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Exploring the diversity: A review of insect pests in agroecosystems.

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Abstract
Insect pests are the important threat to agroecosystem. The review highlights the diversity of insect pests, with thousands of species affecting agroecosystem. According to research studies the recorded common species belonging to the orders as Coleoptera, Lepidoptera, Hemiptera and Dictyoptera. This review paper studies on the diversity of insect pests to provide an overview of the current state of knowledge on the diversity of insect pests from the agroecosystems. It also considers the effect of external factors such as globalization, climate change and high temperature on pest diversity. Future research directions advocate for the molecular insights, integration of ecological principle and innovative technologies to our understanding of insect pest diversity. Cooperative efforts among scientists, researchers and industry investors are essential to study the insect pests diversity.

Keywords: Insect pest, diversity, agroecosystem

Introduction

The majority of countries in the world are depends on agriculture. Crops cultivation practices differ from country to country due to differences in geography and other factors. Globally, soybeans, wheat, rice, corn, sorghum, fruits, cotton, pulses, groundnuts, and sugarcane are among the common crops that are grown. Research on the diverse field of insect pests in agroecosystems should be conducted, with a particular emphasis on the diversity of insect pests from international, national, and regional areas, according to existing synthesizing literature. This review paper based on earlier research studies that integrate the diversity of insect pests or Insect pests cause more losses to the majority of agricultural crops worldwide, according to a recent FAO report. Pests in agroecosystems can be classified in a variety of ways. Some orders of insect pest like Hemiptera, Odonata, Coleoptera, Orthoptera, Lepidoptera, Diptera, Hymenoptera, Dermoptera, Homoptera are the most common found in agroecosystem. (Dayana, L. Merlin, and J. Banu 2019) [13] According to Smith and Basch (1967), other pests are categorized based on their nature, intensity, and status as regular, occasional, prospective, seasonal, migrant, and/or regular pests (Gyeltshen, 2009). There is a wide variety of insect pests in agroecosystems, each insect pests have unique ecological characteristics, behaviors, habitats, and life cycles which is observed during earlier research literatures. These insect pests range in abundance from widely distributed generalists to highly specialized species, and each has developed distinct adaptations that affect how they interact with crops and other creatures in the agroecosystem. Understanding the diversity of insect pests is essential for forecasting pest outbreaks, estimating their effects on crop yields, and creating tailored management strategies that pose challenges for individual species.

In the end, a deeper comprehension of insect pest diversity is based on earlier research publications. This insect pests diversity which is varies from crop to crop and region to region, though some insect pests are frequently found throughout the world. Previous research studies indicate that this review paper study is crucial for enhancing agricultural sustainability, resilience, and food security in a world that is changing quickly. This review aims to fill up some of the knowledge gaps by pointing out areas that could use more research and practical application in agroecosystems across the globe.

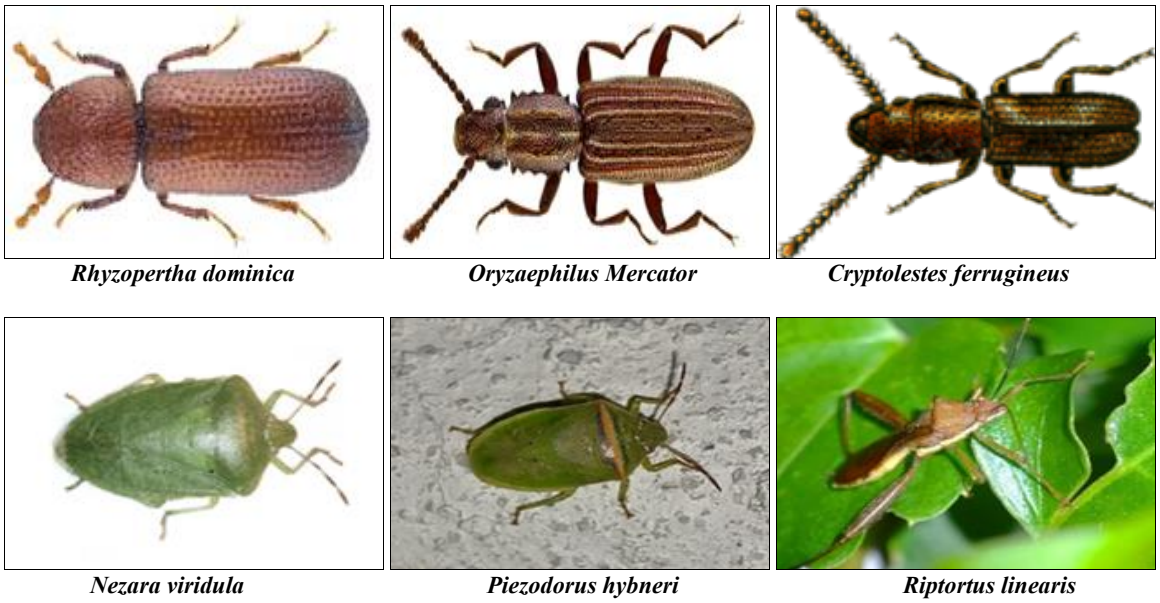
Discussion

Many researchers from different parts of the world have reported insect pests diversity of agroecosystems, which were observed during their studies. Some research studies which are discussed in this review paper according to International, National and Regional level.

