diversity in Conventional Citrus Orchard at Selorejo Village, East Java

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Abstract Fruits and vegetables are one of the Indonesian agricultural products that are much favored by people from own country or abroad. Indonesia farmers have been trying to repel pests that attack plants using excessive pesticides. There is a decrease in abundance and diversity of arthropods in farms. The existence of arthropods in nature can serve as bio-indicators of environmental health because of the number and variety of species of arthropods are very high in the world. It can be assumed that if the environment is still stable and undisturbed. Conventional farming systems result in an adverse impact on the environment; therefore, the organic farming system began to be applied by farmers who have been aware of environmental health. Some due to the application of conventional farming systems are described with an example citrus farm in the Selorejo Village of Malang Regency.

1 Introduction

The use of pesticides is done continuously without considering the accumulation of residues that would be acceptable by both humans and animals (environment), a pest control concept that has long been embraced by farmers. Starting with the historical development of agribusiness starting from an agricultural revolution in Europe that occurred in 1750–1880 AD, the history of agriculture began to develop into commercial agriculture to apply the technology and pressing various limiting factors including pest control.

Furthermore, there is a development of pest management that uses DDT (dichloro diphenyl tricloroetana) in all regions of the world. Along with this, the pesticide industry is progressing very rapidly. At that time, the pest control using pesticides made from chemicals is considered the most secure way and good for farming system. Control of pests and diseases (pathogens) is performed with the use

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of pesticides and synthetic fertilizers, currently known as conventional farming systems. In general, the focus of controlling pests and diseases (pathogens) conducted by the farmers of vegetables and fruits (especially) is still on the use of synthetic pesticides.

Recently, the agricultural system in Indonesia is still conventional. The farmers use synthetic pesticides to control pests that often attack plantations. With the ever-Increased demand for quality agricultural products resulted in farmers used pesticides to maintain crop from pest attacks regardless of the health of the surrounding environment.

Spraying pesticides is done to eradicate pests before harvest with a specific schedule. The use of pesticides with conventional systems is very harmful because it causes the pest resistance to insecticides, the rise or blasting of pest populations, high residual levels on agricultural products that are not safe for consumption by humans. In addition, too frequent use of the pesticides will also lead to the killing of non-targeted insects which may result in an imbalance of ecosystems.

2 Evolving Concepts of Agriculture

Chandrasekaran et al. (2010) stated that agriculture is defined in the Agriculture Act 1947, as including "horticulture, fruit growing, seed growing, dairy farming and livestock breeding and keeping, the use of land as grazing land, meadowland, osier land, market gardens and nursery grounds, and the use of land for woodlands where that use ancillary to the farming of land for Agricultural purposes". It is also defined as purposeful work through which elements in nature are harnessed to produce plants and animals to meet the human needs. It is a biological production process, which depends on the growth and development of selected plants and animals within the local environment.

Agriculture is defined as the art, the science, and the business of producing crops and the livestock for economic purposes.

As an art, it embraces knowledge of the way to perform the operations of the farm in a skillful manner. The skill is categorized as:

- *Physical skill*: It involves the ability and capacity to carry out the operation in an efficient way, for example handling of farm implements, animals, sowing of seeds, fertilizer, and pesticides application.
- *Mental skill*: The farmer is able to take a decision based on experience, such as (i) time and method of plugging, (ii) selection of crop and cropping system to suit soil and climate, and (iii) adopting improved farm practices.

As a science, it utilizes all modern technologies developed on scientific principles such as crop improvement/breeding, crop production, crop protection, and economics to maximize the yield and profit. For example, new crops and varieties developed by hybridization, transgenic crop varieties resistant to pests and diseases, hybrids in each crop, high fertilizer responsive varieties, water management, herbicides to control weeds, use of biocontrol agents to combat pest and diseases.

As a business, as long as agriculture is the way of life of the rural population, production is ultimately bound to consumption. But agriculture as a business aims at maximum net return through the management of land, labor, water, and capital, employing the knowledge of various sciences for production of food, feed, fiber, and fuel. In recent years, agriculture is commercialized to run as a business through mechanization.

