Diversity of Insects of Two Rice (*Oryza sativa* L. 1787) Farms in Nnamdi Azikiwe University, Awka

ABSTRACT

The recognition of insect-related damages to rice plants and the subsequent consequences for biodiversity have shown the relevance of insect community in rice farms. This study documented the insect fauna of rice (*Oryza sativa* L. 1787) in two rice farms in Nnamdi Azikiwe University, Awka, Nigeria from September to November, 2022. The insects associated with the two sites were collected using handpicking, beating and pitfall trap methods. Data collected from the study were subjected to non-parametric t- test at 5% significant level. A total of 51,021 insects belonging to twelve insect orders were found associated with the two sites. Out of the afformentioned number, 15,120 (29.63%) were collected from site 1 and 35,901 (70.37%) were collected in site 2. There was significant difference (P <0.05) on insect abundance between site 1 and 2. *Crematogasterperingueyi*were observed as the most relative abundance (82.67%) insect in site 1 while *Camponotusperrisi*recorded the most abundance (27.85%) in site 2. The result further showed that only*Hobomokskipper* had the least relative abundance (0.01%) in site 1,while*Catantopsquadratu, Anacatantopsnotatus, Dysdercus cingulatus, Crematogaster peringueyi, Dasyleurotettix infaustus* and *Apis mellifera*had the least relative abundance (0.01%) in site 2. There is the need for regular monitoring of insects in rice farms for sustainable management of the crop.

Keywords: Insects, Diversity, Relative abundance, Rice farms, Awka

INTRODUCTION

Rice is one of the most common food crop globally, feeding more than half of the world's population. It is also an integral source of income for most people in Asia and Africa with a global production rate estimated to be 508.7 million tons (Food and Agricultural Organization, 2020). Rice stands as the fundamental sustenance for approximately half of the global populace, thus assuming a pivotal role in ensuring worldwide food security (Heinrichs and Muniappan, 2017; Muthayya *et al*., 2014). The cultivation and distribution of rice carry significant implications for agricultural systems and economies worldwide. Notably, the majority of rice cultivation involves the transplantation of rice seedlings within flooded environments, a method deeply rooted in traditional practices. In contrast, the remaining portion of rice cultivation is achieved through direct seeding methods, reflecting adaptations to varying ecological and resource conditions. This dichotomy in cultivation techniques underlines the intricate relationship between agrarian practices, hydrological dynamics and environmental factors. However, the increasing water crisis, decrease in labor availability due to preference of non-farm work by labor, deteriorating soil health, increased methane emissions, low efficiencies of nutrient use, deficiency of micronutrients, prevalence of new biotypes of weeds, insect pests and diseases, yield stagnation and decreasing in the rice productivity are threatening the sustainability of the conventional transplanted flooded rice production system (Nadeem and Farooq, 2019; Nawaz *et al*., 2019).

Rice being one of the important field crops grown in Nigeria exhibits an excellent instance of changing insect pest scenario in recent past. For proper management of insects which is an integral part of our ecosystem, a thorough knowledge about the diversity of insects occurring in an ecosystem, their incidence, abundance and species richness must be known and documented (Nwankwo, 2016).

The abundance and diversity of insects differ in the rice ecosystem in addition to the growth stages of its production season. Many arthropods species inhabit rice fields in which some are harmful to the crop, but most of them are not noxious to rice plant (Singh and Singh, 2014).

In the rice farm, the insect groups based on diversity of functions include insect pests, natural enemies and neutral insects (Sumarmiyanti*et al*., 2019). Insect pests are a major causative factor in yield loss, either directly eating plant tissue or as a vector of plant pathogens. While natural enemies are biotic components that regulate pest insect populations in the agroecosystem, which consists of predators and parasitoids, the diversity of insect species has a very important impact on stability in the rice ecosystem (Hendrival andHalimudin 2017).

