Entomology

A preliminary survey of arthropods in organic and inorganic paddy fields in Cheranmahadevi Taluk, Tamil Nadu, India

Sivanesh H[1], Augustus Robince[2] and Azhagu Raj R[1*]

[1] Department of Zoology, St. Xavier's College (Autonomous), Palayamkottai, Tamil Nadu, India

[2] Department of Zoology, St. John's College, Palayamkottai, Tamil Nadu, India

Correspondence Author: Azhagu Raj R

Received 24 Nov 2023; Accepted 9 Jan 2024; Published 15 Jan 2024

Abstract

India has a primarily agrarian economy. Agriculture contributes around 16-17% to the overall Gross Domestic Product (GDP) of the country. In this study, conducted in rice fields at Pappakudi (8°45'44"N, and 77°30'59"E) and Odaikarai-Thulukapatti (8°46'52"N, and 77°31'01"E) Cheranmahadevi Taluk**,** Tirunelveli District in Tamil Nadu, India, arthropods were collected from the study area and classified. This collection was done using the roving survey method, and relative abundance percentage composition was analysed. The order Hymenoptera emerged as the most diverse group of beneficial insects in both organic and inorganic fields, notably ants and honey bees. Order Orthoptera, including grasshoppers, had the highest count of 27.7%. The Chrysomelid beetle was completely absent in the organic fields. The ant family Formicidae and the butterfly family Lycaenidae were not found in the inorganic fields. Both agricultural practices exhibited low counts of families and genera in the orders Lepidoptera (butterflies and moths) and Araneae (spiders). This study shows diverse arthropods damaging or benefiting paddy on organic and inorganic farms. Compositional analysis revealed differences in the presence and abundance of certain insect families among these two farming practices.

Keywords: insects diversity, organic farming, beneficial insects, and harmful insects

Introduction

Agriculture is India's backbone. During the previous six years, the Indian agriculture industry has grown at a 4.6 percent annual current [1]. Various predators and parasitoids of rice pests in paddy fields attack the egg and larval stages of these species. Beneficial species in each region enhance the success of their attack on each pest at specific stages and can be useful in conservation biological control programs [2]. The different pest management systems, especially in the case of the use of synthetic pesticides, will have an impact on the abundance and richness of insect species. High diversity and abundance of insects were shown in the use of low-synthetic pesticides [3]. The use of synthetic pesticides will have an impact on the abundance and richness of insect species. High diversity and abundance of insects were shown in the use of low-synthetic pesticides [4]. Conservation and better utilization of these natural enemies might reduce the application of insecticides and various ecological repercussions that arise from the indiscriminate use of insecticides [5]. In the rice farm, the insect groups based on their diversity of functions include insect pests, natural enemies, and neutral insects [6]. Pests are a main causative factors in yield loss, either directly eating plant surface 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 [7].

Materials and Methods

Description of the study area

This study was conducted in and around Papakudi and Odaikarai Thulukapatti, Tirunelveli District, Tamil Nadu, India. The normal climatic condition of the study area is typical of the tropics. The summer is long, hot, and dry, extending from March to June. Winter is generally mild, extending from November to January. The area enjoys maximum rainfall from October to December and summer showers from April to June as a supplement. Pest population that causes damage to paddy fields. The organic agricultural field is located in Pappakudi (8°45'44"N and 77°30'59"E). The inorganic agricultural field is located in Odaikarai Thulukapatti (8° 46' 52 N and 77° 3101E). In the survey carried out from January 2022 to February 2022 in both organic and inorganic agricultural fields, different parts of the plant, namely the lower, middle, and upper leaves, were selected for inspection. The underside of the leaves was meticulously examined for the presence of arthropods. Counts were conducted after 3:30 p.m.

Collection and identification of insects

Roving survey

Assessment of pest population or damage from randomly selected spots representing a larger area, a large area surveyed in a short period, provides information on pest level over a large area.

Identification of insects

Sony 64MP camera (26mm, f/1.8), Sony IMX682 sensor, 1/1.73" sensor size) was used for photography, and all the insect photography was identified from the Department of Entomology at Agricultural College and Research Institute, Killikulam.

