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VEGETATION DIVERSITY AND INTENSITY OF PLANT PESTS AND DISEASES IN TWO POLYCULTURE SYSTEMS IN TANGGAMUS DISTRICT

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ABSTRACT

Vegetation diversity and intensity of plant pests and diseases in two polyculture systems in Tanggamus District. The vegetable crop management cannot be separated from infestation of plant pest and disease which influences the quality and quantity of crop yield. The pest organism development is influenced by agroecosystem. The objective of this research was to analyze vegetation diversity and intensity of pest and disease in Tanggamus District. Methods used in this research were analysis of vegetation diversity based on Shannon index, percentage of pests damage and diseases incidence. The results showed that the vegetation diversity in polyculture of agriculture typology were 11 plant species with diversity index of 0.64; while in polyculture of agroforestry typology there were 11 plant species with diversity index of 0.74 and both of these indices were less than 1 (H' < 1). The percentage of pests damage in the polyculture of agriculture larger than polyculture of agroforestry typology ranging from 7.20% to 81.67% and 3.04% to 26.67% respectively. While the incidence of disease in polyculture of agriculture ranging from 0.65% up to 100% and polyculture of agroforestry typology 0.65% up to 68.00%.

Key words: polyculture of agriculture, polyculture of agroforestry, Shannon Index

ABSTRAK

Keanekaragaman vegetasi dan intensitas hama dan penyakit tanaman sayuran pada dua sistem polikultur di Kabupaten Tanggamus. Pengelolaan tanaman sayuran tidak terlepas dari adanya gangguan oleh organisme pengganggu tanaman yang berdampak terhadap kualitas dan kuantitas produksi sayuran yang dalam perkembangan organisme tersebut dipengaruhi oleh agroekosistem. Tujuan penelitian ini adalah menganalisis keanekaragaman vegetasi tumbuhan dan besarnya serangan hama dan penyakit tanaman pada tanaman sayuran di Kabupaten Tanggamus. Metode penelitian yang digunakan yaitu analisis keanekaragaman vegetasi berdasarkan indek Shannon, persentase serangan hama dan kejadian penyakit. Hasil penelitian menunjukkan keanekaragam vegetasi di tipologi polikultur pertanian tercatat 11 species tumbuhan dengan indek keanekaragaman vegetasi sebesar 0,64; sedangkan pada tipologi polikultur agroforestri tercatat 11 species tumbuhan dengan indek keanekaragaman sebesar sebesar 0,74 yang keduanya lebih kecil dari 1 (H' < 1). Intensitas serangan hama dan kejadian penyakit tanaman pada tipologi polikultur pertanian lebih besar dibandingkan polikultur agroforestri dengan kisaran hama sebesar 7,20% sampai 81,67% berbanding 3,04% sampai 26,67% dan penyakit antara 0,65% sampai 100% berbanding 0,65% sampai 68,00%.

Kata kunci: indeks Shanon, polikultur pertanian, polikultur agroforestri

INTRODUCTION

An agricultural typology or landscape has different aesthetical qualities from one to another. This depends on diversity of plant types to cultivate. Polyculture of agriculture and agroforestry are examples of differences of agricultural diversity types. These two types of culture have roles not only at production aspects, but also in other environment aspects including diversity of pests and plant pathogens. Diversity, which is all compositions of types of plants, animals, and microorganisms interacting in a particular ecosystem is very influential in determining agriculture productivity level. Diversity in an agricultural landscape attracts attentions from many experts, because it contributes significantly to the agriculture productivity, food sustainability, financial profit, and conservation of nature (Liu *et al.*, 2013).

Plant diversity in an agroecosystem can reduce the effects of pest and diseases through some ways both individually and in combinations, including some effects of pest oppression in visual and pest smelling ways, disorders in pest life cycles, reducing inoculums because there is no host plant, antagonist mechanism, the plant physiology resistance because sufficiency of plant nutrients, natural predator conservation, and agricultural landscape effects such as physical barriers and micro climate changes (Ratnadass *et al*., 2012). Global practices of diversity are familiar to agriculture people, because the agriculture activity covering 25-30% areas in the world is an important activity influencing diversity.