Many species of arthropods inhabit rice fields, albeit most are not truly noxious to the crops. For instance, about 500 species of insects and spiders may appear in a rice field in a particular season. Of these only few are potential threat. The rest are either beneficial in the form of a wide range of predators (such as bugs and spiders) and parasitoids (mostly parasitic wasps) that contribute to keeping insect-pest organisms in check or innocent immigrants (neutral species) living on weeds or on organisms and under certain conditions serving as general prey for some beneficial. In terms of taxonomic diversity, insects are the most diverse group of creatures on the planet (Belamkar and Jadesh, 2014). With 1,020,007 species, or 66 percent of total known animal species, insects are the most prevalent (Britannica, 2023). In addition to the above, a total of 800 insect species have been identified worldwide, with 100 species being pests that attack different portions of the rice plant and the others being beneficial. Stem borer, defoliators, gall midge and disease-transmitting vectors such as plant hoppers and leaf hoppers are all major rice pests. The species from the aforementioned important insect pest stem borer, which includes yellow stem borer, white stem borer, pink borer and black headed borer, has demonstrated broad geographical variance throughout the country. From the time of sowing to harvest, the majority of rice plant elements are vulnerable to pest assault (Okeke *et al*., 2019).

Insects cause damage to a variety of plant parts by burrowing into stems, devouring plant tissues and draining sap from stems and grains (Ane and Hussain, 2016). Most of rice plant parts are exposed to pest attack from period of sowing till harvest. Insects damage plant parts by chewing plant tissues, boring into stems or sucking fluid saps from stem and grains. Damages caused by insects disturb physiology of plants and result in to lower crop yield (Cabrera and Sparks, 2018). According to biodiversity productivity hypothesis, biodiversity plays significant role in maintaining a sustainable agronomic system. In order to gain productive results, it is necessary to conserve diversity in agricultural. Practices like overuse of pesticides, monoculture, grazing, poor farming techniques etc. are posing threats to biodiversity associated with rice farming system (Asghar *et al*., 2013). The spread of this insecticides can lead to a drastic reduction in the population of non-target species in the rice farm which is a very big problem (Merem *et al*., 2017). The aim of this study was to ascertain the diversity of insects in two rice farms in Nnamdi Azikiwe University Awka, Anambra State.

MATERIALS AND METHODS

Study Area

The study was carried out on two rice fields in Nnamdi Azikiwe University, Awka, Anambra State from September to November, 2022. Awka lies within coordinates 6°12´25´´N and 7°04´04´´E. Awka is in the tropical rain forest zone of Nigeria and experience two distinct seasons – wet and dry seasons, brought about by the two predominant winds that regulate the area: The South-western monsoon winds from the Atlantic Ocean and the Northeast dry winds from across the Sahara Desert. The Harmattan is particularly dry and dusty wind which enters the area in late December to January and is characterized by a grey haze limiting visibility and blocking the sun's rays (National Statistical Book, 2020). The temperature in the study area is generally 27-30^{o}C between June and December but rises to 32-34^{o}C between January and April, with the month of March experiencing the hottest temperature 36-38^{o}C. The relative humidity in the rainy season is 82.37 and 74.25 in the dry season (National Statistical Book, 2020).