1. International Status: (World Wide)

Fauzia Abdullah *et al*, (2008) [8] This survey study was conducted from Malaysia during July 2006 and March 2007. They are observed nine orders of insect pests belonging to 45 families. John T. Trumble *et al*, (2009) [14] Climate change will impact the movement of nonnative insect species into California. Fluctuation of insect pest biodiversity because of climatic changes. M. M. H. Khan (2013) [26] This study conducted from coastal rice habitat to determine abundance and diversity of insect pests and natural enemies. This study conducted in Patuakhali district sheds light on the different seven insect pests and seven natural enemies found during July 2010 to January 2011 in rice fields, with a focus on the influence of rice growth stages. Noor U Ane *et al*, (2015) [27] This study was conducted during June 2015 to September 2015 on major Rice growing countries of the world were studied in terms of pest diversity that they had in their rice fields that included many countries like Thailand, Philippines, China, India, and Sri Lanka, Bangladesh. Waongo *et al*, (2015) [2] This research study provides informative data on the insect pest dynamics affecting stored sorghum in Burkina Faso. The research identifies the primary insect pest is *Rhyzopertha dominica* (6), and secondary insect pests are the *Oryzaephilus Mercator* (20), *Cryptolestes ferrugineus,*

and *Sitophilus zeamais*. 14 species of insect pests were recorded from two different orders including coleopteran twelve and lepidopteran two species. Sri Wahyuni Indiati *et al*, (2017) [40] The survey conducted in East Java mung bean fields revealed a spectrum of insect pests. Among them, bean fly, thrips, and grasshoppers were consistently observed but in low numbers. However, there are some pods sucking bugs *Nezara viridula*, *Piezodorus hybneri*, and *Riptortus linearis* posed a significant threat due to their relatively high population densities. Tetiana Grabovska *et al*, (2020) [42] The research study is insects diversity in Soybean crops under organic and conventional farming. In this research study, researchers identified insect pests from 13 families from the studied areas. Kazi Ashad-Uz-Jaman *et al*, (2022) [17] In this study, 314 individuals from 37 families across 9 Orders were documented. Among the 82 insect pest species, 72 were identified. The observation of this study is the Lepidopterans constituted 62%, while Coleopterans accounted for 19%. The peak insect pest activity occurred in July (18.89%), while September witnessed the lowest incidence (1.91%). Alexey Pachkin *et al*, (2022) [1] This research study aimed to monitor the species diversity and the dynamics of the number of soybean pests with the help of light traps to monitor soybean pests. These light traps capture 44 insect species from the 8 orders and 27 families. Virginie Roy *et al*, (2023) [43] This study used DNA barcoding to identify insect pests in common bean and pigeon pea fields across agricultural regions in the Republic of Congo. The cosmopolitan seed-beetle (*Acanthoscelides obtectus*) emerged as a major pest in common bean, while the sub-Saharan species (*Specularius erythraeus*) dominated pigeon pea plots.



