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Diversity of Insects Related to Paddy Field in Tala Taluka of Raigad District

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Abstract

Rice, a major agricultural crop grown in India, has undergone changes in its insect pest dynamics in recent times. The quantity and diversity of insects in the rice ecosystem vary alongside the growth phases of the sowing season. Although some arthropod species pose a threat to rice crops, most are benign and coexist within rice fields. The study was conducted in a paddy field (Oryza sativa) from August 2024 to October 24 during the rainy season. The quadrant method is involved in insect collection. The process entails arranging ropes of uniform length at right angles to create squares of suitable dimensions and documenting the count of various species within the quadrant. There were 2 quadrants in a single field and nearly 15 paddy fields were selected. The data was collected from August 2024 to October 2024 through net sweeping and handpicking revealed the diversity of insects in rice fields, highlighting their richness and rarity. The collected insects comprises of 9 orders, 21 families, and 33 species (191individuals). The orders and number of individuals include Diptera, Hemiptera, Mantodea, Orthopteran, Lepidoptera, Hymenoptera, Odonata, Thysanoptera and Coleoptera. Quadrant method is used to study insect communities where different indices were used like Index of dominance=2.0638, Index of frequency: =0.9961, Shannon Index of general diversity=277.954 and Index of species diversity=69.10. Rarity Indices of Diptera sp-0.07, Hemiptera sp-6.25, Mantodea sp-66.66, Orthopteran sp-12.82, Lepidoptera sp-3.546, Hymenoptera sp-38.46, Odonata sp-5.319, Thysanoptera sp-96.15 and Coleoptera sp-10.10.

Keywords: *Rice, diversity indices, insects, ecosystem, humid, dynamic*

Introduction

Paddy fields are natural wetland ecosystems that produce rice for human consumption and offer habitat for various animals and insects. Rice is cultivated primarily in warm and humid environments, adapting to various cultural conditions and a broad geographical range (Dale, 1994). A tropical rice field creates a diverse ecosystem that fosters the development of microbial, floral, and invertebrate populations soon after flooding, sustaining their vitality well beyond the closure of the canopy (Schoenly et al., 1998; Settle et al., 1996). The favourable conditions in the paddy field exhibit a variety of organisms, particularly insects, that consume leaves and roots, burrow into stems, and extract fluid sap from the stems, posing a significant threat to rice production (Drechsler et al. 2001). The Green Revolution in India was initiated in the 1960s (Andersen et al. 1985) to enhance food production and address malnutrition. However, it also involved interventions that replaced traditional rice with high-yielding varieties (Beigh et al. 2015). Kalaisekar and Ramamurthy (2004) documented three prevalent insect species, *Altica cyanea* and *Coccinella septempunctata*, during the kharif season. Diraviyam et al. (2003) indicated *Micraspis discolour* is the most dominant species during the samba season. Arthropod inventories serve as effective indicators of habitat biodiversity due to the rapid response of arthropods to environmental changes, reflecting their inherent diversity (Longino, 1994). Insect pests have been recognized as major biotic stress responsible for significantly reducing rice yield in different system zones of India (Chelliah et al., 1989). The study focused on documenting the significant arthropod insects and quantifying various ecological indices, including species richness, population diversity, and evenness indices, in irrigated paddy fields throughout the study period. The crop cycle of *Oryza sativa* in Maharashtra commences in June and continues until October, coinciding with the southwest monsoon period. Planting seeds in the nursery bed marks the initial phase of the aesthetic process of agricultural cropping in India, accompanied by traditional songs while avoiding using chemical fertilizers to enhance crop yield. Farmers typically engage in a traditional agricultural practice called 'Rab.' In this method, trees are felled and burned on the ground to prepare the soil for planting rice crops. The creatures exhibit versatility due to their small size, enabling them to occupy niches that larger organisms cannot utilize (Meeran et al. 2021). While they provide advantages to the ecosystem, certain species also function as pests due to their herbivorous and polyphagous nature.

Materials and Methods:

The study area encompasses Tala taluka in Raigad District, The quadrant method is involved in insect collection. The process entails arranging ropes of uniform length at right angles to create squares of suitable dimensions and documenting the count of various species within the quadrant. There were 2 quadrants in a single field and nearly 15 paddy fields were selected at randomly chosen locations in paddy fields, and from the aggregated data, the relative abundance of each species within the community can be determined.

Insects were gathered from August 2024 to October 2024 using sweeping nets, which were employed to collect the insects from the paddy fields. Insects were gathered using the hand- picking technique. Insect collection occurred weekly from various random locations across several fields. Net sweeping was conducted while traversing the fields at various random locations. The collection used sweep net, hand picking, and light trap techniques. Insects were kept in coupling jars filled with 70% to 90% ethyl alcohol, after which they were dried on trays in an incubator using entomological pins. Nocturnal insects were captured using light traps illuminated in the evening from 6 pm to 9 pm. On the following day, after a thorough inspection and servicing of each trap, the insects were dispatched to the laboratory for identification. Identification was conducted utilizing the standard keys of Kunte et al. (2000), Subramanian, K.A. (2009), and David, K.J. (2005).The population analysis is conducted using the quadrant method.

