ARTHROPOD COMMUNITIES IN THREE DIFFERENT AGRICULTURAL PRODUCTION SYSTEMS IN WANG NAM KHIAO, NAKHON RATCHASIMA PROVINCE, THAILAND

Komain Booncher[1] Benyaporn Sornsa[2] Sasitorn Hasin[3*]

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Abstract

Agricultural management has a significant influence on a large proportion of arthropod species, negatively impacting the community structure of arthropods, as reported in modern intensive agriculture. Our research aims to explore differences in arthropod species diversity and abundance between agricultural areas and their surrounding environments under three different agricultural practices and to investigate the relationships between arthropod diversity and local impact factors such as climate and agricultural practices. Arthropod diversity and abundance were sampled using pitfall trapping in three types of agricultural areas and their adjacent zones. In total, 99 morphospecies were identified within the study area. Greater richness values were recorded for the organic farming system (OM) compared to good agricultural practice (GAP) and conventional agricultural sites (CH). The number of species was higher in the inside zones than in the outside zones across all study sites. Significantly higher species richness in the inside zones compared to outside zones was observed at the OH and GAP ($P<0.05$), whereas no significant difference was found at the CH ($P>0.05$). Additionally, in the OM and GAP areas, but not in the CH, these differences suggest that the field edges of agricultural practices can play an important role in maintaining biodiversity in agroecosystems, and this role is related to edge-of-field practices in agriculture.

Keywords: Agroecosystem, Agricultural practice, Agricultural fauna, Biodiversity

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[1] *Assistance Professor, Faculty of Agriculture and Life Sciences, Chandrakasem Rajabhat University, e-mail: komain_b@hotmail.com*

[2] *Researcher, Research and Development Institute, Valaya Alongkorn Rajabhat University under the Royal Patronage, e-mail: benyaporn.sorn@vru.ac.th*

[3] *Assistance Professor, College of Innovative Management, Valaya Alongkorn Rajabhat University under the Royal Patronage, e-mail: sasitorn.ha@vru.ac.th*

* *Corresponding author, e-mail : sasitorn.ha@vru.ac.th*

Introduction

Arthropod species are one of the main components of the agricultural fauna. They have high diversity and abundance, and perform various important ecosystem services in agrarian ecosystems such as pollination, nutrient recycling, changing soil structures, and natural enemy and bioindicator species in habitat change (McLaughlin and Mineau, 1995; Eggleton et al., 2002; Luke et al., 2014; Muvengwi et al., 2017). For example, the abundance and species composition of arthropods change under agricultural management (Brussaard et al., 1997; Rubiana et al., 2015) and agrarian intensification, which results in changes in the physical and chemical properties of the soil (Batary et al., 2012). Previous research has shown that arthropod species such as ground beetles, rove beetles, and ants were highly tolerant of a wide range of environmental conditions from agricultural practices (Büchs, 2003; Luke et al., 2014; Martin et al., 2020) and field margins (Helenius and Bäckman, 2004; Werling and Gratton, 2008; Gallé et al., 2020). The diversity and abundance of arthropods varied in response to environmental stress or other factors. Thus, various groups of soil insects are currently used as a standard in assessing the ecological risks to soil in agricultural production systems (McLaughlin and Mineau, 1995; Büchs, 2003). Over the past by a few centuries, some land that once hosted Thailand's native forests has been changed to agricultural use through human activities such as logging, clearing for agriculture, and natural disasters.

Therefore, a significant part of Thailand's natural agriculture is found in rural landscapes. Through optimizing farm diversification, the agricultural sector has a major type of land management practice such as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or pasture, land under market or kitchen gardens, land temporarily fallow and land abandoned as a result of shifting cultivation after land reclaimed by forest reclamation policy of Thailand. However, there is a clear need to provide easily available guidance based on existing knowledge, best practice and publications inform that a sustainable resource in an agriculture area for increasing economic viability coupled with improving the sustainability of agroecosystem in the medium to long term based on the sustainable development goals (World Wildlife Fund, 2021), which is can be easily understood and rapidly translated into actions by practitioners and stakeholders. Agroecosystems play an important role in integrating biodiversity into various agricultural areas. The sustainability of the regional agroecological economic platform aims to strengthen the link between the business sector and the conservation of agrobiodiversity. This includes the development of best-practice guidance on the main risks, responsibilities, and opportunities for farmers related to nature and biodiversity conservation (World Wildlife Fund, 2021).