Relative abundance

Relative abundance is the percent composition of an organism of a particular kind relative to the total number of organisms in the area [8]. Relative abundance was calculated:

$$\text{Relative abundance} = \frac{\text{Total no. of each species}}{\text{Total no. of all species}} \text{X } 100$$

Results

In this present study, we observed arthropods in organic and inorganic paddy fields. Table (1 and 2) documents and tabulates the arthropods identified on 2 acres of organic and 2 acres of inorganic agricultural land. In arthropods, two classes, insect and Arachnida, were recorded. Within the class Insecta, six orders were identified: Orthoptera, Coleoptera, Hemiptera, Hymenoptera, and Lepidoptera. Under the order Orthoptera, one family was observed: Acrididae. In the Acrididae family, four genera were recorded. The order Coleoptera included two families: Coccinellidae and Chrysomelidae. The Coccinellidae family had the genus Harmonia, and the *Chrysomelidae* family included the genus *Aulacophora*. Three families, Pentatomidae, Alydidae, and Berytidae, were documented within the order Hemiptera. Each of these families had one genus: Eurydema, Leptocorisa, and Jalysus, respectively. The order Odonata was represented by the two families Coenagrionidae and Libellulidae, which contained two genera: *Ischnura* and *Diplacodes.* Within the order Hymenoptera, two families were identified: Formicidae and Apidae. These families were associated with the genera *Lasius*, *Dolichoderus*, and *Apis*, respectively. In the class Arachnida, the order Araneae was the sole representation, with one family: Araneidae. The family featured the genera *Argiope*.

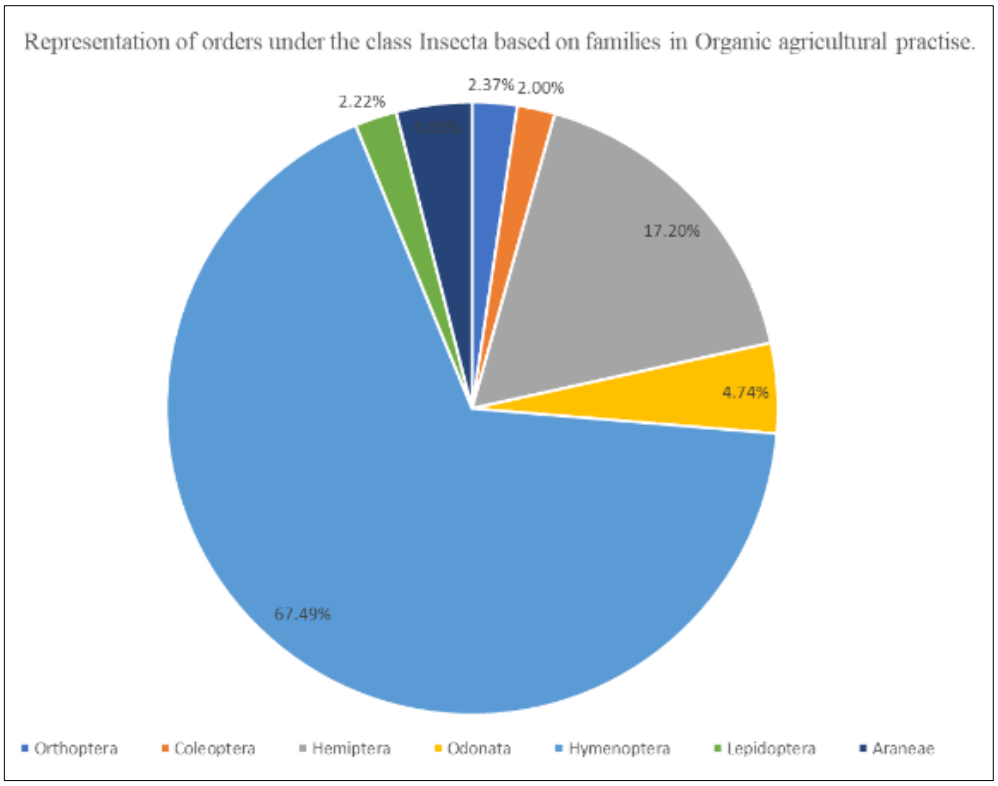
Table 1: List of arthropods belonging to different classes, Orders, Families and Genus in Organic paddy fields