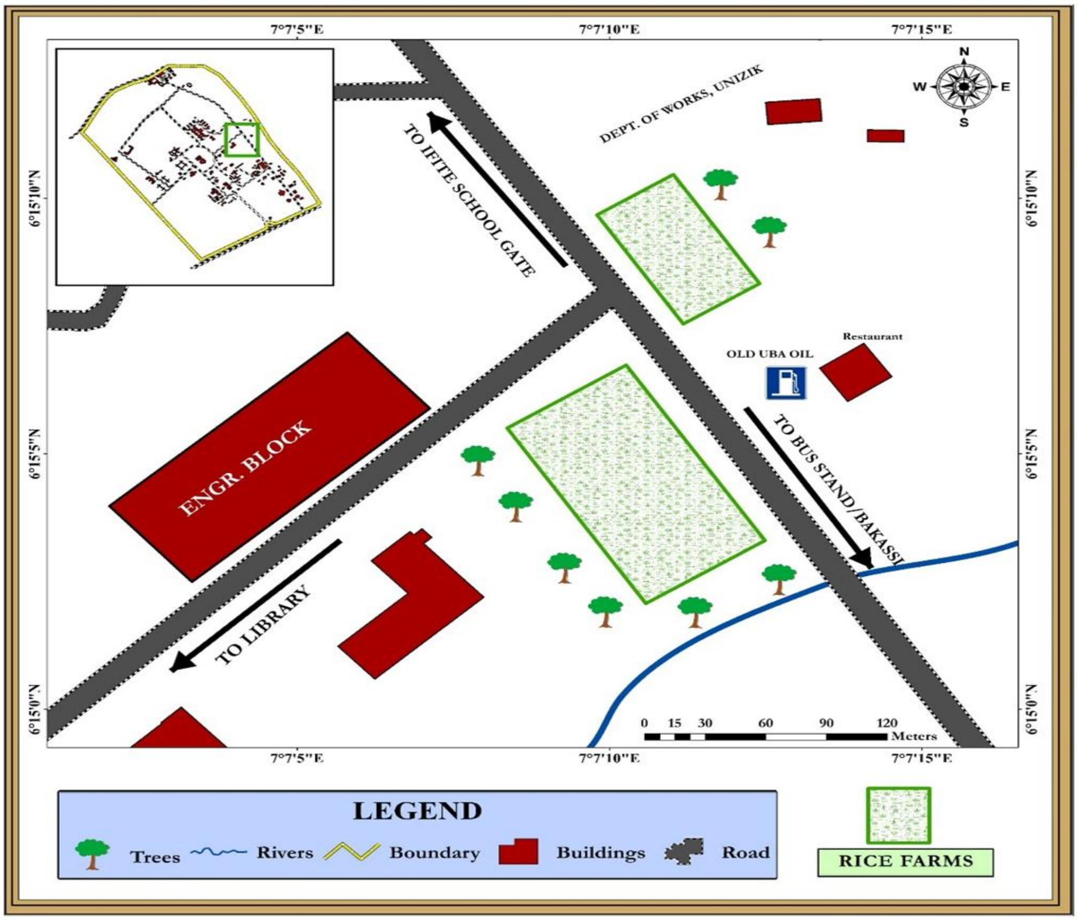

Figure 1: Map of Nnamdi Azikiwe Univesity, Awka showing the location of the 2 rice farms

Source: Researcher's field work and Gis Mapping, 2023

Experimental Design

Two randomly selected rice fields within Nnamdi Azikiwe University, Awkawere used for sampling and locations of these sites were recorded as site 1- 7°7'11.115" E, 6°15'9.1" N and site

2- 2. 7°7'10.344" E, 6°15'4.443" Nusing a portable global positioning system / GPS (GARMIN-etrex SUMMIT), starting from September to November, 2022. The rice farm in site 1 covered a land area of $200m^2$ and site 2 covered a land area of $250m^2$ respectively. The researcher used random sampling method to directly observe and collect insects from the rice fields. Sampling was done three times a week at each site. Sampling of each site was done from 8am-9am in the morning and 4pm -5pm in the evening.

Plate 1: Experimental Site 1

Plate 2: Experimental Site 2

Diversity of insect species in the rice farm

The diversity of insect species in the rice farms were determined by collection of the insects in the rice farms

Insect collection

using a single insect collecting technique may be biased as some insect species may be over represented while others might be underestimated or even missing. However, multiple sampling techniques described by Akunne*et al*. (2014) were used including hand-picking, sweep nets, water trap, and pitfall traps.The collection of insects from the two rice farms took place from September to November, 2023. Insects were collected three times a week for the period of the research and it was done from 8am – 9am in the morning and 4pm-5pm in the evening. The collected insects were transferred to a killing bottle with 75% ethanoldiluted with water before sorting and proper identification.

Handpicking method

This method as described by Akunne*et al*. (2014) was utilized to collect insects from leaf blades, flowers, dry leaves, and the ground stratum with fine forceps. Care was taken to ensure that no harm was caused to the insects. The ground area close to the plants was also searched.

Sweep net

The sweep net was swung side by side and back and forth; the hoop end was nearest to the ground, taking one step per stroke and covering all the places in the sampling site. The net was swung as deeply as possible in shorter vegetation while in taller vegetation, it was swung just enough to keep the upper edge of the sweep net opening even with the top of the plants as described by Gibb and Oseto, 2010.The method used was the "U" shaped walking sampling pattern. The distance between the U-shape correlates with the measurement of the two sweep nets. The speed was constant to uniformly collect insects throughout the field as stated by Ubaub, 2015

Pitfall traps

Ground-dwelling insects were sampled using pitfall traps for collection of insects. Twelve traps made of plastic containers, measuring 12 cm in diameter and 10 cm deep, six containers each for the two rice farms were used. Each trap was placed on the soil until the rim flushes with the ground level. Precaution was taken not to disturb the soil markedly to avoid "digging –in-effects". The traps were filled with 75% ethanol to about two-third of the volume of each container using Ewuim and Ezeani, 2007 method. The traps were then placed at 1m apart from each other.