There is a correlation between agroecosystem diversity and pest disease incidence with indicators such as level of pests/disease incidence, low productivity, and pesticide residue. Some research results showed that agrochemical treatments (especially pesticide an fertilizer) had caused problem social and environmental changes (Altieri *et al*., 1984; Altieri, 1999; Scherr*et al*., 2008). Agricultural and forestry environment managements are keys for conservation of diversity which significantly improve richness and abundances of species, while tree able to reduce able to improve pest, pathogen incidence, and also to provide ecology services in strengthening beneficial insects (Batary *et al.*, 2011; Tomback *et al*., 2016; Aluja *et al*., 2014).

Agriculture systems in developing countries with relatively small sizes of land provide opportunities to reduce effects of pest and disease through practices of increase diversity. This method is very important in conducting sustainable agriculture system (Simon *et al.*, 2010, Muniappan & Heinrichs, 2014). The objective of pest management is to contribute agriculture sustainability with some different aspects such as food sustainability, balanced relationship between human and ecosystem, and ecosystem conservation. The agroecosystem diversification efforts often reduce negative effects of modern agriculture or agricultural industry (Timprasert *et al*., 2014; Gurr *et al*., 2013; Savary *et al*., 2012). Agriculture landscape is representation of habitat including plants, forests, wet lands, and grass land. The diversity of vegetation can serve the dynamics of pest and natural enemy (Philpott, 2013).

The objective of this research was to analyze the vegetation diversity and the damage of pests and the incidence of disease vegetable crop in Tanggamus District Lampung Province.

MATERIALS AND METHODS

Study Site. This research was conducted in Gisting and Sumberejo Subdistrict, Tanggamus District Lampung Province and Laboratory of Plant Pests and Disease of Faculty of Agriculture, Lampung University, from March to November 2015.

Research Procedure. Data in this research were vegetation diversity, damage of pests and the disease of incidence in some vegetable crops in polyculture of agriculture and polyculture of agroforestry typologies.

This research used quadrant sampling technique. The research locations were taken purposively to represent typology of the regions i.e. the polyculture with crop (polyculture of agriculture) and polyculture with forest tree (polyculture of agroforestry). From each typology, five were selected where plot 400 m^2. From each plot the following variable were observed 1) plant species and numbers, 2) vegetation diversity, 3) intensity of pests damage, and 4) incidence of disease. The vegetation diversity was determined using Shannon's index (Shannon and Wienner in Ludwig & Reynolds, 1988) as follows:

$$H' = \sum_{i=1}^{s} \{ (\frac{n_i}{n}) \ln (\frac{n_i}{n}) \}$$

With:

H' = Shannon's diversity index of vegetatiton in sampled plot

ni = Number of species in plot

n = Total number of plant in plot

s = Total number of plant species observed in the plot

The value of diversity index is defined as folow (1) H' > 3, indicates high diversity high; (2) H' 1 < H' < 3 indicates moderate diversity, and (3) H' < 1 indicates low diversity (Mason & McDonald, 1986).

The intensity of plant pest and incidence of diseasein each sampaled plot was determined with the following equation:

$$P = \frac{n}{N} \times 100\%$$

P = Intensity of pest damage or disease incidence
n = Numbers of plants damaged by pests or disease in plot
N = Total numbers of plants observed in plot

RESULTS AND DISCUSSION

The research was conducted in Gisting Atas Village, Gisting Bawah Village of Gisting Subdistrict, and Wonoharjo Village, Sumber Muyo Village, Simpang Kanan Village of Sumberejo Subdistrict in Tanggamus District, Lampung Province. The site can be reached in ± 2-3 hours by car from the Province capital Bandar Lampung. This site at 600-1000 m above the sea level (asl) with air temperature ranges of 18-28 °C. Geographically Tanggamus District is located at 104°18'-105°12' east longitude and 5°05'-5°56' south latitude, with flat to wavy topographies. The most common vegetation types in these regions area annual plants such as rice and horticultures and perennial plants such as cacao and coffee. There is a conservational forest in the Tanggamus mountain slopes and this is integrated to Conservational Forest Management Unit (or KPHL) of North Kota Agung area, Lampung Province. The forest site is located in the vicinity of local state crop area and the site is managed jointly by the local community and local goverment ini form community forest or public forest (or Hkm). This public forest has poor road acces. It only footpaths where farmers can walk along or drive their motorcyle. Meanwhile the agricultural fields in the sitewith relatively flat topography were owned and cultivated by local farmers. Infrastructures like roads, drainages, irrigation, and electricity are available in this agricultural part of the site. The summary of research site presented in Table 1.