Rhyzopertha dominica ***Oryzaephilus Mercator*** ***Cryptolestes ferrugineus***

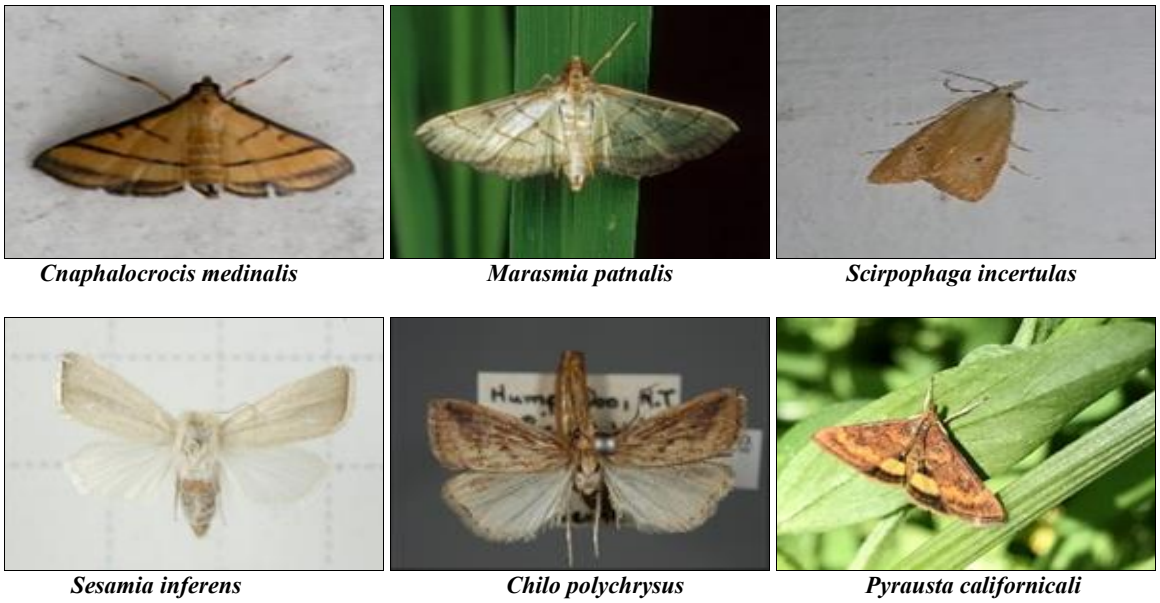
Nezara viridula ***Piezodorus hybneri*** ***Riptortus linearis***

Fig 1

National Status: (India)

H. C. Sharma *et al*, (2003) [4] On the researchers observation, they are evaluated 30 Arachis spp. Accessions and 12 derived lines for resistance to insect pests in groundnut. Notably, species like *Arachis cardenasii*, *Arachis duranensis*, and *Arachis jappressipila* exhibited multiple resistances. J. Edwin *et al*, (2011) [12] Research has shown that the diversity and population dynamics of light trapped insects from Courtallam Tropical Rainforest in Tamil Nadu, South India. This study conducted in the Western Ghats region provides valuable data of the insect species from orders Coleoptera,36tha Hemiptera, Hymenoptera, Isoptera, Lepidoptera are found in this unique ecosystem. Babita Bhatt *et al*, (2016) [3] In this study, researchers investigated the diversity of insect pests and predators in an experimental field during the kharif season of 2016. The findings reveal a total of 17 species of insect pests and a diverse predator population, providing valuable insights into the dynamics of pest-predator interactions in okra cultivation. Navendu Nair *et al*, (2017) [28] This study examined insect pests in Tripura's okra fields during both summer and winter seasons. A total of 28 pest species from 6 orders were identified. Hemiptera dominated (12 species), followed by Lepidoptera (9) and Coleoptera (4). The diversity indices were comparable between seasons. Notably, leaf hoppers, aphids, and white flies were more abundant in winter, while blister beetles caused damage in summer. JK Bana (2018) [15] This research study was conducted between 2013 and 2017 to explore the diversity and extent of damage caused by major and minor insect pests affecting mango crops. During extensive field surveys, the primary insect pests observed were hoppers, thrips, and fruit flies. Kanagaraj L *et al*, (2019) [18] This research study conducted during the Rabi season (October to February) at the Agricultural College and Research Institute in Madurai, researchers investigated the diversity of major insect pests affecting rice crops. Researchers observed three species of rice leaf folders: *Cnaphalocrocis medinalis*, *Marasmia patnalis*, and *Marasmia ruralis* and three species of rice stem borers were identified: *Scirpophaga incertulas*, *Sesamia inferens*, and *Chilo polychrysus*. SS Bora *et al*, (2020) [39] Researchers conducted a study at the Horticultural Research Farm of Assam Agricultural University in Jorhat, Assam during the rabi season for two consecutive years (2017-18 and 2018-19). A total of 23 insect pests were identified as affecting the Bhut Jolokia crop. Ramesh Prajapat *et al*, (2021) [36] This research study on the diversity of insect fauna in Rajasthan, India. This review by Ramesh Prajapat and Shashi Meena from the University of Rajasthan provides a comprehensive overview

of the insect species found in four eco-geographical regions of Rajasthan. With 878 insect species and subspecies recorded across 104 families and 14 orders, this study highlights the rich insect diversity present in the state. Pawan kumar *et al*, (2022) [32] This study explored insect pest diversity across four selected sites in Himachal Pradesh, India. Researchers investigated 32 insect species, including Coleoptera (beetles), Hymenoptera, Hemiptera, Orthoptera, Dermaptera, and Lepidoptera (butterflies and moths). Notably, Coleoptera emerged as the dominant insect group attacking trees in these high-altitude transitional zones, followed by Lepidoptera and Hemiptera (aphids). The study sheds light on the intricate dynamics of insect pests in this region.