Class	Order	Family	Geneus	Number of insect (1 month)	Relative abundance %
Insecta	Orthoptera	Acrididae	*Chorthippus*	16	2.37
Insecta	Coleoptera	Coccinellidae	*Harmonia*	14	2.0
		Chrysomelidae	*Aulacophora*	0	0
Insecta	Hemiptera	Pentatomidae	*Eurydema*	33	4.89
		Alydidae	*Leptocorisa*	67	9.94
		Berytidae	*Jalysus*	15	2.22
Insecta	Odonata	Coenagrionidae	*Ischnura*	11	1.63
		Libellulidae	*Diplacodes*	21	3.11
Insecta	Hymenoptera	Formicidae	*Lasius*	45	6.67
		Formicidae	*Dolichoderus*	10	1.48
		Apidae	*Apis*	400	59.34
Insecta	Lepidoptera	Lycaenidae	*Euchrysops*	15	2.22
Arachnida	Araneae	Araneidae	*Argiope*	27	4.00

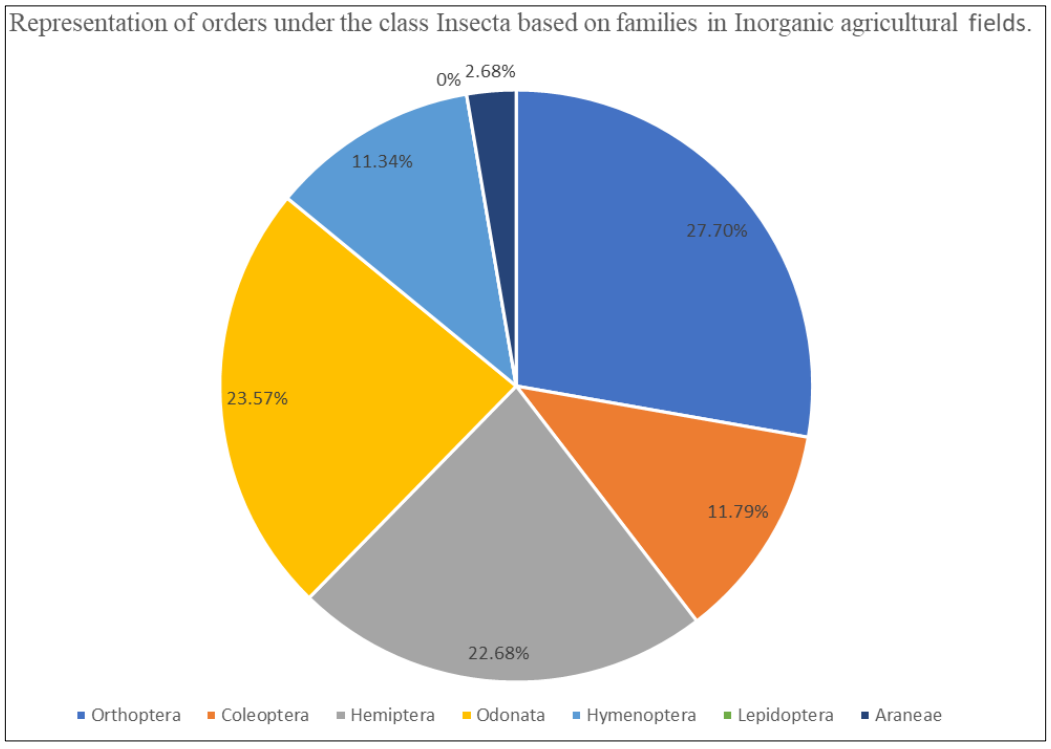
Table 2: List of arthropods belonging to different classes, orders, families and genus in inorganic paddy fields

Class	Order	Family	Geneus	Number of insect (1 month)	Relative abundance %
Insecta	Orthoptera	Acrididae	*Chorthippus*	93	27.7
Insecta	Coleoptera	Coccinellidae	*Harmonia*	34	10.14
		Chrysomelidae	*Aulacophora*	6	1.79
Insecta	Hemiptera	Pentatomidae	*Eurydema*	18	5.37
		Alydidae	*Leptocorisa*	58	17.31
		Berytidae	*Jalysus*	0	0
Insecta	Odonata	Coenagrionidae	*Ischnura*	45	13.43
		Libellulidae	*Diplacodes*	34	10.14
Insecta	Hymenoptera	Formicidae	*Lasius*	13	3.88
		Formicidae	*Dolichoderus*	0	0
		Apidae	*Apis*	25	7.46
Insecta	Lepidoptera	Lycaenidae	*Euchrysops*	0	0
Arachnida	Araneae	Araneidae	*Argiope*	9	2.68