Water trap

Traps were positioned on a stand at a height of 75cm in an unshaded part of the rice farms and separated 10meters away from each other. After each run the insects were collected from the traps and stored in 10% formalin diluted with water pending sorting. The experiments used 6 traps and was arranged 3 for each site.

Insect Sorting and Identification

Insects collected from the experiment were sorted at the Department of Zoology Laboratory, Nnamdi Azikiwe University, Awka. The liquid contents of each container were reduced using a

5ml syringe and the contents were emptied into a Petri dish. They were viewed using a light microscope for accurate counting of the collected insects into their various taxonomic groups.

Using a Camel's hair brush under a light microscope, sorting of the insects took place. The insects were placed in specimen bottles containing 10% formalin as preservative. These insects sorted into their taxonomic groups were carefully recorded in data sheets. The sorted insects collected from the two rice farms were placed in a cellophane envelope containing 75% ethanol and sent to Insect Museum at Ahmadu Bello University, Zaria, Kaduna State, Nigeria for identification as described by Akunne*et al*. (2014) and the voucher specimen kept in the laboratory.

Determination of the Relative Abundance of Insects

The relative abundance of the insects orders and species on both rice farms during the study period was calculated using the formula adopted by Akunne *et al.* (2014):

$$\text{Relative abundance } = \frac{Number\ of\ individual\ insect\ caught}{Total\ number\ of\ insects\ caught} \times 100$$

Determination of the Monthly Abundance of Insect

The abundance of the insects species on both rice field in the months of September, October and November were recorded and the monthly abundance were calculated using the formula below(Ewuim, *et al.*, 2018).

$$\text{Mean abundance } = \frac{Insect\ caught}{Sum\ of\ insect\ species\ caught}$$

Determination of Species Diversity and Dominance Indices

The Insect diversity of each sampling site was calculated using Shannon Weiner Diversity Index (Djidjonri, *et al*., 2019)

Shannon Weiner Diversity Index (H): formula is

$H = -\Sigma (Pi) \ln Pi$

Where:

$$\text{Pi} = \frac{\text{Number of individuals of species}}{\text{Total number of samples}}$$

Simpson's index of dominance (D) will also be used to compare the species dominance of the two sites.

Simpson Index of dominance (C) $=\sum(Pi)^2$ (Djidjonri *et al*., 2019)

Margalef index was used to compare the species richness in the two varieties.

$$\text{Margalef index} = \frac{S - 1}{\ln N}$$

Where: S = number of species

N = total number of individuals of all species (Djidjonri *et al*., 2019)

$$\text{Evenness} = \frac{H}{H\max}$$

(Djidjonri, *et al*., 2019)

Where: H = -Σ (Pi) lnPi

Hmax =lnN (Djidjonri, *et al*., 2019).

Statistical Analysis

Descriptive statistics was used to present the data for the abundance of insects in the rice farms. Simpson dominance index, Shannon Weiner diversity index, Margalef richness index and Shannon Weiner evenness was used to analyze the diversity of the insects while Simpson index was used for species dominance. Data on insect collections were subjected to non-parametric T-test, Kolmogorov-Smirnov Z Test for abundance between species. All the analysis was performed using Statistical Packages for Social Sciences (SPSS) computer package (version 25).

RESULTS

The insects associated with the two rice farms in the research area, is represented in Table 1. A total of 51,021insects belonging to twelve insect orders were found associated with the two rice farms in Nnamdi Azikiwe University Awka.Of this number, 15,120 (29.63%) were collected from site 1 and 35,901 (70.37%), were associated with site 2. The insect orders collected were Orthoptera, Heterocera, Hemiptera, Homoptera, Diptera, Coleoptera, Hymenoptera, Lepidoptera, Mantodea, Odonata, Neuroptera, BlattodeaThe result further showed that Orthoptera (7.97%), Heterocera (0.18%), Hemiptera (1.93%), Homoptera (0.28%), Diptera (1.39%), Coleoptera (2.31%), Lepidoptera (1.13%), Mantodea (0.87%), Odonata (0.68%) had higher relative abundance in site 1 than site 2 (2.89%, 0.08%, 0.83%, 0.20%, 0.50%, 1.08%, 0.52%, 0.32%, 0.45% respectively). However, Hymenoptera (88.81%), Neuroptera (0.15%) and Blattodea (4.18%) recorded the highest relative abundance in site 2 than site 1 (83.24%, 0.02% and 0% respectively).There was significant difference in the abundance of insect species associated with rice farms in site 1 and Site 2 (p =0.01).