Table 1. Summary of information abaout research site

Plot	Villages	Location Coordinate (GPS)		Elevation	Kinds of plants
		South latitude	East longitude	(asl, M)	
1	Gisting Bawah, Gisting	05˚.25'.30,4"	104˚.43'.56,5"	512	Chili, cabbage, mung bean, green mustard, eggplant, tomato
2	Simpang Kanan, Sumberejo	05˚.23'.23,3"	104˚.43'.09,5"	536	Chili, mung bean, cabbage, rice
3	Sumber Mulyo, Sumberejo	05˚.22'.21,1"	104˚.43'.10,5"	490	Chili, mung bean, eggplant, rice, burflower-tree, papaya, banana, chinaberry
4	Wonoharjo, Sumberejo	05˚.22'.21,1"	105˚.23'.16,4"	496	Tomato, cabbage, mung bean, yardlong bean, chili, eggplant, rice, coconut, chinaberry
5	Gisting Atas, Gisting	05˚.26'.39,7"	104˚.43'.42,4"	568	Tomato, clove, banana, coconut, chinaberry, nutmeg, papaya
6	Gisting Permai, Gisting	05˚.27'.12,9"	104˚.42'.56,7"	600	Eggplant, burflower-tree, white teak, nutmeg, papaya, cacao, rubber, chinaberry, coffee
7	Gisting Atas, Gisting	05˚.26'.05,9"	104˚.42'.22,3"	767	Chili, cabbage, tomato, green mustard, nutmeg, banana, mahogany, coffee, bitter bean, teak, chinaberry, avocado
8	Gisting Atas, Gisting	05˚.26'.06,7"	104˚.42'.10,5"	806	Green mustard, welsh onion, cabbage, chili, rubber, banana, bamboo, cacao, coffee, chinaberry, papaya
9	Gisting Atas, Gisting	05˚.26'.00,1"	104˚.42'.09,1"	842	Chili, cabbage, green mustard, banana, mahogany, chinaberry, white lead tree, medang, pule
10	Gisting Atas, Gisting	05˚.25'.54,8"	104.42'.03,2"	900	Cabbage, eggplant, welsh onion, banana, pea, mahogany, pule, coffee, sugar palm, avocado, papaya

The average air temperature were 24.8 °C and 22 °C for polyculture of agriculture typology and for polyculture of agroforestry typology with relative humidity of 88.4% and 90.6% respectively.

Vegetation Diversity. There were 11 species in polyculture of agriculture typology with 13,564 individual plants (Table 2). Shannon's diversity index showed the polyculture of agriculture was H' < 0.1. Only in Gisting Bawah Village that H' > 1. Shannon's diversity index in all polyculture of agriculture plot was 0.64. This value indicated that the diversity in these regions was low. The lower the diversity index is in a particular location, then the lower the productivity.

There were 11 species with 5,373 individual plants in polyculture of agroforestry field; they were vegetables such as mung bean, nutmeg, and green mustard, and plants such as *khailendra, mindi*, and mahogany. Shannon's diversity index in all polyculture of agriculture plot was 0,74. In addition, in the polyculture of agroforestry locations there were other plant types such as bitter bean, coffee, nutmeg, *ranti*, and papaya (Table 3). The diversity index in this polyculture of agroforestry typology was under 1 ($H \leq 1$), and this indicated that these locations had low diversity (Mason & McDonald, 1986). However, the diversity index of polyculture of agroforestry site was higher than polyculture of agriculture site (0.74 > 0.64) (Table 2). At least, these low diversity index need serious attention, not only both in ecology and economy considerations, but aslo for their existences and management of sustainability.