The graph (1) illustrates the diversity in organic agricultural practices of arthropod orders, families, and genera within the classes Insecta and Arachnida. Within the Insecta class, the order Hymenoptera stands out with the highest count of families and genera, while the orders Lepidoptera and Odonata exhibit the lowest counts of families and genera. Graph (2) illustrates the diversity in inorganic agricultural practices of arthropod orders, families, and genera within the classes Insecta and Arachnida. Within the Insecta class, the order Orthoptera stands out with the highest count of families and genera, while the orders Lepidoptera and Araneae exhibit the lowest counts of families and genera.



Graph 1: Representation of orders under the class insecta based on families in organic agricultural fields.



Graph 2: Representation of orders under the class insecta based on families in inorganic agricultural fields

Discussion

Hemke and Giri [10] reported that we know honeybees play a vital role in pollination services for plants and crops and also play a mainly ecological and economic role. Beekeeping and honeybees are affected by practices of agrochemicals (inorganic cultivation) on farms. Usually, flower blooming time farmers use agrochemicals (pesticides), while flower blooming time honey bees collect pollen from plant flowers, which harms the honey bee colony. Parasappa [12] analyzed a large number of insect species associated with rice production and their damage to rice production. Many important pest species have been identified, and a large number of natural enemies (predators and parasitoids) species have founded their shield of the crop growing period from pests. Providing good biological control agents can be exploited in the management of the major insect pests of rice. Anbalagan [13] has reported that Hymenoptera and Odonata were found to be the most important predatory insects in paddy crops, and the maximum numbers of insects were found to be samba season between those favorable climatic factors to influence. Ambar and Ilmi [14]

analysed the diversity of arthropods trapped in rainfed rice fields during the generative phase is 35 species, and arthropods trapped in rainfed rice fields were 6 species (17.8%), while natural enemies were 29 species (82.2%). Pustika [15] analyzed pest insects found during the vegetative stage of rice consist of more species, while lower numbers were found at the generative stage with fewer species. They belonged to six orders (more than 10 families), such as Diptera, Lepidoptera, Coleoptera, Orthoptera, Hemiptera, and Hymenoptera. The leading harmful insect was Cicadellidae, followed by Delphacidae and Alydidae. Mbelede [15] reported the complex dynamics inside agricultural ecosystems by investigating several aspects of insect abundance, distribution, and connections with temperature and relative humidity. Sangeetha [16] reported the major insect pests in the rice field ecosystem: rice stem borers, *Scirpophaga incertulas*, rice leaf folders, *Cnaphalocrocis medinalis* and leafhoppers, *Nephotettix virescens*, *Nephotettix nigropictus*, *Nephotettix malayanus*, and *Cofana spectra*. Yunus [17] reported orders Diptera and Aranea had the most species, with 18 species each, while the order Hymenoptera had the highest number of individuals.

Conclusion

This study analyzed and compared the diversity and relative abundance of beneficial insects found in organic and inorganic rice fields using the roving survey method. The results showed that the order Hymenoptera, including ants and honey bees, was the most diverse group in both agricultural systems. However, there were some key differences. Organic fields supported a greater diversity of beneficial insects overall, harboring certain families like *Formicidae* (ants) and *Lycaenidae* (butterflies) that were absent in inorganic fields. The populations of several typically beneficial insect taxa, like *Lepidoptera* and *Araneae* (spiders), were lower in both systems. The data indicate that agricultural practices impact arthropod diversity and composition. Organic farming tends to support a wider variety of beneficial insect families, while inorganic farming favors crop pests over natural enemies. Further research is needed to clarify the long-term ecological impacts of different farming practices.

Acknowledgements

The author extends their sincere thanks to the Department of Zoology, St. John's College, Palayamkottai. Author thanks to Dr. T. Abdul Razak Department of Entomology, Agricultural College and Research Institute Killikulam. the authors would like to thanks Farmar's Mr. Poosadurai Arasamuthu and Mr. V. Chanthira Shekhar.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

Conceptualization: HS, RA. Data curation: HS, Formal analysis: HS, PA RA. Investigation: PA, Methodology: HS, PA. Resources: PA. Supervision: PA. Visualization: PA. Project administration: PA. Software: HS. Validation: HS. Writing – original draft: HS. Writing – review and editing: HS, PA, RA.