Objectives

1. Study on communities in three different agricultural production systems
2. Relationships among arthropod biodiversity assemblages and environmental factors in agricultural areas

Materials and methods

The study area

This study was conducted in an agricultural area located in the Thai Samakkee subdistrict, Wang Nam Khiao district, Nakhon Ratchasima Province, Northeastern Thailand (14.343°N, 101.897°W). The average elevation is 500 metres above mean sea level. The mean annual temperature ranges from 10°C (Min) to 42°C (Max). The average relative humidity is 30.20 ± 10.1 SE %. Vegetation and land management data were used to identify three agricultural areas: a conventional agricultural site (CH), a good agricultural practice site (GAP), and an organic farming system site (OM). A conventional agricultural site (CH) was used for growing chilli with year-round high-level pesticide and fertilizer application, and modern tractor ploughing with three harvests per year. Good agricultural practice (GAP) involves cultivating crops by considering their economic viability, food safety, quality controls, year-round low-level pesticide application, compost, and liquid fertilizer (e.g., manure) for the agricultural area. The organic farming system (OM) is a method for growing crops without the use of pesticides, fertilizers, and growth hormones. Major vegetables grown at the OM and GAP include Green Oak, Red Oak, Cos lettuce, Butterhead lettuce, Iceberg lettuce, red leaf lettuce, cucumber, and pumpkin. Land use activities at the OM and GAP were traditional ploughing (farmers work the land with a weeding tool) with three harvests per year: November 2016 to October 2017

Arthropod sampling

Agricultural sample plots (ca. 1 ha) were randomly selected from each agricultural area to assess arthropods and environmental factors. Each sample plot was divided into two areas: the inside crop area (IA) and the field edges (OA). Three transects measuring 10 m in length were set up at each sample zone. Arthropods were sampled by using pitfall traps. At each sample zone, pitfall traps were buried in the soil along the transect line at every 2 m, with 5 traps per transect line and 15 traps per sampling zone (i.e., the IA and OA), and in total 30 traps per agricultural sample plot. Pitfall traps were set up on the day before data collection. Arthropod specimens were preserved in 80% alcohol and labelled for identification. Collections were performed six times based on the seasons, with three times in the dry season from November 2016 to April 2017 and three times in the wet season from June 2016 to October 2017. In addition, a total of 540 pitfall traps were set up in this study.

Environmental factors

After collecting arthropod data, three points of air temperature and relative humidity above the soil surface were measured at each sample zone. Air temperatures and relative humidity were measured at 20 cm above the soil surface using a Temperature Data Logger and Digital Thermometer (SK-L200 Series).

Identification of Arthropods

Collections of ground-dwelling arthropods were sorted, and two taxonomic levels (i.e., arthropod orders and families) were classified. Ground-dwelling arthropod orders were identified using a systematic keys (Aoki et al., 2014) and taxonomic expertise on these groups. Ants were identified by using a reference of the insect collection at the Department of National Parks, Wildlife and Plant Conservation (DNP). All ant individuals were sorted into species and morphospecies in each trap, and other arthropods were identified at the family level. The data on the number of individuals for each ant species or arthropod family were counted for analysis.

Data analysis

The total number of GDA species determines the species richness. We calculated and analysed the frequency of occurrence (F) of each GDA family in each study area separately by using the presence or absence of GDA. Abundance was considered the number of individual workers captured in the pitfall traps. Shannon diversity (H´) and Evenness (*E*) were used to evaluate the species diversity indices and dominance of arthropod assemblages in each agricultural area. The H´ and *E* were calculated using the PAST (Paleontological Statistics) program version 3.0

Comparisons of the richness, the H´ and *E* between the different agricultural areas, and the test for differences in data between the seasons were evaluated using univariate ANOVA. Pairwise comparisons (LSD post-hoc tests) were conducted when the differences were considered significant at $P < 0.05$, with the study areas and seasons serving as explanatory variables. The data's normality and homoscedasticity were confirmed before the analyses were performed using Shapiro-Wilk and Levene's tests. All data were transformed to reduce heteroscedasticity for the analysis. All univariate statistical analyses were performed using SPSS version. 20.0.0 for Windows (SPSS Inc., Chicago, IL, USA).