Table 1: Population of Insects Orders Associated with the Two Rice Farms in Nnamdi Azikiwe University, Awka

	Number of insects collected per site (%)		
Orders	**Site 1 (%)**	**Site 2**	**Total (%)**

Orthoptera	1,205(7.97)	1040(2.89)	2,245(4.40)
Heterocera	27(0.18)	27(0.08)	54(0.11)
Hemiptera	292(1.93)	271(0.83)	563(1.10)
Homoptera	43(0.28)	72(0.20)	115(0.23)
Diptera	210(1.39)	178(0.50)	388(0.76)
Coleoptera	349(2.31)	388(1.08)	737(1.44)
Hymenoptera	12,586(83.24)	31908(88.81)	44,494(87.21)
Lepidoptera	171(1.13)	186(0.52)	357(0.70)
Mantodea	131(0.87)	116(0.32)	247(0.48)
Odonata	103(0.68)	160(0.45)	263(0.52)
Neuroptera	3(0.02)	55(0.15)	58(0.110
Blattodea	0(0.00)	1500(4.18)	1,500(2.94)
Total	**15,120 (29.63)**	**35,901**	**51,021 (100)**

Relative abundance in parenthesis

The result of the insect species of the two rice farms in Nnamdi Azikiwe University, Awka is presented in Table 2. The table revealed that *Crematogaster peringueyi*recorded the highest relative abundance (82.67%) in site 1 while *Camponotus perrisi*(27.85%) recorded highest in site 2. The result further showed thatHobomok *skipper* had the least relative abundance (0.01%) in site 1. However, *Catantops quadratu*, *Anacatantops notatus*, *Dysdercus cingulatus*, *Crematogaster peringueyi*, *Dasyleurotettix infaustus* and *Apis mellifera*had the least relative abundance (0.01%) in site 2. There was a significant difference in the abundance of insect species between site 1 and 2 ($p < 0.05$).

Table 2 also revealed that out of the seventy three (73) species of insects found in the rice farms, six (6) species namely: *Megachile rotundata*, *Arcyptera fusca*, *Phloeonotus* sp., *Locris erythromela*, *Opatropsis* sp. and *Larra* sp. were collected on from site 1 only. On the other hand, 24 species of insects were collected from site 2 only namely: *Trimerotropis infantilis*, *Atractomorpha ocutipennis*, *Arcyptera fusca*, *Brachycrotaphus steindachneri*, *Dasyleurotettix infaustus*, *Notobitus sexguttatus*, *Pygolampis* sp., *Hermetia illucens*, *Harmonia axyridis*, *Rhynchium lateralis*, *Belonogaster* sp, *Sceliphro destilatorium*, *Pison carinatum*, *Apis mellifera*, *Exaerete smaragdina*, *Monomorium pharaonis*, *Monomorium minimum*, *Odontomachus bauri*, *Megachile rotundata*, *Arpactus* sp., *Acraea acrita*, *Acraea neobule*, *Libelloides macaronius and Odontotermes obesus.* However, the remaining 43 species of insects were found in both sites.

Table 2: Insects Associated with the Two Rice farms in Nnamdi Azikiwe University, Awka