The vegetation diversity index in the research locations varies but under 1 (H' < 1) and this indicates a low diversity. This low diversity makes it susceptible to pest intensity or disease incidence. Increasing habitat diversity can increase abundance of natural enemies and their effectiveness to overcome the pest. Higherplant diversity provide alternative hosts, nectars and pollens for adult parasitoids and predators, protect nests and maintain pest population in lower number (Altieri, 1993).

Pests Damage Charateristic and Vegetation Diversity Index. The pests damage rate in vegetables with polyculture of agroforestry typology was averagely lower than polyculture of agriculture typology. The pests found were diamondback moth (*Plutella* sp.), aphids (*Aphis* sp.), whitefly (*Bemisia* sp.), cabbage cluster caterpillar (*Crocidolomia* sp.), fruit fly (*Bactrocera* sp.), corn earworm (*Helicoverpa* sp.), and armyworms (*Spodoptera* sp.) in cabbage has highest pests damage intensity of 47.2%, while white mustard only had one type of pest, diamond back moth (*Plutella* sp.), with 7.2% pests damage (Table 4).

Pests damage intensity on polyculture of agroforestry typology was lower than that polyculture of agriculture typology. Chili and tomato had highest pests damage intensity (13.6% and 11.8%), while green mustard and currant tomato (*rampai*) had no pests damage. A possible reason for the lower pests damage

Table 2. Plant and diversity index in polyculture of agriculture and agroforestry typologies in Tanggamus District

Location code	Village, Sub district	Individual numbers	Plant species numbers	Plant diversity Index (H')
Polyculture of agriculture plot				
A1	Gisting Bawah, Gisting	2045	5	1.04
A2	Simpang Kanan, Sumberejo	1565	4	0.71
A3	Sumber Mulyo, Sumberejo	3187	2	0.59
A4	Wonoharjo, Sumberejo	5363	3	0.16
A5	Gisting Atas, Gisting	1804	5	0.70
	Total	13,964	11	0.64
Polyculture of agroforestry plot				
F1	Gisting Permai, Gisting	215	5	1.09
F2	Gisting Atas, Gisting	1160	6	0.91
F3	Gisting Atas, Gisting	2308	3	0.73
F4	Gisting Atas, Gisting	182	4	0.91
F5	Gisting Atas, Gisting	1508	2	0.06
	Total	5373	11	0.74

Table 3. Vegetation in various polyculture of agriculture and agroforestry typologies in Tanggamus District