Agriculture in Indonesia according to Estu (2014) is one of the key sectors of Indonesian economy. Although the share of agriculture sector contribution to the national gross domestic product has declined significantly in the last half-century, today, it still provides income for the majority of Indonesian households. In 2013, the agricultural sector contributed to 14.43% of national GDP, a slight decline compared to a decade earlier (2003) which reached 15.19%. In 2012, this sector provides jobs for around 49 million Indonesians, which represents 41% of the total labor force in the country. Currently, around 30% of Indonesian land area is used for agriculture purposes. Indonesian agriculture sector is overviewed and regulated by Indonesian Ministry of Agriculture (Indonesian Ministry of Agriculture 2015).

Generally, Estu (2014) believed that the agricultural sector of Indonesia comprises two types which corresponds scale:

- Large plantations either owned by state or private companies.
- Smallholder production modes, mostly traditional agricultural households.

The large plantations tend to focus on export commodities, such as palm oil and rubber, while the small-scale farmers focus on horticultural commodities to supply the food consumption of local and regional population, such as rice, soybeans, corn, fruits, and vegetables.

According to the Ministry of Agriculture in Indonesia (2015) said that Indonesia gets rain and abundant sunshine almost all the time because Indonesia is located in the tropics, where rain and sunshine are important elements for agriculture. Most of the global agricultural commodities are growing in Indonesia. The country has a fertile and vast land. Indonesia is a major producer of tropical agricultural products. Important agricultural commodities in Indonesia include palm oil, natural rubber, cocoa, coffee, tea, cassava, rice, and tropical spices that are easy to find all the time.

Over the last six years, citrus production in Indonesia has increased by about 400% to reach 2.2 million tons in 2005. Citrus represented about 10% of fruit production in 2005. Five provinces dominate citrus production—North Sumatra, East Java, South Sumatra, South Sulawesi, and West Kalimantan—accounting for 70% of Indonesia's production. East Indonesian citrus accounted for 11.9% of the volume of all citrus produced in Indonesia in 2005; this is a decline from 22.4% share of production in 1999. Over the last 6 years, production of citrus in East Indonesia has increased by only 163% compared to 392% across all provinces. South Sulawesi is the main citrus-producing province in East Indonesia

Table 1 Citrus production by province 1999–2005 (modified from BPS 2007, unit: ton)

No	Province	Year						
		1999	2000	2001	2002	2003	2004	2005
1	NAD (Aceh)	9956	17,074	13,834	32,191	31,486	20,258	11,395
2	North Sumatra	91,638	186,926	195,352	273,847	432,431	549,504	586,578
3	West Sumatra	42,470	25,643	38,543	39,040	54,491	57,212	68,675
4	Riau	19,326	50,965	58,428	69,421	57,814	112,913	85,204
5	Jambi	1865	1785	4380	5274	7438	19,605	12,038
6	South Sumatra	3962	21,218	35,332	42,638	57,664	167,689	218,397
7	Bengkulu	2155	3970	5124	5067	6187	4932	4147
8	Lampung	2141	8486	15,613	41,107	76,319	76,368	95,570
9	Bangka Belitung	–	–	1598	1143	5274	11,979	39,620
10	DKI Jakarta	11	3	8	1	1	4	15
11	West Java	32,664	37,228	23,288	26,584	22,225	20,226	21,221
12	Central Java	20,039	31,553	58,477	51,075	25,131	25,263	29,510
13	DI Yogyakarta	899	1097	976	1320	2498	2328	2980
14	East Java	40,576	46,488	67,905	150,476	421,829	467,466	395,428
15	Banten	–	–	1464	1364	1893	1732	1529
16	Bali	58,080	55,489	48,380	45,279	68,847	57,067	107,563
17	NTB	1306	1694	1536	1150	3994	4336	4183
18	NTT	17,105	19,039	21,729	24,506	23,896	24,714	21,434
19	West Kalimantan	1848	1034	1283	2402	49,435	108,211	146,314
20	Central Kalimantan	2072	2065	3379	3918	2400	2266	1112
21	South Kalimantan	17,394	10,687	19,119	19,035	75,787	95,845	114,432
22	East Kalimantan	1927	3934	5510	4200	3809	7894	7998
23	North Sulawesi	398	409	1009	1939	1281	1519	1534

(continued)

Table 1 (continued)