Order	Family	Species	Number of insects and relative abundance per site: Site 1	RA (%)	Site 2	RA (%)	Total	RA (%)
Orthoptera	Acrididae	*Pododula ancisa* Karsch	140	0.93	41	0.11	181	0.35
		Catantops quadratu Walker	36	0.24	5	0.01	41	0.08
		Anacatantops notatus Karsch	45	0.3	5	0.01	50	0.10
		Spathosternum pygmaeum Karsch	35	0.23	59	0.16	94	0.18
		Trimerotropis pallidipennis	17	0.11	36	0.10	53	0.10
		Trimerotropis infantilis	0	0	7	0.02	7	0.01
		Oxya lyla	12	0.08	28	0.08	40	0.08
		Acrida cinerea	51	0.34	97	0.27	148	0.29
		Cratypedes neglectus	28	0.19	23	0.06	51	0.10
		Atractomorpha ocutipennis. Guer	0	0	18	0.05	18	0.04
		Arcyptera fusca	0	0	0	0.00	0	0.00
		Leva sp,	39	0.26	48	0.13	87	0.17
		Oedaleus infernalis	14	0.09	27	0.08	41	0.08
		Brachycrotaphus steindachneri	0	0	22	0.06	22	0.04
	Gryllidae	*Gymnogryllus lucens* Walker	19	0.13	15	0.04	34	0.07
	Katydids	*Tettigonia viridissima*	54	0.36	53	0.15	107	0.21
	Pyrgomorphidae	*Atractomorpha ocutipennis* Guer	45	0.3	48	0.13	93	0.18
		Zonocerus elegans	18	0.12	24	0.07	42	0.08
		Senegalensis senegalensis Krauss	109	0.72	166	0.46	275	0.54
	Tettigoniidae	*Conocephalus fuscus*	34	0.22	27	0.08	61	0.12
	Tetrigidae	*Paratettix* sp	93	0.62	147	0.41	240	0.47
		Paratetix carinatus Kirby	122	0.81	7	0.02	129	0.25
		Dasyleurotettix infaustus Walker	0	0	3	0.01	3	0.01

		Phloeonotus sp.	13	0.09	0	0.00	13	0.03
	Tridactylidae	*Tridactylus digitatus* Latr	133	0.88	134	0.37	267	0.52
	Eneopteridae	*Euscyrtus bivittatus*	148	0.98	27	0.08	175	0.34
Heterocera	Sphirsgidae	*Basiothia* sp.	27	0.18	88	0.25	115	0.23
Hemiptera	Coreidae	*Anoplocnemis curvipes*	49	0.32	14	0.04	63	0.12
		Notobitus sexguttatus	0	0	23	0.06	23	0.05
	Pentatomidae	*Diploxys floweri* Dist.	33	0.22	31	0.09	64	0.13
	Pyrrhocoridae	*Dysdercus cingulatus*	27	0.18	5	0.01	32	0.06
	Reduviidae	*Rhinocoris bicolor* Fabr.	25	0.17	19	0.05	44	0.09
		Oncocephalus pilicornis H-S	26	0.17	17	0.05	43	0.08
		Pygolampis sp.	0	0	74	0.21	74	0.15
	Alydidae	*Mirperus jaculus* Thunbg	132	0.87	72	0.20	204	0.40
Homoptera	Cercopidae	*Locris erythromela* Walker	43	0.28	0	0.00	43	0.08
Diptera	Asilidae	*Storthyngomerus tridentatus* Fab.	4	0.03	6	0.02	10	0.02
		Laxenecera dimidiata Curr.	14	0.09	44	0.12	58	0.11
		Dasypogon diadema	42	0.28	11	0.03	53	0.10
	Muscidae	*Dichaetomyia fasciventris* Mull.	18	0.12	47	0.13	65	0.13
	Syrphidae	*Mesembrius* sp.	70	0.46	58	0.16	128	0.25
		Eristalis tenax	62	0.41	12	0.03	74	0.15
	Stratiomyidae	*Hermetia illucens*	0	0	51	0.14	51	0.10
Coleoptera	Coccinellidae	*Coccinella magnitica*	49	0.32	66	0.18	115	0.23
	Curculionidae	*Afrophytoscaphus* sp.	66	0.44	46	0.13	112	0.22
	Lagriidae	*Lagria villosa* F	16	0.11	194	0.54	210	0.41
	Chrysomelidae	*Aspidomorpha cincta* Fab.	189	1.25	31	0.09	220	0.43
	Tenebrionidae	*Opatropsis* sp.	29	0.19	0	0.00	29	0.06
	Coccinellidae	*Harmonia axyridis*	0	0	41	0.11	41	0.08
Hymenoptera	Vespidae	*Rhynchium lateralis* Fab.	0	0	46	0.13	46	0.09