References

1. Economic Survey of India, Ministry of Finance, Government of India, 2022. https://www.indiabudget.gov.in/economicsurvey/doc/echapter/echap08.pdf
2. Ardestani M. The Most Important Natural Enemies of Oryza Sativa L. Pests in Asian Rice Fields: A Survey. Pests in Asian Rice Fields: A Survey, 2023, 1-20. https://dx.doi.org/10.2139/ssrn.4349772
3. Fathima S, Pirya S, Meeran M., Arivoli S, Tennyson S. Assessment of insect diversity in paddy fields of Uthamapalayam, Theni district, Tamil Nadu, India. Journal of Wildlife and Biodiversity. 2021;5(2):88-98.
4. Afifah L, Sugiono D. The Diversity of Insect in Paddy Field in Karawang, West Java with Different Pest Management Techniques. Jurnal Ilmu Pertanian Indonesia, 2020, 25(2).
5. Tenguri P, Kranthi S, Naik CB, Mari A, Kumar R, Suke R, *et al*. The comparison of species diversity and abundance of insect natural enemies in the domesticated species of cotton using the yellow pan trap method. Scientific Reports. 2024;14(1):2787.
6. Sumarmiyanti Handayani F. SundariInsect diversity in lowland rice plantations in Kutai Kartanegara district, East Kalimantan in Proceedings of the Indonesian Biodiversity Society Seminar, 2019, 217-221.
7. Hendrival HL, Halimudin. Composition and diversity of predatory arthropods in agroecosystems. Rice Journal of Floratek. 2017;12(1):21-3.
8. Angelo MPW, Canencia MOP. Physio-chemical Parameters and Macrobenthic Invertebrates of the Intertidal Zone of Gusa, Cagayan de Oro city, Philippines. Advances in Environmental sciences–International J. of the Bioflux Society. 2016;8(1):71-82.
9. Hemke V, Giri Y. Present Status and Impact of Insecticide on Honey Bees in India: A Review. International Journal of Researches in Biosciences, Agriculture and Technology. 2022;3(10):99-102.
10. Tenguri P, Kranthi S, Naik CB, Mari A, Kumar R, Suke R, *et al*. The comparison of species diversity and abundance of insect natural enemies in the domesticated species of cotton using the yellow pan trap method. Scientific Reports. 2024;14(1):2787.
11. Parasappa HH, Narasa Reddy G, Neelakanth. Rice insect pests and their natural enemies complex in different rice ecosystem of Cauvery command areas of Karnataka. Journal of Entomology and Zoology Studies, JEZS. 2017;5(5):335-338.
12. Anbalagan V, Nithiyanandam T, Ponni C. Insect diversity and species distribution in rice field of Tharangambadi Taluk, Nagapattinam district, Tamil Nadu, India. International Journal of Entomology Research. 2020;5(3):29-32.
13. Ambar AA, Ilmi N. Arthropods Diversity at Paddy Generative Phase in Rainfed Rain Field. Nusantara Science and Technology Proceedings, 2023, 1-7.
14. Pustika AB, Widyayanti S, Kobarsih M, Rumanti IA, Widyastuti Y, Wibowo BP, *et al*. Insect Diversity of Some Hybrid Rice Genotypes in Sleman-Yogyakarta Irrigated

Agroecosystem. In IOP Conference Series: Earth and Environmental Science, IOP Publishing. 2023;1287(1):012023.
15. Mbelede KC, Akunne CE, Ononye BU, Chidi CA, Okafor KP, Okeke TE, *et al*. Diversity of Insects of Two Rice (Oryza sativa L. 1787) Farms in Nnamdi Azikiwe University, Awka, Nigeria. Asian Journal of Biology. 2023;19(3):44-56.
16. Sangeetha M, Alaguchamy N. Biodiversity and Distribution pattern of Hemipteran insect bugs associated with Rice field Ecosystem of Sivaganga, Tamil Nadu, India. Sustainability, Agri, Food and Environmental Research, 2024, 12(2).
17. Yunus M. Arthropoda Diversity in Paddy Field with Refugia Plants. In *2nd International Interdisciplinary Conference on Environmental Sciences and Sustainable Developments 2022 Environment and Sustainable Development (IICESSD-ESD-22)*. Atlantis Press, 2024, 34-39.