No	Province	Year						
		1999	2000	2001	2002	2003	2004	2005
24	Central Sulawesi	2911	1151	3212	7010	7110	17,012	46,152
25	South Sulawesi	75,791	110,120	54,708	108,174	68,731	197,825	157,783
26	S.East Sulawesi	1931	4995	9496	6374	17,093	11,400	22,557
27	Gorontalo	–	–	160	578	516	378	923
28	Maluku	162	153	5	1607	3056	3478	2952
29	North Maluku	–	–	194	603	168	1179	2525
30	Irian Jaya	904	846	1385	809	1020	481	4251
	Total	449,531	644,052	691,433	966,132	1,529,824	2,071,084	2,214,020

with 157,783 tons in 2005 (60% share) up from 75,791 tons in 1999. However, South Sulawesi's share of citrus production in Indonesia has declined from 16.9 to 7.1% over the last 6 years. The major citrus regions are in the north of South Sulawesi, representing 88% of all *Siam* citrus production. Statistics Indonesia and Directorate General of Horticulture Production Development had citrus production data as shown in Tables 1 and 2 (Phillip 2007).

2.1 What Is Conventional System of Agriculture?

Conventional farming is a term used to designate farming techniques that are traditionally, and often controversially, oriented toward using technology, pesticides, chemicals, and other synthetic tools in the cultivation of crops. Thus, "conventional" is often used as an antonym for "organic," a farming approach that alternatively seeks to limit or eradicate the introduction of synthetic elements into agriculture. According to the USDA (2005), there is no concrete example of conventional farming, as it takes different forms depending on the farm, the region, and the nation. However, some consistent features include high levels of capital investment and technological innovation as well as the frequent use of commercial pesticides. Opponents of conventional farming often associate it with less vigilant ecological practices, particularly with regard to the use of chemicals employed to manage the infiltration of weeds and pests. According to *Fresh Connect*, such practices may lead to unacceptable levels of toxicity and long-term health implications for consumers.

Kim (2011) in Fraser et al. (2005) stated that modern agriculture has been working within the global food system to feed the world's urbanized masses via a gamut of advents in farming practices to become what is now known as industrial agriculture. The mass production of food through the techniques that define modern agriculture has led to the conventionalization of agriculture in a technocratic approach to agriculture (*Fraser*, personal communication). The intensive farming that characterizes modern agriculture uses a higher amount of labor and chemicals per unit area than any other approach to farming. Much of this labor is mechanized to allow for a much more efficient use of land, providing a higher yield-*output* to human labor-input ratio. However, this conventional and mechanized form of agriculture is extremely energy intensive, requiring fossil fuels to power the machines that allow humans to farm on such a large scale (Pimentel et al. 1973, 2005). One of the defining methods that CA employs is the use of conventional fertilizers (Crews and Peoples 2004). Applied conventional fertilizers come in various standard N-PK ratios for application on a crop. Fertilizers provide renewed applications of nutrients onto the soil, effectively removing considerably long-term strategies to retain and replenish soil nutrient and soil organic carbon. Fertilizers are also the cause for one of the primary concerns of CA. Methane and nitrous oxide emissions are, respectively, the second and third most important GHGs after carbon dioxide (UNESCO-SCOPE 2007), and their emissions from agricultural fields has

Table 2 Citrus harvested by province, 1998–2005 (modified from BPS 2007, unit: hectare)

No	Province	Year							
		1998	1999	2000	2001	2002	2003	2004	2005
1	NAD (Aceh)	379	535	826	788	837	1314	946	456
2	North Sumatra	5466	6819	6219	10,354	10,321	11,239	13,842	14,521
3	West Sumatra	1292	1798	1594	2248	2819	3283	2817	3212
4	Riau	827	2212	4044	3771	4022	3014	3875	2662
5	Jambi	70	97	100	259	253	272	594	614
6	South Sumatra	1240	395	2304	2660	2728	5447	6534	5763
7	Bengkulu	105	72	234	360	258	461	200	145
8	Lampung	339	108	428	968	1950	3237	3147	3266
9	Bangka Belitung	–	–	–	92	166	752	358	1668
10	DKI Jakarta	–	–	–	–	–	–	0,2	2,0
11	West Java	871	639	808	637	481	458	617	785
12	Central Java	478	765	1463	1855	1337	1229	1538	1136
13	DI Yogyakarta	66	63	72	62	95	78	83	87
14	East Java	1883	1557	2101	2392	4421	9995	14,747	11,473
15	Banten	–	–	–	57	45	120	86	62
16	Bali	3080	2572	2503	2338	1849	7851	4066	4014
17	NTB	117	99	95	104	40	117	112	105
18	NTT	1052	1014	1423	1036	1247	2458	1564	956
19	Timor Timur	46	–	–	–	–	–	–	–
20	West Kalimantan	220	204	59	77	151	1409	3059	4594
21	Central Kalimantan	216	166	132	154	167	138	143	150
22	South Kalimantan	956	822	826	971	945	6804	2474	2481
23	East Kalimantan	172	145	240	243	95	122	210	224