The relationships among arthropod biodiversity assemblages, soil environmental factors, and agricultural practices were examined using principal component analysis (PCA). These analyses were done with the PC-ORD program v. 5

Results and discussion

Arthropod diversity and occurrence

99 morphospecies were found, distributed in 8 orders among 17 families (Appendix Table 1). Ants (59 species) showed the most diversity occurring in agricultural areas, followed by beetles (16 species) and spiders (10 species). Greater richness values (± SE) were recorded for the organic farming system (OM) with 59 ± 4.5 SD than for the good agricultural practice (GAP) (44 ± 5.9 SD) and the conventional agricultural site (CH; 35 ± 9.3 SD). Univariate ANOVA revealed there were no significant differences in arthropod richness among the farming areas in the wet season (65 ± 5.1 SD) or in the dry season (15 ± 4.5 SD).

Species diversity indices (H´) differed slightly among the three agricultural areas. The average of the H´ value was somewhat higher in the GAP with 3.02 ± 0.32 SD, followed by the OM (2.76 ± 0.52 SD) and the CH (2.62 ± 0.69 SD), but the difference was not significant (P>0.05). The average of evenness (E) was high in the OM (0.52 ± 0.03 SD) and the GAP (0.48 ± 0.08 SD), followed by the CH (0.39 ± 0.15 SD). Significant differences between the wet and dry seasons were not detected for the H´ and the E.

The frequency of occurrence was higher for Formicidae (ants) in the range of 60% to 97% (Appendix Table 1). In the CH, larger values were found at the outside zone for Araneae (spiders) with a 26% frequency of occurrence, followed by ants with a 90% frequency. In the GAP, larger values were observed in the outside zone for ants, with a 97% frequency of occurrence. In the OM, larger values were found at the outside zone for, ants (78%) and Tridactylidae (22%)

Difference in diversity between the inside zone and the outside zone.

In the inside zone, the average number of arthropod species in the OM (37 ± 8.4 SD) and the GAP (29 ± 7.4 SD) and the CH (26 ± 4.4 SD) with a statistically significant difference (P > 0.05). In the outside zone, the average number of arthropod species in the OM (58 ± 8.3 SD) was significantly higher than the number of arthropod species in the GAP (43 ± 5.9 SD) and CH (31 ± 6.6 SD), with a statistically significant difference (P < 0.05). Interestingly, important differences between the inside and outside zones were found in the OM and GAP (P < 0.05), but not in the CM.

The average number of arthropod species varied by season and interaction among the agricultural sampling areas. In the OM, for the average number of arthropod species in the inside zone (34.5 ± 0.6 SD), the significance was higher than the outside zone (24.3 ± 1.8 SD) in the dry season (P < 0.05; Figure 1A). No statistically significant difference between the inside and outside zones was detected for the CH and GAP (P> 0.05). The difference of species was effect by season. The the average number of arthropod species in the inside zone (39.3 ± 0.5 SD) the significance was higher than the outside zone (29.3 ± 1.6 SD) for the CH in the wet season (P < 0.05; Figure 1B). Meanwhile, for the average number of arthropod species in the inside zone

(28.1 ± 1.5 SD) the significance was lower than the outside zone (37.1 ± 2.0 SD) for the GAP in the dry season ($P < 0.05$).