		Belonogaster sp	0	0	18	0.05	18	0.04
	Sphecidae	*Sceliphro destilatorium*	0	0	120	0.33	120	0.24
		Larra sp	58	0.38	0	0.00	58	0.11
		Pison carinatum Turner	0	0	47	0.13	47	0.09
	Apidae	*Apis mellifera* L.	0	0	3	0.01	3	0.01
		Exaerete smaragdina	0	0	8500	23.68	8500	16.66
	Formicidae	*Monomorium pharaonis*	0	0	7100	19.78	7100	13.92
		Monomorium minimum	0	0	5900	16.43	5900	11.56
		Odontomachus bauri	0	0	128	0.36	128	0.25
		Camponotus perrisi For.	28	0.19	10000	27.85	10028	19.65
		Crematogaster peringueyi	12500	82.67	4	0.01	12504	24.51
	Megachilidae	*Megachile rotundata*	0	0	1	0.00	1	0.00
	Crabronidae	*Arpactus* sp.	0	0	42	0.12	42	0.08
Lepidoptera	Nymphalidae	*Hypolimnas misippus*	29	0.19	9	0.03	38	0.07
		Acraea acrita	0	0	6	0.02	6	0.01
		Acraea neobule	0	0	102	0.28	102	0.20
	Erebidae	*Ophiusa coronata*	140	0.93	27	0.08	167	0.33
	Hesperiidae	*Hobomok skipper*	2	0.01	116	0.32	118	0.23
Mantodea	Mantidae	*Sphodromantis lineola*	131	0.87	118	0.33	249	0.49
Odonata	Libellulidae	*Orthetrum chrysostigma*	103	0.68	42	0.12	145	0.28
Neuroptera	Myrmeleontidae	*Euroleon* sp.	3	0.02	13	0.04	16	0.03
	Ascalaphidae	*Libelloides macaronius*	0	0	42	0.12	42	0.08
Blattodea	Termitidae	*Odontotermes obesus*	0	0	1500	4.18	1500	2.94
		Total	**15,120**	**29.63**	**35,901**	**70.37**	**51,021**	**100**

RA = Relative abundance

Result of dominance, diversity and richness of insects in the rice farm

The results on dominance, diversity and richness of insects found on rice cultivated in the two sites studied are presented in Table 3 which shows that Simpson dominance index of site 1 (0.6845) was higher than that of site 2 (0.0019). The Shannon Weiner diversity index of site 1 (1.07597) was higher than that of site 2 (0.41248). The Margalef richness index of site 2 (6.3879) was higher than that of site 1 (4.9876). The Shannon Weiner evenness of site 1 (0.1118) was higher than that of site 2 (0.0393).

Table 3: Simpson dominance, Shannon Weiner Diversity and Mangalef richness of insects in the rice farm

Sites	**Simpson dominance index (C)**	**Shannon weiner diversity index (H)**	**Margalef richness index (D)**	**Shannon Weiner Evenness (E)**
Site 1	0.6845	1.07597	4.9876	0.1118
Site 2	0.0019	0.41248	6.3879	0.0393

DISCUSSION

The findings of this study shed light on the insect diversity and abundance within two rice farms located at Nnamdi Azikiwe University, Awka. The research encompassed the enumeration of insect populations across twelve insect orders, providing insights into the ecological dynamics of these agricultural ecosystems. The total insect count across the two farms were 51,021, demonstrating a rich insect presence. Site 2 exhibited a substantially higher insect abundance with 35,901 insects (70.37%) compared to the 15,120 insects (29.63%) collected from site 1. This variation in insect numbers could be attributed to a range of factors, including microclimate differences, habitat complexity and agronomic practices. Such disparities in insect abundance have been observed in other studies as well (Okeke *et al*., 2019), reinforcing the idea that diverse ecological factors influence insect distribution within agricultural landscapes.

Among the identified insect orders, Orthoptera, Heterocera, Hemiptera and several others displayed a higher relative abundance in site 1 compared to site 2. These results align with the work of (Iqbal, 2020; Odebiyi, 2017), who reported the prevalence of Orthoptera and Hemiptera in similar agricultural settings. Conversely, Hymenoptera, Neuroptera andBlattodea demonstrated greater abundance in site 2. This differential distribution may arise from variations in vegetation cover, microclimate conditions and potential ecological niches (Okeke *et al*., 2019; Bhatt *et al*., 2018; Deutsch *et al*., 2018). The significant difference in insect populations between the two sites, as indicated by a p-value of 0.01, underscores the distinctiveness of each farm's entomological community. This finding resonates with the observations of Cinar and Koklu (2019), who documented significant variations in insect diversity across different farm management practices. The implications of these differences extend beyond the immediate study area and contribute to the broader discourse on biodiversity patterns within agricultural landscapes. Comparing these findings with the study by Asghar *et al*. (2013) conducted in similar Nigerian agricultural contexts, there is a similarity in the observed variation of insect abundance influenced by ecological details. This similarity not only validates the present study results but also underscores the consistent influence of environmental factors on insect populations in Nigerian rice farms.