(continued)

Table 2 (continued)

No	Province	Year							
		1998	1999	2000	2001	2002	2003	2004	2005
24	North Sulawesi	55	34	37	56	48	75	78	91
25	Central Sulawesi	226	273	111	221	353	203	754	1039
26	South Sulawesi	3785	4416	10,943	2956	12,513	7706	9150	6735
27	S.East Sulawesi	352	153	312	449	330	1185	961	1093
28	Gorontalo	–	–	–	10	27	17	16	35
29	Maluku	66	31	29	1	56	106	126	213
30	North Maluku	–	–	–	18	83	23	106	101
31	Irian Jaya	322	221	217	230	87	26	103	180
	Total	23,681	25,210	37,120	35,367	47,824	69,139	72,306	67,883

Sources BPS—Statistics Indonesia and Directorate General of Horticulture Production Development (2007)
Note Data not available

been greatly increased with the application of ammonium-based environmental problems that have arisen from the use of conventional fertilizers highlight the disjunction between intensive industrial farming and care for natural ecosystem processes. For example, conventional fertilizers are used to provide an abundant amount of nutrients in biochemically available forms, but the scale at which fertilizers are applied coupled with the natural water cycle has led to nutrient-loaded runoff that feeds into aquatic systems (Goetz and Zilberman 2000). The loss of dissolved oxygen driven by nutrient-laden waters has led to the eutrophication of coastal regions and lakes throughout North America, altering ecosystem dynamics of entire aquatic systems (Carpenter et al. 1998). The post-World War II Green Revolution produced another example showcasing the large divide between CA development and environmental considerations. The first suite of synthetic pesticides was produced, leading overtime to the refined synthesis and common applications of pesticides to eradicate pest insects, weeds, and other undesired organisms. Pesticides are used to control natural biological processes that disrupt the homogeneity and production efficiency of industrial crop farms by disrupting the natural chemical functions (Hussain et al. 2009) of unwanted organisms in the farm system. The problem herein lies in the chemical selectivity of the pesticides and the biological evolution of tolerance and resistance to these pesticides, rendering them ineffective and biochemically obsolete. Furthermore, human consumption of foreign and synthetically produced chemicals is an aspect of agriculture that the general public is not too comfortable with (Dunlap and Beus 1992). The introduction of GMOs presented a technocratic solution to the biological problems associated with excessive pesticide use. GMOs gave farms the ability to grow masses of phenotypically and genotypically monoculture crops, fitting into the CA system by allowing the creation of machines specialized to handle vast quantities of single crop types. Such a precise specialization of crops delivers an even higher yield output per unit of energy input (Gardner 2003), resulting in less land required for farming and leaving more natural land intact. As a whole, the mechanization of farming in today's conventionally industrial agriculture has brought about an approach to farming that is disconnected from the earth and the people it feeds. The growing number of links in the food chain renders it harder and harder to see firsthand the ecological impacts that conventional farming has (Cone and Myhre 2000), facilitating the ease with which we can forget its connection to climate change and food security. The term "conventional agriculture" as it applies to the area of agriculture can be defined as "generally used to contrast common or traditional agricultural practices featuring heavy reliance on chemical and energy inputs typical of large-scale, mechanized farms to alternative agriculture or sustainable agriculture practices. Mold-board plowing to cover stubble, routine pesticide spraying, and use of synthetic fertilizers are examples of conventional practices that contrast to alternative practices such as no-till, integrated pest management, and use of animal and green manures".