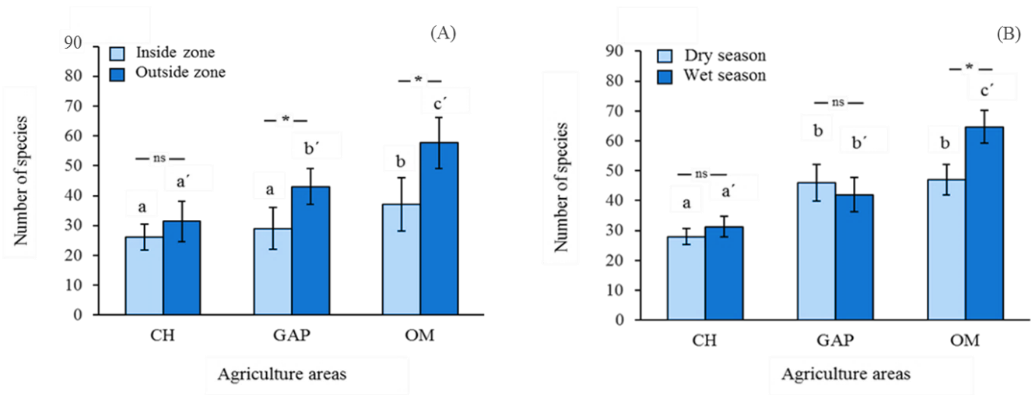

Figure 1: Difference in average (± SD) of the number of species between (A) inside crop areas and field edges and (B) dry season and wet season for each agricultural sampling area. The significant values are indicated with an asterisk for * = $P < 0.05$. Different lower-case letters indicate significant differences in sampling between the inside and outside zones. Differences in the average (± SD) number of species between the inside and outside zones for each sampling plot were indicated by ($P < 0.05$).

Variation of air temperature and relative humidity above the soil surface.

The average air temperature was a higher value in the CH (34.9± 2.3 SD) and the GAP (34.5± 2.1 SD) than the OM (32.1± 2.1 SD), with no statistically significant difference ($P > 0.05$). The average relative humidity above the soil surface was a higher value in the CH (51.2±3.8 SD) and the OM (51.0±2.7 SD) than the GAP (47.8±4.9 SD), with no statistically significant difference ($P > 0.05$). The average air temperature above the soil surface did not vary by season (Figure 2a; $P > 0.05$) and agricultural sampling area (Figure 2B; $P > 0.05$). In contrast, a significant difference between inside and outside areas was detected for relative humidity at GAP both in wet and dry season (Figure 2C; $P < 0.05$), and the CH and OM in wet season (Figure 2D; $P < 0.05$).

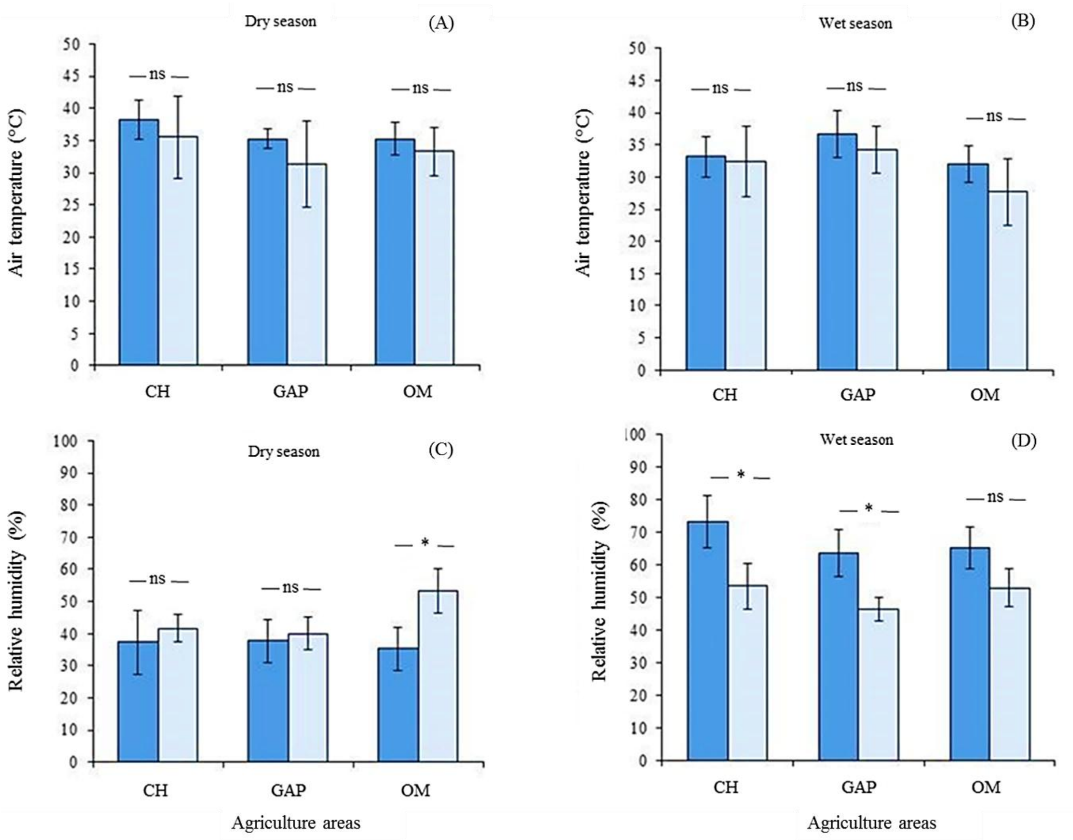

Figure 2 Difference in average (±SD) of air temperature between inside crop areas (blue) and field edges (light blue) for (A) dry season and (B) wet season, and relative humidity at above ground between inside crop areas (blue) and field edges (light blue) for (C) dry season and (D) wet season each agricultural area. The significant values are indicated with an asterisk for * = $P < 0.05$.