The examination of insect species within the two rice farms at Nnamdi Azikiwe University, Awka, unveils a more complex depiction of insect diversity and their site-specific associations. The results presented in Table 2 delineate the relative abundance of insect species across the two farms, showing meaningful insights into the insect community composition. The data highlights a remarkable distinction in the relative abundance of specific insect species between the two sites. Among the identified species, *Crematogaster peringueyi* occurred as the most abundant (82.67%) insect species in site 1, while *Camponotus perrisi* was highest (27.85%) in site 2. Moreover, the study documented *Hobomok skipper* as the least abundant species (0.01%) in site 1. Correspondingly, in site 2, species such as *Catantopsquadratu, Anacatantopsnotatus, Dysdercuscingulatus, Crematogasterperingueyi, Dasyleurotettixinfaustus* and*Apis mellifera* shared the same minimal relative abundance (0.01%). This diversity in species distribution underscores the complex interaction of environmental factors and habitat preferences among insect species (Okeke *et al*., 2019).

The calculated statistical significance, denoted by a p-value less than 0.05, emphasizes the meaningful disparity in insect species abundance between the two sites. These findings align with the research by Edirisinghe and Bambaradeniya (2010), who reported site-specific variations in insect species richness and composition within Nigerian rice fields. Table 2 also shows fascinating insights regarding species exclusivity. The phenomenon of species exclusivity emphasizes the distinct ecological niches that each site offers to specific insect species. Comparatively, these findings are in line with the outcomes of Asghar *et al*. (2013), who observed differential species compositions between varying agricultural management practices. The study by Isnawan and Ramadhanti (2021) further corroborates these results by reporting a similar pattern of insect species distribution within Nigerian rice ecosystems.

The investigation into insect dominance, diversity and richness within the rice fields of the two study sites offers a clearer view on the entomological dynamics of these agricultural landscapes. The findings, as presented in Table 3, presented the details of insect community structure and provide insights into the prevalence of specific insect traits across the two sites. The Simpson dominance index, a metric indicating the abundance of dominant species, revealed that site 1 exhibited a Simpson dominance index of 0.6845, marginally higher than that of site 2 which also recorded a value of 0.0019. This slight variance in dominance implies that there is a balance between dominant insect species in both sites. The similarity in dominance indices could arise from shared environmental conditions and habitat characteristics across the two sites (Okeke *et al*., 2018; Okeke *et al*., 2019).

The Shannon-Weiner diversity index, a measure of species diversity, highlighted a divergent depiction. Site 1 boasted a higher diversity index of 1.07597, whereas site 2 displayed a lower value of 0.41248. This disparity signifies that site 1 hosts a more varied range of insect species compared to site 2. This finding is in line with the work of Kotey *et al*. (2020), who similarly reported higher insect diversity in specific crop varieties. The Margalef richness index, reflecting species richness, exhibited a contrasting pattern. Site 2 documented a Margalef richness index of 6.3879, surpassing site 1 which had a value of 4.9876. This implies that site 2 supports a greater number of distinct insect species. Such variations in species richness are influenced by habitat complexity and environmental factors (Nadeem and Farooq, 2019; Nawaz *et al*., 2019), substantiating the observed pattern.

Furthermore, the Shannon-Weiner evenness index, an indicator of species evenness, showed a disparity. Site 1 recorded a higher evenness index of 0.1118, in contrast to site 2 which has lower value of 0.0393. This finding implies that insect community in site 1 is more evenly distributed among various species, while site 2 displays a less balanced distribution. The interaction between dominant and less common species contributes to these variations. These results collectively emphasize the complex interaction of ecological variables within the two study sites. By comparing these findings to established literature, it becomes apparent that the diversity, dominance and richness patterns observed in this study align with broader ecological principles (Liu *et al*., 2021).

CONCLUSION

The comprehensive analysis of insect dynamics in some selected rice farms in Nnamdi Azikiwe University Awka, Anambra State offers valuable insights into the complex relationships that shape insect populations and their interactions with environmental variables. Through the exploration of various facets of insect abundance, distribution and relationships with temperature and relative humidity, this study contributes to our understanding of the complex dynamics within agricultural ecosystems.

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