2.2 What Is Organic Farming System of Agriculture?

Organic farming is a method of crop and livestock production that involves much more than choosing not to use pesticides, fertilizers, genetically modified organisms, antibiotics, and growth hormones according to the Martin opinion (2009), while Tridjaja (2016) declared that organic farming system is a form of agriculture system which avoids or largely excludes the use of synthetic fertilizers and pesticides, plant growth regulators, and livestock feed additives. As far as possible, organic farmers rely on crop rotation, integrated pest management, crop residues, animal manures, and mechanical cultivation to maintain soil productivity and till to supply plant nutrients, and to control weeds, insects, and other pests. Definition of organic farming according to Martha et al. (2003) is organic agriculture that has both general and legal definitions. Generally, organic agriculture refers to farming systems that avoid the use of synthetic pesticides and fertilizers. In the USA, organic farming is defined by rules established by the US Department of Agriculture's National Organic Standards Board (NOSB), while based on National Standardization Agencies in Jakarta, organic farming is a form of agriculture which avoids or largely excludes the use of synthetic fertilizers and pesticides, plant growth regulators, and livestock feed additives. For animals, it means that they were reared without the routine use of antibiotics and without the use of growth hormones. In most countries, organic produce must not be genetically modified. Organic farming is now gaining popularity and is being accepted by people all over the world. A growing consumer market is naturally one of the main factors encouraging farmers to convert to organic agricultural production. Increased consumer awareness of food safety issues and environmental concerns has contributed to the growth in organic farming over the last few years (Sumner 2005).

Recently, organic foods are becoming much more widely available. Entering the twenty-first century, there emerged the "back to nature" lifestyle where people became more aware of the negative impact of *chemo-sy*nthetic inputs. Therefore, organic farming became one of the alternatives to the new lifestyle. The consumer preference to organic products had increased its demand, and consequently, organic farming continued to develop in the country. Especially, organic farming systems in Indonesia that had farmers characteristic are small farmer with large cultivation area less than 0.25 ha each and lack of technology information access and networking (Suleman 2007). Based on this situation and condition, the consumers demand for safety and healthy product and its concern to sustainable environment (eco-labeling attributes) has become a basic rationale to the Government of Indonesia to develop organic farming system and use it as an alternate agriculture to increase food production and food safety. All the regulations are contained in the Guidelines for Certification of Organic Farming.

Jahroh (2010) declared that the organic farming movement in Indonesia started in 1984 through the establishment of Bina Sarana Bakti (BSB) Foundation as the center for organic agriculture development by Rev. Agatho Elsener. It is the first organic farming training center in Indonesia that has trained more than 10,000 farmers and organizations all over the country. From 1985 to 1990, Integrated Pest Management (IPM) program was largely conducted, especially in rice farming. This program had decreased the use of pesticide up to 90%. In 1990, the first network of farmer and fishery group, SPTN-HPS, was founded in Jogjakarta. Afterward, the first Indonesian Organic Agriculture Network (JAKERPO) was established in 1998 by Biotani PAN Indonesia, SPTN-HPS, Konphalindo, PPLH Seloliman, and Gita Pertiwi during Organic Agriculture Workshop supported by International Federation for Organic Agriculture Movements (IFOAM).

2.3 Conventional Farming of Citrus in Indonesia

Orange is one kind of annual fruit crops that are widely cultivated in Indonesia. Citrus plants are generally grown in the highlands to the middle plains. Citrus is one of the important fruits in Indonesia, and its production increased from 449.5 thousand tons in 1999 to 2.5 million tons in 2006, although slightly decreased to 2.2 million tons in 2009. The condition causes the orange crop to be one option that can increase farmers' commodities in Indonesia. Oranges are considered beneficial because the selling price is quite high (Ahmada et al. 2011).

Many types of oranges that have become processed products in Indonesia, even in some areas, declared citrus plants can provide benefits for citrus farmers in the plantation area. Citrus is one of the horticultural commodities which have priority to be developed, because the farming of citrus provides high gain, so it can be used as generating fund or source of farmers income. Several kinds of citrus include *Citrus sinensis*, *Citrus reticulata*, *Citrus nobilis*, *Citrus maxima* Merr, *Citrus grandis Osbeck, Citrus aurantifolia* Swingle, and *Citrus limon* Linn. The highest production is *Citrus sinensis* L. The citrus commodity achieved an average profit of IDR 16,037,449.17/year. Achievement of these advantages can be as an indicator of the abundance of citrus production in Indonesia (Bappenas 2000).