Relationships among arthropod biodiversity assemblages and environmental factors in agricultural areas. The canonical correspondence analysis (PCA) results showed that the arthropods could be divided into two groups (Figure 3). The first group was three ant species whose increasing presence was related to increasing soil moisture, including *Carebara affinis*, *Carebara diversa* and *Monomorium* sp.1. The second group was three ant species whose increasing presence was related to increasing air temperature, including *Meranoplus bicolor*, *Monomorium floricola* and *Trichomyrmex destructor*.

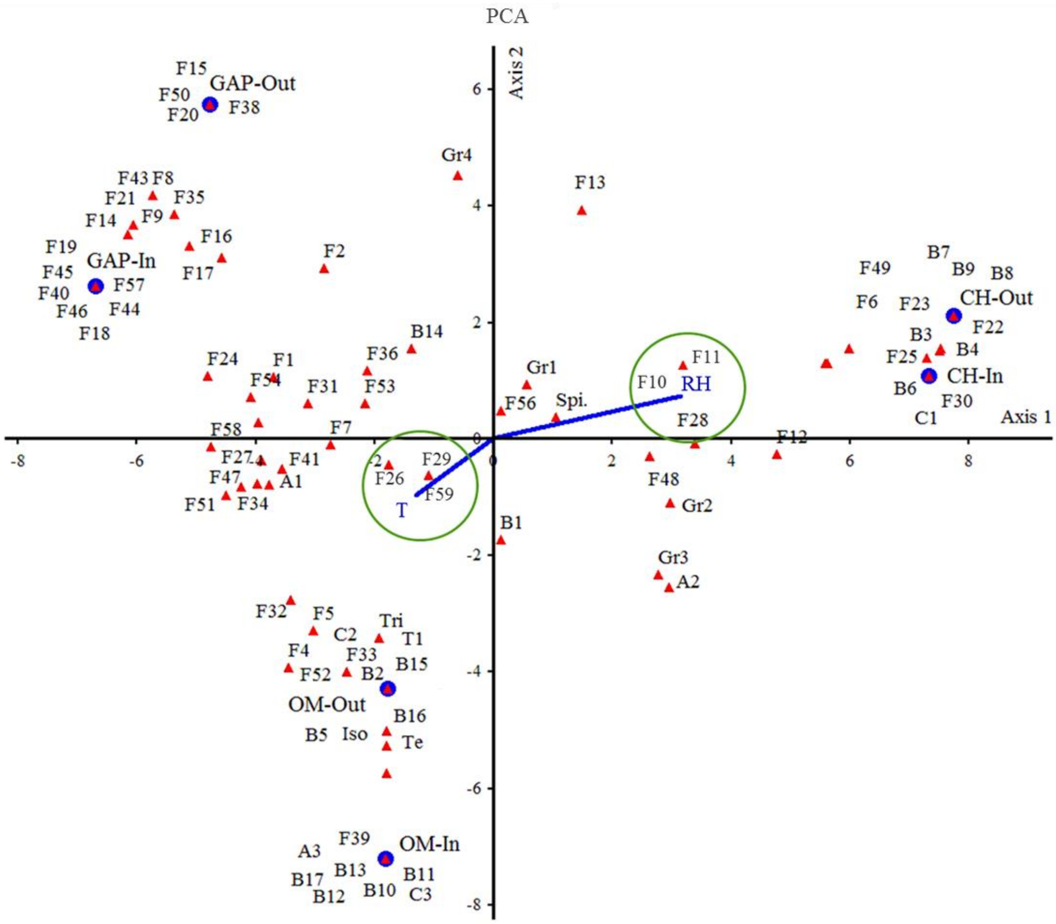

Figure 3 Principal correspondence analysis (PCA) of the arthropods in each study area. The lines show the direction and strength of the relationships among the environment factors— air temperature (T), relative humidity (RH)— and are plotted with respect to the structure of the arthropod assemblages in each study area — organic farming system (OM), good agricultural practice (GAP), conventional agricultural sites (CH)—, and abbreviations are shown in Appendix Table 1.