Cnaphalocrocis medinalis ***Marasmia patnalis*** ***Scirpophaga incertulas***

Sesamia inferens ***Chilo polychrysus*** ***Pyrausta californicali***

Fig 2

Regional Status: (Maharashtra)

T.V. Sathe *et al*, (2010) [41] This research study revealed 27 aphid species across 14 genera, including *Acyrthosiphon*, *Aphis*, *Brevicoryne*, and more. Additionally, 16 new aphid species were documented on both agricultural and non-agricultural plants. Notably, the most abundant genera were *Aphis*, *Rhopalosiphum*, and *Myzus*. V.G. Thakare *et al*, (2011) [44] This research conducted in the Kolkas region of Melghat Tiger Reserve, Maharashtra, scarab beetles were studied from May to October 2009. A total of 26 species across 14 genera and 8 subfamilies were identified. The dominant subfamily was Scarabaeinae, with Onthophagus as the prevailing genus. S.M. Dadmal *et al*, (2014) [37] This research study explored insect species attracted to light traps. Notably, Coleoptera dominated, comprising 41.81% (2011-12) and 35.10% (2012-13) of the total collection. Hemiptera and Lepidoptera followed. Scarab beetles, especially from the Melolonthinae subfamily, played a significant role. The study sheds light on insect diversity using the Shannon Biodiversity index. Somnath Waghmare *et al*, (2015) Survey of Short-Horned Grasshoppers (Orthoptera: Acrididae) in Solapur District, Maharashtra, India. A total of 7 grasshopper species were identified. These species belonged to 7 different genera: *Acrida*, *Gastrimargus*, *Trilophidia*, *Catantops*, *Calaptenopsis*, *Chrotogonus*, and *Atractomorpha*. Pradeep Kale *et al*, (2020) [31] This research study explored aphid diversity and associated predators across Kharif and Rabi crop systems in Akola. Seven aphid species were identified, including *Aphis gossypii*, *Aphis craccivora*, and *Lipaphis erysimi*. Linta Paulson *et al*, (2020) [22] This study provides valuable scientific data on the incidence and infestation severity of pest insects in the Vadodara agroecosystem. A total of 163 pest species were documented. Coleoptera emerged as the most diverse order, with 69 species across 16 families. Other orders included Orthoptera (34 species), Lepidoptera (31 species), and Hemiptera (29 species). Lokesh N Wankhade *et al*, (2021) [20] Insect Fauna Survey conducted during the rainy season, a comprehensive survey of the agricultural fields in Karanja (Ghadge), located in Wardha District, was conducted to explore the insect diversity. A total of 44 insect species were identified. These species belonged to 9 orders and 28 families. Lokesh N Wankhade *et al*, (2021) [20] A comprehensive study on moth diversity was conducted during the rainy season in Tirora, located in Gondia District, Maharashtra. A total of 34 moth species were identified. These species belonged to 8 families and 17 subfamilies. Rupesh B. *et al*, (2022) [35] The research study conducted between September 2020 and March 2021, 25 insect pest species were identified by researcher, across 29 sampling sites in 7 villages. These pests spanned 4 orders (Orthoptera, Hemiptera, Coleoptera, and Lepidoptera) and 12 families (including Gryllidae, Acrididae, and Chrysomelidae). Mahale P. N *et al*, (2023) [25] This study conducted across different localities in Dhule Tehsil, Maharashtra, revealed a total of 39 agricultural insect pests from 20 families and 10 orders. Notably, Thysonopterans, Hemipterans, Lepidopterans, and Isopterans caused significant crop damage. Meanwhile, other orders like Diptera, Orthoptera and Coleoptera were minor pests.

Aphis gossypii *Aphis craccivora* *Lipaphis erysimi*

Fig 3

Conclusion

This review research paper is a compilation of all the information related to the diversity of insect pests. Insect pests exhibit considerable diversity in agroecosystems. The species range includes both native and introduced pests that target different crops, resulting in varying effects on agro-organisms and their productivity.

Continued research is essential to understand the behavior, ecology, outbreaks and genetics of insect pests. This knowledge can help to develop more targeted and sustainable pest management methods. From diverse species affecting crops to the influence of external factors like climate change, our exploration highlights the need for sustainable and adaptable pest management strategies. Rising temperatures and shifting weather patterns can affect pest populations and the effectiveness of control measures. Research studies have indicated that certain common insect pests are found globally in agroecosystems. There are identified some common insect pests species belonging to the orders Coleoptera, Lepidoptera, Hemiptera, and Dictyoptera, Orthoptera.

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