Recently, citrus production has decreased in many regions, but the production of citrus has declined more than 50%. The condition causes citrus growth failure due to the pest attack. One pest that attacks citrus crops is *Diaphorina citri* (Homoptera: Psyllidae). *Diaphorina citri* is the major insect pests of citrus, their role as a vector of Citrus Vein Phloem Degeneration (Wijaya et al. 2010).

The majority of agricultural systems in Indonesia still apply conventional farming systems. The use of chemical fertilizers and synthetic pesticides, also the application of non-organic farming systems in the short term is economically beneficial, but there are negative impacts on the surrounding environment. The conventional farming systems will lead to declining agricultural production. Conventional farming is usually contrasted to organic farming, as this responds to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity. It also causes land degradation with the loss of soil fertility, damage vegetation in the environment, and environmental pollution caused by hazardous substances from chemical pesticides (USDA 2005). Conventional agriculture is marked by the use of synthetic fertilizers and pesticides intensively. Conventional agriculture is marked by the use of synthetic fertilizers and pesticides intensively. Conventional farming can provide a very detrimental impact such as environmental pollution, pesticide residues, human health impairment, reduced useful organisms, pests become resistant to pesticides, and resurgence. The use of synthetic fertilizers may increase some types of nutrients but interfere with absorption of other nutrients and nutrient balance in the soil. Synthetic fertilizers also suppress the growth of soil microbes that cause a reduction in soil humus (Sudana 2003).

3 Impact Using Various Chemical Pesticides Toward Diversity of Arthropods

3.1 Arthropod Diversity as Affected by Agricultural Managements (Organic and Conventional Farming), Plant Species, and Landscape Context

Biological diversity has emerged in the past decade as a key area of concern for sustainable development. It provides a source of significant economic, esthetic, health, and cultural benefits. It is assumed that the well-being and prosperity of earth's ecological balance as well as human society directly depend on the extent and status of biological diversity. Generally, it is assumed that higher biodiversity results in higher productivity for biomass. In the tropics, where the climate is warmer, wetter, and less seasonal, biodiversity is richer, compared to temperate and polar regions. Latin America, the Caribbean, Asia, and the Pacific together host 80% of the ecological mega-diversity of the world. Consequently, biodiversity is, to a large degree, influenced by man, as changes in agro-biological management will influence biodiversity in such countries overall. Threats to global biodiversity, including loss of animal or plant biodiversity, occur in many parts of the world, and this often occurs rapidly. It can be measured by loss of individual species, groups of species, or decreases in the numbers of individual organisms. In a given location, the loss will often reflect the degradation or destruction of a whole ecosystem. According to the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA 2003), habitat loss is the greatest, most serious of all threats to biodiversity. The introduction of non-native species and genetic stock is a major threat to biodiversity.

Some researchers said that agricultural practices also influence terrestrial and aquatic biodiversity within and around agricultural fields (Tilman 1999; Tilman et al. 2002). Fertilizers, pest control chemicals, tillage, and even crop rotation still have an impact on the biodiversity of agricultural ecosystems (Beringer 2000; Ross et al. 2002). The study about correlation between arthropod diversity and agricultural management observed by Boutin et al. (2009) showed that beneficial and phytophagous arthropod abundance differed between organic and conventional sites (only with sweep net) but family richness did not. Beneficial arthropods were more abundant in woody hedgerows, while phytophagous arthropods were more abundant in crop fields. This study also demonstrated a strong relationship between plant and arthropod composition. Habitats (total old field cover, total hedgerow length, and Shannon diversity index, all within 250 m radius) in the surrounding landscape influenced arthropod composition but were not leading factors in explaining richness and abundance. It is therefore of prime importance to consider both local factors (management practices and local vegetation) and regional factors such as landscape features as explanatory variables when attempting to explain biodiversity.