Discussions

Sample zones and agricultural sampling areas varied in the average number of arthropod species, and interactions among agricultural sampling areas were detected. Larger values of arthropod diversity were found in the OM plots compared with the GAP and CH. Two possible reasons can be explained. First, arthropod communities respond to often stress or disturbance in agricultural sampling areas and zones of ecotone in agroecosystems, resulting in a high abundance and assemblage in outside zones, where the land is covered byvegetation. (i.e. greases, three, shrub) In a whole year at any particular site. Another possible reason, a difference in arthropod diversity, might be caused by agricultural practices, particularly the pesticide application behaviour (ELN-FAB, 2012; Hasin and Booncher, 2020). In the GAP and CH, agriculturists perceived arthropods as insect pests of agricultural crops; hence, they applied various insecticide controls to pest insects and weeds (i.e. homes and shelters). While the OM did not use insecticides on their farm, their pest control technique is handpicking insects or hand-pulling weeds.

Results revealed that ant species were found in specific habitat areas, such as *Recurvidris recurvispinosa* (Forel, 1890), *Pseudolasius* sp.1, *Dorylus orientalis* and *Gnamptogenys bicolor* (Emery, 1889). Typically, these ant species are specialised predators of termites and centipedes (Cerdá and Dejean, 2011), which are found only in the OM. These results reveal that food webs in soil might be a limiting factor for ant species in particular. Additionally, the characteristics of habitats and land utilisation may benefit from a reduction in shade and an increase in bare soil surfaces, which may favour unimpeded ant colony dispersion and foraging areas. Interestingly, a positive relationship was found between the abundance of ant species and the result. Three ant species— *Carebara affinis*, *Carebara diversa* and *Monomorium* sp.1 — whose increasing presence was related to increasing soil moisture, and the three ant species—*Meranoplus bicolor*, *Monomorium floricola* and *Trichomyrmex destructor*—were linked to increasing air temperature. These results reveled that ant composition often differ from each other in their responses to the same stress of climate such that species richness and abundance of ant possible can be good bioindicator for detected the impact of air temperature and relative humidity change in agroecosystems (Peck et al., 1998; Tiede et al., 2017).

According to the significant effect of agriculture practices on arthropod species, species diversity indices and evenness were not detected in the study areas. The presence of field edges around agricultural regions of the OM and GAP had a significant effect, which was not found in the CH. This study revealed that arthropod diversity had detrimental effects on vegetation cover in agricultural areas (Pribadi et al., 2011; Junior et al., 2014; Ackerman et al., 2009), field margins (Gallé et al., 2020), and farmland heterogeneity (Martin et al., 2020).

Conclusions

In summary, research results were developed to address two issues. First, according to human land use changes from forest to agricultural use, there was obvious damage to native insect biodiversity, especially soil insects, in the native vegetation and vegetation remnants of Nakhon Ratchasima province. Second, arthropod diversity served as a bioindicator category for land utilization by humans. All of the results could be used as research information to support the study of evaluation of the diversity and abundance of arthropods (e.g., frequency of occurrence for each area) when arthropods were used as bioindicators to assess the condition of soil ecosystems (Folgarait, 1998; Pribadi et al., 2011; Ackerman et al., 2009).

Recommendation

This study is a pilot research investigation of the interaction between habitat characteristics and arthropod diversity. These research results demonstrated that the field borders of agricultural practice can play an important role in maintaining biodiversity in an agroecosystem (Helenius and Bäckman, 2004; Ma et al., 2013; Werling and Gratton, 2008; Martin et al., 2020; Gallé et al., 2020), and those roles can be related to agricultural practice in an agroecosystem. However, understanding which species are good bioindicators in agroecosystems, and how the impacts of future environmental changes on arthropod communities could provide more ecological interaction data. Thus, two interesting topics for future studies in agricultural areas would be explored: (1) the relationship between arthropod community composition and agricultural system management practices in particular dimensions of functional groups of arthropods such as feeding behaviour, nutrient fixation ability, digestion types, nest construction type, and building materials (Ackerman et al., 2009), and (2) the diversity of arthropod species affected by the combination of factors, soil environment variables, and climate change.