Family	Polyculture of agriculture site		Diversity index (H')	Family	Polyculture of agriforestry site		Diversity index (H')
	Common name	Species Latin name			Common name	Species Latin name	
Polyculture of agriculture 1				Polyculture of agroforestry 1			
Brassicaceae	Green mustard	*Brassica chinensis*		Fabaceae	Mung bean	*Phaseolus radiatus*	
Fabaceae	Mung bean	*Phaseolus radiatus*		Palmae	Coconut	*Cocos nucifera*	
Solanaceae	Cabai	*Capsicum annum*	1.04	Meliaceae	Chinaberry	*Melia azedarach*	1.09
Solanaceae	Currant tomato	*Solanum lycopersicum*		Meliaceae	Mahagony	*Swietenia mahagoni*	
Convolvulaceae	Sweet potato	*Ipomoea batatas*		Rubiacea	Burflower- tree	*Anthocephalus cadamba*	
Caricaceae	Papaya	*Carica papaya*		Lauraceae	Avocado	*Persea americana*	
Polyculture of agriculture 2				Polyculture of agroforestry 2			
Fabaceae	Yardlong bean	*Vigna unguiculata*		Fabaceae	Yardlong bean	*Vigna unguiculata*	
Solanaceae	Chili	*Capsicum annum*		Brassicaceae	Mung bean	*Brassica chinensis*	
Musaceae	Banana	*Musa paradisiaca*		Coffea	Coffee	*Coffea arabica*	
Arecaceae	Palm	*Chrysalidocarpus lutescens*	0.71	Meliaceae	Mahagony	*Swietenia mahagoni*	0.91
				Meliaceae	Chinaberry	*Melia azedarach*	
				Myristicaceae	Nutmeg	*Myristica fragrans*	
				Fabaceae	Bitter bean	*Leucaena leucocephala*	
				Meliaceae	Papaya	*Carica pepaya*	
Polyculture of agriculture 3				Polyculture of agroforestry 3			
Solanaceae	Eggplant	*Solanum melongena*		Solanaceae	Currant tomato	*Solanum lycopersicum*	
Fabaceae	Mung bean	*Phaseolus radiatus*	0.59	Brassicaceae	Green mustard	*Brassica chinensis*	0.73
				Meliaceae	Mahagony	*Swietenia mahagoni*	
				Meliaceae	Chinaberry	*Melia azedarach*	
Polyculture of agriculture 4				Polyculture of agroforestry 4			
Brassicaceae	Cabbage	*Brassica oleracea*		Brassicaceae.	Tomato	*Solanum lycopersicum*	
Brassicaceae	Green mustard	*Brassica chinensis*		Myristicaceae	Nutmeg	*Myristica fragrans*	0.91
Solanaceae	Chili	*Capsicum annum*	0.16	Meliaceae	Chinaberry	*Melia azedarach*	
Solanaceae	Eggplant	*Solanum melongena*		Meliaceae	Mahagony	*Swietenia mahagoni*	
Myristicaceae	Nutmeg	*Myristica fragrans*		Dipterocarpaceae	Meranti	*Shorea leprosula*	
Polyculture of agriculture 5				Polyculture of agroforestry 5			
Solanaceae	Tomato	*Solanum lycopersicum*		Brassicaceae	Tomato	*Solanum lycopersicum*	
Liliaceae	Welsh onion	*Allium fisulosum*		Brassicaceae	Green mustar	*Brassica chinensis*	
Caricaceae	Papaya	*Carica papaya*	0.70	Meliaceae	Mahagony	*Swietenia mahagoni*	0.06
Palmae	Coconut	*Cocos nucifera*		Meliaceae	Chinaberry	*Melia azedarach*	
Musaceae	Banana	*Musa paradisiaca*					

Table 4. Crop pest damage in polyculture of agriculture and agroforestry typologies in Tanggamus District

Location code	Type of plant	Kinds of pests	Species	Pests damage (%)
Polyculture of agriculture				
A1	White mustard	Diamondback moth	*Plutella* sp.	7.2
	Mung bean	-	-	
	Chili	-	-	
	Currant tomato	-	-	
A2	Yardlong bean	Aphids	*Aphis* sp.	81.7
		Pod borer	Lepidoptera	10.6
	Chili	Whitefly	*Bemisia* sp.	32.9
A3	Eggplant	-	-	-
	Mung bean	Diamondback moth	*Plutella* sp.	67.0
		Cabbage cluster caterpillar	*Crocidolomia* sp.	18.7
A4	Cabbage	Diamondback moth	*Plutella* sp.	63.0
		Cabbage cluster caterpillar	*Crocidolomia* sp	63.0
	Green mustard	-	-	
	Chili	Aphids	*Aphis* sp.	31.4
		Whitefly	*Bemisia* sp.	31.4
A5	Tomato	Fruit fly	*Bactrocera* sp.	12.6
		Corn earworm	*Helicoverpa* sp.	10.3
		Whitefly	*Bemisia* sp.	12.6
	Onion leaf	-	-	-
Polyculture of agroforestry				
F1	Mung bean	Diamondback moth	*Plutella* sp.	8.8
F2	Currant tomato	-	-	-
	Green mustard	-	-	-
F3	Tomato	Whitefly	*Bemisia* sp.	9.0
		Corn earwarm	*Helicoverpa* sp.	5.0
		Fruit fly	*Bactrocera* sp.	20.0
F4	Currant tomato	Armyworms	*Spodoptera* sp.	6.0
		Corn earworm	*Helicoverpa* sp.	3.0
F5	Chili	Trips	*Trips* sp.	3.0
		Armyworms	*Spodoptera* sp.	11.0
		Whitefly	*Bemisia* sp.	27.0

on polyculture of agroforestry was that agroecosystem might be stable so that it was able to facilitate better activities of natural enemies which in enable them control and maintain pest population at low number.