3.2 Community Structure of Arthropods in the Citrus Conventional Systems: A Case Study of Citrus Farming at Selorejo Village, Malang

Recently, Malang city is one of the tourist destinations. There are many attractions including agro-picking oranges in the villages Selorejo, Dau, Malang. Citrus is a major commodity in the village Selorejo. Data agriculture department in 2009 showed that the national citrus production reached 2.5 million tons per year (Cahyana 2009). Commodity crops, horticulture, and livestock are something in deficit up to 2012. Export target was not achieved due to the implementation, and realization is very small compared with the potential of national (Ministry of Agriculture) in 2014. The government hopes that the crop can improve the public incomes. In addition, it is encouraging farmers to use pesticides to achieve the maximum harvest as they expected. There *was can be* seen in the citrus orchad at Selorejo Village. Citrus orchard management is quite easy because of good harvests depend on routine pesticide spraying (Taufiqurrohman 2015). There are more than 10 kinds of pests that can cause damage to trees or citrus fruits, for example, fruit flies, fleas scales, aphids, and caterpillars (Marpaung et al. 2014). Pesticides would be reducing the ecological functions of the area. The impact of these pesticides will lead to loss of functions ecology that is no longer a balance between flora and fauna surrounding citrus groves. Changes in plantation caused the loss of ecosystem biodiversity especially in the agricultural sector. The use of chemicals has a major impact on soil organisms. Agricultural activity contains a lot of negative effects because it causes changes in the structure of the soil, temperature, humidity, and soil organic matter content which led to a reduction in arthropods abundance.

Arthropods that live in soil have a very vital role in the food chain, especially as decomposers, because without this natural organisms will not be able to recycle organic materials. In addition, arthropods also serve as prey for other smaller predators, so it will sustain other arthropods. As a consequence of micro-arthropod community structure will reflect the environmental factors that affect the soil, including human activity (Lavelle et al. 2006).

One study already investigated in conventional farming of citrus at *Selorejo V*illage. The purpose of this study is to identify the structure of arthropod community and determine the stability of the environment in citrus orchards with conventional systems. Observations already conducted before the citrus harvest season (April to September 2015) at the Selorejo Village, Malang Regency. Arthropod diversity was observed by visual encounter and pan trap methods. Observation of arthropods was also carried out with pitfall traps methods. Repetition is done three times before harvest. The results of pitfall traps and yellow traps indicated that there are three classes of arthropods (Insecta, Myriapoda, and Diplura), 7 orders and 21 families were found prior to spraying. There are 3 classes, 7 orders and 20 families of arthropods after spraying. After spraying insecticides on citrus crops showed that there was a decrease in the abundance of insects around the plantation. Myriapoda and Diplura can be found before spraying but after spraying did not find anymore. Before spraying, the citrus crop obtained 5 orders, 11 families of arthropods and in the refugia found 8 orders, 19 families of arthropods while after spraying, there was decline. Actually, the result of observation only found 5 orders, 7 families of arthropods but on refugia increased to 9 orders, 20 families of arthropods. It can be assumed that before spraying, so many arthropods exist in citrus plants, but when citrus are sprayed with insecticides that some arthropods are moved and hidden to refugia to avoid odors and toxins from insecticides. The abundance of insects was found in conventional farming at Selorejo Village. Before spraying pesticides and after spraying pesticides are shown in Table 3.

Figure 1 showed that the diversity index of soil arthropod decreases after spraying pesticides, but this did not happen on terrestrial arthropods. This is because of soil arthropods trapped, and they cannot run after spraying; consequently, these arthropods die into the trap. As for arthropods that live on land, it is easier to fly to avoid spraying and after spraying will come again.

3.3 Relationship Between the Diversity of Arthropods and Excessive Use of Pesticides

It was long ago presented by Berry et al. (1996) that modern agriculture has often created conditions favorable for pest populations, but inimical to those of beneficial arthropods. Heavy reliance on synthetic insecticides and herbicides over the last 40 years has been a significant factor in the decline of some invertebrate natural enemy populations in agricultural systems. In contrast, organic farming involves production systems which avoid or largely exclude the use of synthetic fertilizers, pesticides, growth regulators, and livestock feed additives. It has been established