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Appendix Table 1 List of Class/Order/ Family of arthropod collected by pit fall trap, and it frequency of occurrence (FO) in agriculture araes (N=540), and the FO in two sampling zones– inside areas (IA: N=90) and outside areas (OA: N=90) – for each agriculture sampling plot including a conventional agricultural site (CH), good agricultural practice (GAP) and organic farming system (OM)

Class/Order/ Family/Species	Abrr.	FO (%) in agriculture sampling plot					
		CH		GAP		OM	
		IA	OA	IA	OA	IA	OA
Arachnida							
Araneae; Oxyopidae (3 sp.), Salticidae (7sp.); Spider	A1	7	51	22	18	24	11
Pseudoscorpions (5 sp.); False scorpion	A2	0	0	4	4	4	4
Chilopoda							
Lithobiomorpha; Lithobiidae (2 sp.) ; Stone centipedes	C1	2	0	0	0	0	0
Scutigeromorpha; Scutigeridae (*Scutigera* sp.1) ; House centipedes	C2	0	0	0	0	2	2
Diplopoda							
Spirostreptida; Harpagophoridae (1 sp.): Millipede	D1	13	20	0	13	20	24
Insecta							
Coleoptera (16 sp.); Beetle							
Anthicidae (*Notoxus* sp.1)	B1	0	0	0	0	0	2
Bostrichidae; Bostrichidae sp.1	B4	0	0	0	0	2	2
Carabidae							
Brachinus sp.1	B5	2	0	0	0	0	0
Amblytelus sp.1	B6	0	2	0	0	0	0
Attelabidae (*Apoderus* sp.1)	B7	0	2	0	0	0	0
Curculionidae (*Alcidodes* sp.1)	B8	0	2	0	0	0	0
Scarabaeidae							
Anomala sp.1	B9	0	0	0	0	2	0
Anomala sp.2	B10	0	0	0	0	2	0
Holotrichia sp.1	B11	0	0	0	0	2	0
Holotrichia sp.2	B12	0	0	0	0	2	0
Staphylinidae							
Callicerus sp.1	B13	0	2	2	0	2	2
Carpelimus sp.1	B14	0	0	0	0	0	2
Carpelimus sp.2	B15	0	0	0	0	0	2
Paederus dermatitis	B16	0	0	0	0	2	0
Tachyporus o sp.1	B2	2	0	0	0	0	0
Tachyporus o sp.2	B3	0	2	0	0	0	0

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Class/Order/ Family/Species	Abrr.	FO (%) in agriculture sampling plot					
		CH		GAP		OM	
		IA	OA	IA	OA	IA	OA
Hymenoptera; Formicidae (59 sp.); Ant							
Anoplolepis gracilipes Smith, 1857	F1	2	0	20	69	16	42
Camponotus rufoglaucus (Jerdon, 1851)	F2	0	2	2	9	2	0
Camponotus sp.1	F3	7	4	7	2	0	0
Camponotus sp.2	F4	0	0	4	0	4	0
Camponotus sp.3	F5	0	0	2	0	2	4
Cardiocondyla emeryi Forel, 1881	F6	27	36	2	4	2	4
Cardiocondyla nuda Mayr, 1866	F7	13	0	27	33	27	36
Cerapachys sp.1	F8	0	0	2	0	2	0
Cerapachys sp.2	F9	0	0	2	0	2	0
Carebara affinis (Jerdon, 1851)	F10	2	0	20	13	11	20
Carebara diversa (Jerdon, 1851)	F11	36	31	9	13	7	7
Carebara sp.1	F12	0	0	4	2	9	2
Oligomyrmex sp.2	F13	0	0	2	2	2	2
Diacamma rugosum LeGuillou, 1842	F14	11	16	0	2	0	2
Diacamma sp.1	F15	0	2	0	0	0	0
Diacamma vagans Smith, 1860	F16	24	20	0	2	0	16
Dolichoderus thoracicus (Smith, 1860)	F17	0	2	0	2	0	0
Dorylus orientalis Westwood, 1835	F18	0	0	11	4	0	0
Gnamptogenys bicolor Emery,1889	F19	0	0	0	4	0	0
Hypoponera sp.1	F20	0	0	7	2	7	2
Hypoponera sp.2	F21	0	0	2	0	7	2
Hypoponera sp.3	F22	0	0	2	0	0	0
Hypoponera sp.4	F23	0	0	2	0	0	0
Hypoponera sp.5	F24	0	0	0	2	0	0
Leptogenys diminuta Smith, 1857	F25	0	0	4	2	0	0
Meranoplus bicolor (Guerin- Meneville, 1844)	F26	83	67	0	0	0	0
Meranoplus sp.1	F27	0	0	0	0	0	2
Monomorium sp.1	F28	0	0	18	11	7	4
Monomorium floricola (Jerdon, 1851)	F29	38	36	0	0	2	0
Monomorium pharaonis (Linnaeus 1758)	F30	0	0	11	16	7	13