The differences of seasons and population dynamics influence insects in different habitats which change over time and according to development stages (Teodore *et al.,* 2008). Natural vegetation is able to promote natural enemy diversity with varying effects; the same agroecosystem can explain some pests which are more influential than others in a more complex landscape (Henri *et al*., 2015).

The agroforestry landscape perspective enables knowledge transfer between farmers on agronomy and ecology in participative approach to help driving a management which balances economy and ecology needs (Tscharntke *et al*., 2011). Polyculture of agriculture reduces ecological sustainability of land use system, while environment change and extreme climate require higher quality responses than ever. Adaptation strategies to environment changes such as cultivating shady trees and field conversion type are common practices to improve sustainability against environment changes. Polyculture of agriculture pattern in a wide overlay is a good for plant growth and development as well as for pest migration from one place to another. A uniformed cultivar in a wide field creates the same situations with effects of interactions of pest, pathogen, and plant growth (Altieri & Nichollas*,* 2004).

The vegetation diversity index in polyculture of agriculture system ranged 0.59-1.26; while in polyculture of agroforestry system the vegetatiaon diversity index ranged 0.73-1.09 (Table 5). The diversity index value is lower than criteria to use; under 1 (H'< 1). Lower diversity index value means lower productivity as indications of severe ecology pressure and unstable ecosystem. Mason & McDonald (1986) suggests that in diversity index value is lower than 1, it means low diversity. If it is around 1-3, it means moderate diversity, and more than 3 means high diversity. The low diversity index in the locations are caused by the facts that the field is continually planted, with low supply of soil nutrients, excessive sun rays, and few water supply, which make trees are difficult to grow in these areas.

Charateristic of Disease Incidence and Vegetation Diversity Index. The disease incidence rate in polyculture of agriculture typology varies between 1% to 100%, pathogen infection of *Colletotrichum* sp. and *Alternaria* sp. caused 100% disease incidence especially in mung bean. The infections are was low in white mustard, cabbage, eggplant, chili, and their pathogens are *Erwinia* sp*.*, *Plasmidiophora* sp., and *Cersospora* sp. The only vegetable crop free from disease is leek, and the highest rate of disease occurred in tomato.

The disease incidence in vegetable crop in polyculture of agroforestry typology is lower than in polyculture of agriculture typology range 0.65% to 100% versus 0.67% to 68.00%. The highest disease incidence is in tomato and chili, while the lowest is in currant tomato vegetable (Table 6).

Each typology has different diversity index and disease incidence rate and polyculture of agroforestry have higher diversity index than polyculture of

Table 5. Vegetation diversity index (H') and pests damage percentage for vegetable crop in Tanggamus District

Location code	Village, Sub district	Vegetation diversity index (H')	Ranges of pest damage (%)
Polyculture of agriculture			
A1	Gisting Bawah, Gisting	1.26	0.00-7.20
A2	Simpang Kanan, Sumberejo	0.71	10.64-81.67
A3	Sumber Mulyo, Sumberejo	0.59	18.74-66.99
A4	Wonoharjo, Sumberejo	0.83	31.36-62.99
A5	Gisting Atas, Gisting	0.70	10.32-12.59
Polyculture of agroforestry			
F1	Gisting Permai, Gisting	1.09	0.00-8.83
F2	Gisting Atas, Gisting	0.91	0.00-0.00
F3	Gisting Atas, Gisting	0.73	5.08-19.92
F4	Gisting Atas, Gisting	1.01	2.50-6.41
F5	Gisting Atas, Gisting	0.75	3.04-26.67

Table 6. Types diseases and incidence in some vegetable crops in polyculture of agriculture and agroforestry typologies in Tanggamus District