Table 3 The abundance of arthropods at the citrus orchard

Class	Ordo	Family	The average arthropods (indv.)	
			Before spraying	After spraying
Insects	Diptera	Drosophilidae	48.3	98.5
		Tipulidae	2.0	0.5
		Cecidomyiidae	0.7	0
		Culicidae	43.3	8.5
		Antomizae	1.0	0.5
		Tiphiidae	17.0	1
		Chironomidae	0.0	26.5
		Bibionidae	2.0	12.5
		Tephritidae	4.5	2
		Muscidae	2.0	1.5
	Coleoptera	Scarabidae	2.7	5.5
		Dermestidae	24.5	65.5
		Dytiscidae	0.0	2.5
		Coccinellidae	32.0	7
		Curculionidae	1.3	2.5
		Ichneumonidae	1.0	0
		Stapylinidae	4.0	0.5
		Chrysomelidae	13.0	3
	Orthoptera	Blattidae	1.3	0.5
	Hymenoptera	Formicidae	13.7	29
	Hemiptera	Delphacidae	1.5	0
		Gerridae	1.0	0.5
	Dermaptera		1.3	0.5
	Lepidoptera	Pyralidae	1.0	0
		Ceratomimidae	0.0	1.5
Myriapoda			0.3	0
Diplura			1.0	0

by some authors that "organic" farming methods can lead to higher populations and species diversity of beneficial arthropods.

The comparison between the abundance and diversity of ground beetles (Coleoptera: Carabidae) by using pitfall traps on four pairs of conventional and organic farms in the USA showed that all pairs of farms had similar soil types and cropping histories, but differed in that one farm in each pair was managed conventionally, the other organically. Eight hundred and twenty-five carabid individuals were collected over three sampling periods, although the bulk of the data was collected during one period only. Organic farms had significantly higher numbers of carabid beetles and also had about twice the number of carabid species compared with conventional farms, but the two farm types had approximately the same level of community diversity as measured by the Shannon-Wiener index. Kromp (1989)

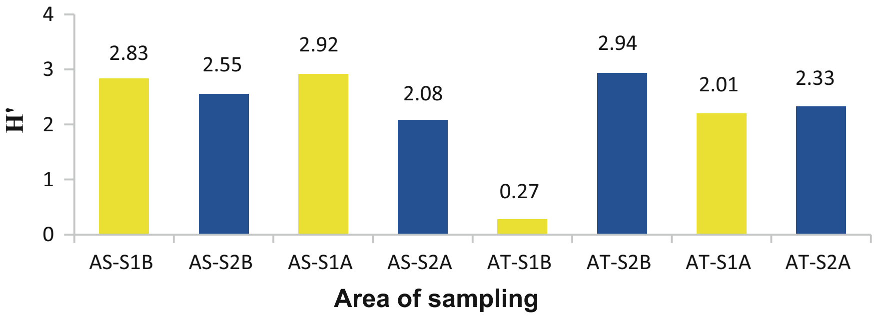

Fig. 1 Diversity index of arthropods at the citrus orchard (Gama et al. 2015). *Note* AS-S1B = the soil arthropods before spraying of insecticides (Plot 1), AS-S2B = the soil arthropods after spraying of insecticides (Plot 1), AS-S1A = the soil arthropods before spraying of insecticides (Plot 2), AS-S2A = the soil arthropods after spraying of insecticides (Plot 2), AT-S1B = the terrestrial arthropods before spraying of insecticides (Plot 1), AT-S2B = the terrestrial arthropods after spraying of insecticides (Plot 1), AT-S1A = the terrestrial arthropods before spraying of insecticides (Plot 2), AT-S2A = the terrestrial arthropods after spraying of insecticides (Plot 2)

also studied carabids in relation to organic/conventional agriculture and showed that the abundance and species number of this group of beetles, caught in pitfall traps, was considerably higher in "biological" (equivalent to organic) winter wheat than in conventional wheat. Some "farming systems" studies have also shown that populations of carabids and other beneficial arthropods are higher under some low-input (though not organic) regimes compared to high-input regimes (Booij and Noorlander 1992; Berry et al. 1996).

4 Conclusions

The majority of farmers in Indonesia are still applying conventional farming system because the farmers expect harvests quickly so that it can immediately reap the financial benefits. Some communities already knew the negative effects toward application of excessive pesticide on the surrounding environment, especially the effects on the diversity of arthropods. Organic farming systems are more effective than conventional systems because the system can minimize the use of pesticides, thereby reducing the expenditure of funds for the purchase of pesticides. In addition, conventional systems can lead to decreased diversity of arthropods from the use of pesticides that regardless of the dose.

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