Appendix Table 1 List of Class/Order/ Family of arthropod collected by pit fall trap, and it frequency of occurrence (FO) in agriculture araes (N=540), and the FO in two sampling zones– inside areas (IA: N=90) and outside areas (OA: N=90) – for each agriculture sampling plot including a conventional agricultural site (CH), good agricultural practice (GAP) and organic farming system (OM) (Cont.)

Class/Order/ Family/Species	Abrr.	FO (%) in agriculture sampling plot					
		CH		GAP		OM	
		IA	OA	IA	OA	IA	OA
Monomorium sechellense (Emery, 1894)	F31	0	0	13	16	13	11
Nylanderia sp.1	F32	4	7	2	0	2	2
Nylanderia sp.2	F33	0	0	0	0	0	2
Nylanderia sp.3	F34	2	0	0	0	0	0
Odontoponera denticulata Smith, 1858	F35	11	16	67	138	44	107
Pachycondyla leeuwenhoeki Forel, 1886	F36	0	0	18	11	13	13
Pachycondyla luteipes (Mayr, 1862)	F37	0	0	29	38	13	22
Paratrechina longicornis Latreille, 1807	F38	4	9	9	36	9	20
Pheidole sp.1	F39	4	2	0	2	0	2
Pheidole sp.2	F40	0	0	0	2	0	0
Pheidole parva Mayr, 1865	F41	0	0	0	0	16	0
Pheidole plagiaria Smith, 1860	F42	0	0	31	0	0	0
Polyrhachis proxima Roger, 1863	F43	0	0	7	7	0	0
Ponera sp.1	F44	0	0	9	0	0	0
Pseudolasius sp.1	F45	0	0	11	0	0	0
Recurvidris recurvispinosa (Forel, 1890)	F46	0	0	7	0	0	0
Smitristruma sp.1	F47	0	0	2	0	0	2
Solenopsis geminata Fabricius, 1804	F48	58	53	0	31	36	40
Tapinoma melanocephalum Fabricius, 1793	F49	44	36	18	18	22	33
Technomyrmex butteli Forel, 1913	F50	0	0	0	7	0	0
Technomyrmex kraepelini Forel, 1905	F51	0	0	13	2	9	2
Tetramorium bicarinatum (Nylander, 1846)	F52	0	0	0	0	0	2
Tetramorium lanuginosum Mayr, 1870	F53	4	0	20	9	13	4
Tetramorium polymorphum Yamane & Jaitrong, 2011	F54	0	0	7	11	4	7
Tetramorium smithi Mayr, 1879	F55	27	24	40	20	42	20
Tetramorium walshi (Forel, 1890)	F56	20	24	16	22	13	20
Tetraponera attenuata Smith, 1877	F57	0	0	0	4	0	0
Tetraponera nigra (Jerdon, 1851)	F58	0	0	7	2	4	0
Trichomyrmex destructor (Jerdon, 1851)	F59	38	36	0	0	2	0
Isoptera; Termitidae (Odontotermes feae); Termites	T1	0	0	0	0	0	7

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Class/Order/ Family/Species	Abrr.	FO (%) in agriculture sampling plot					
		CH		GAP		OM	
		IA	OA	IA	OA	IA	OA
Orthptera (6 sp.); Grasshoppers, Katydids & Crickets							
Gryllidae							
Acheta domesticus (Linnaeus, 1758)	Gr1	16	13	20	18	9	9
Gryllus sp.1	Gr2	0	2	0	0	0	2
Gryllus sp.2	Gr3	4	0	0	0	2	2
Gryllus sp.3	Gr4	0	2	0	0	4	0
Tetrigidae (1 sp.)	Te	2	2	7	7	22	44
Tridactylidae (Tridactylus sp.)	Tri	0	0	0	0	7	20