Location code	Kinds of plant	Disease	Pathogen	Disease incidence (%)
Polyculture of agriculture				
A1	White mustard	Leaf blight	*Erwinia* sp.	6.24
		Clubroot	*Plasmodiophora* sp.	0.65
		Leaf spots	*Xanthomonas* sp.	1.91
	Mung bean	Anthracnose	*Colletotrichum* sp.	100.00
		Black spot leaf	*Alternaria* sp.	100.00
	Chili	Leaf curl	*Curly virus*	5.33
		Yellow leaf	*Gemini virus*	1.34
	Currant tomato	-	-	-
A2	Yardlong bean	Black spot leaf	*Uromyces* sp.	10.90
		Cowpea witches-broom	*Cowpea witches-broom virus*	2.05
	Chili	Anthracnose	*Colletotrichum* sp.	100.00
		Leaf curl	*Curly virus*	100.00
A3	Eggplant	Leaf spot	*Cercospora* sp.	3.70
		Water molds	*Phytophthora* sp.	1.00
	Mung bean	Anthracnose	*Colletotrichum* sp.	20.00
		Black spot leaf	*Uromyces* sp.	80.00
A4	Cabbage	Leaf spot	*Cercospora* sp.	1.26
		Clubroot	*Plasmodiophora* sp.	1.51
	Green mustard	Clubroot	*Plasmodiophora* sp.	0.50
		Leaf blight	*Erwinia* sp.	2.83
	Chili	Leaf curl	*Curly virus*	33.90
		Yellow leaf	*Gemini virus*	16.95
A5	Tomato	Anthracnose	*Colletotrichum* sp.	78.00
		Leaf spots	*Cercospora* sp.	68.00
		Soft rot	*Phytophthora* sp.	100.00
	Leek	-	*Erwinia* sp.	-
Polyculture of agroforestry				
F1	Mung bean	Black spot leaf	*Uromyces* sp.	5.00
F2	Currant tomato	-	-	-
	Green mustard	Leaf blight	*Erwinia* sp.	2.34
F3	Tomato	Leaf spot	*Cercospora* sp.	16.02
		Black spot leaf	*Uromyces* sp.	10.81
		Anthracnose	*Colletotrichum* sp.	40.00
F4	Currant tomato	Leaf spot	*Cercospora* sp.	14.06
		Anthracnose	*Colletotrichum* sp.	4.69
F5	Chili	Anthracnose	*Colletotrichum* sp.	68.00
		Yellow leaf	*Gemini virus*	0.67
		Leaf curl	*Curly virus*	2.17

Table 7. Vegetation diversity index (H') and disease incidence in vegetable crop in Tanggamus District

Location code	Village, sub district	Vegetation diversity index (H')	Ranges of disease incidence (%)
Polyculture of agriculture			
A1	Gisting Bawah, Gisting	1.26	0.65-100
A2	Simpang Kanan, Sumberejo	0.71	2.05-100
A3	Sumber Mulyo, Sumberejo	0.59	1.00-80.00
A4	Wonoharjo, Sumberejo	0.83	0.50-33.90
A5	Gisting Atas, Gisting	0.70	68.00-100
Polyculture of agroforestry			
F1	Gisting Permai, Gisting	1.09	0.65-8.83
F2	Gisting Atas, Gisting	0.91	0.00-0.00
F3	Gisting Atas, Gisting	0.73	5.08-19.92
F4	Gisting Atas, Gisting	1.01	2.50-6.41
F5	Gisting Atas, Gisting	0.75	3.04-26.67

agriculture (Table 7). The polyculture of agriculture typology is potentially more susceptible to disease than the polyculture of agroforestry. The agroforestry pattern influences on pest and disease are not only depending on the types of plants, but also depending on other factors including kinds of pests, pest preferences, and micro climate (Tomlinson *et al*., 2015; Pumarino *et al.,* 2015). Structure and landscape heterogeneity tends to influence disease dynamics and distributions and they function as inhibitors to limit pathogen distribution (Plantegenest & Fabre, 2007).

CONCLUSION

The conclusions of this research are that the vegetation diversity in polyculture of agriculture typology were 11 plant species with diversity index of 0.64, while in polyculture of agroforestry typology there were 11 plant species with diversity index of 0.74, and both of these indices were less than 1 (H' < 1). The percentage of pests damage in the polyculture of agriculture larger than polyculture of agroforestry typology the range of 7.20 to 81.67% and 3.04 to 26.67% and the incidence disease in polyculture of agriculture ranged from 0.65 up to 100% and polyculture of agroforestry typology 0.65 up to 68.00%.

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