Table 1: Names of orders, families and species of insects found in paddy fields in Tala

Order	Family	Scientific Name
Diptera	*Syrphidae*	*Eristalinus megacephalus Rossi, 1794*
Hemiptera	*Scutelleridae*	*Chrysocoris stolli (Wolff, 1801)*
	Pyrrhocoridae	*Probergrothius sanguinolens (Amyot and Serville, 1843)*
	Aleyrodidae	*Trialeurodes vaporarioum Westwood, 1856*
	Alydidae	*Leptocorisa oratoria (Fabricius, 1764)*
Mantodea	*Mantidae*	*Hierodula patellifera Serville, 1839*
		Schizocephala bicornis (Linnaeus, 1758)
Orthoptera	*Acrididae*	*Spathosternum prasiniferum (Walker, 1871)*
		Oxya sp.
Diptera	*Syrphidae*	*Eristalinus megacephalus Rossi, 1794*
	Pentatomidae	*Halyomorpha halys*
Lepidoptera	*Pieridae*	*Catopsilia pyranthe*
		Appias lyncida
	Papilionidae	*Papilio ulysses*
		Papilionidae
Hymenoptera	*Apidae*	*Apis dorsata*
	Vespidae	*Vespa tropica*
Odonata	*Chlorocyphidae*	*Heliocypha bisignata (Hagen, 1853)*
	Coenagrionidae	*Ischnura aurora (Brauer, 1865)*
	Lestidae	*Lestes viridulus Rambur, 1842*
	Coenagrionidae	*Aciagrion occidentale Laidlaw, 1919*
	Libellulidae	*Acisoma variegatum Kirby, 1898*

Table 2: Total number of species diversity in various orders

Sr. No.	Order	No of Species found	No of Individuals
1	*Diptera*	2	26
2	*Hemiptera*	5	31
3	*Mantodea*	2	3
4	*Orthoptera*	7	15
5	*Lepidoptera*	31	54
6	*Hymenoptera*	3	5
7	*Odonata*	12	36
8	*Thysanoptera*	1	2
9	*Coleoptera*	11	19
		74	191

Table 3: Communities of animals

Quadrants	*Diptera sp*	*Hemiptera sp*	*Mantodea sp*	*Orthopteran sp*	*Lepidoptera sp*	*Hymenoptera sp*	*Odonata sp*	*Thysanoptera sp*	*Coleoptera sp*
1	7	9	1	3	12	0	6	1	3
2	8	5	0	4	8	2	5	0	5
3	4	8	1	2	14	1	4	0	7
4	3	6	0	4	12	0	15	1	2
5	4	3	1	2	8	2	6	0	2
ni =	26	31	3	15	54	5	36	2	19

Where ni is important value (number of biomass) of each species and **N** is the total important value of all species in a community ni= 26, 31,03, 15, 54, 05,36, 02, 19
26+31+03+15+54+05+36+02+19=191=N

Table 4: Various indices for relative abundance of each species by quadrant method

Indices	*Diptera sp*	*Hemiptera sp*	*Mantodea sp*	*Orthopteran sp*	*Lepidoptera sp*	*Hymenoptera sp*	*Odonata sp*	*Thysanoptera sp*	*Coleoptera sp*	
Index of dominance	0.0184	0.026	0.00023	0.006	0.079	0.00067	0.035	0,00010	0.0098	0,10407
Index of frequency	0.136	0.162	0.015	0.078	0.282	0.026	0.188	0.01	0.099	10.986
Rarity Index	0.07	6.25	66.66	12.82	3.546	38.46	5.319	96.15	10.1	
Shannon Index of general diversity	$(\bar{\square}) = \sum$ ni/N X loge X ni/N =10.986 X2.303X10.986 =277.954									
Index of species diversity	d=S√N= 5 √191 = 69.10									

Index of dominance: 0,10407
Index of frequency: 10.986
Where **S** is the number of species in the community and **N** is the total number of all individuals of all species in a community
Rarity Index (R): It is the measure of how rare a particular species is in a given community under consideration. It is calculated as R=1/F

Rarity Index	*Diptera sp*	*Hemiptera sp*	*Mantodea sp*	*Orthopteran sp*	*Lepidoptera sp*	*Hymenoptera sp*	*Odonata sp*	*Thysanoptera sp*	*Coleoptera sp*
Rarity Index	1.96	6.172	66.66	12.82	3.546	3.846	5.319	100	10.98

Index of species diversity (d): It may be used in place of Shannon Index. It can be calculated as d=S√N = Where S is the number of species in the community and N is the total number of all individuals of all species in a community=0.6215

Index of species diversity	*Diptera sp* 1.88	*Hemiptera sp* 2.243	*Mantodea sp* 0.2170	*Orthopteran sp* 1.085	*Lepidoptera sp* 3.907	*Hymenoptera sp* 0.3617	*Odonata sp* 2.604	*Thysanoptera sp* 0.1447	*Coleoptera sp* 1.374
Index of species diversity					*Lepidoptera* Abundant			*Thysanoptera* Rare	

Shannon Index of general Diversity $(\bar{\square}) = \sum$ ni/N X $\log_e$ X ni/N =2.0638 X 2.303 X 2.0638 = 9.8090 Where $\log_e$ =$\log_{10}$ = 2.303

Result and Discussion:

The present study recorded a total of 191 insects across 33 species and nine orders: *Coleoptera* (11), *Diptera* (2), *Hemiptera* (5), *Lepidoptera* (31), *Mantodea* (2), *Odonata* (12), *Orthoptera* (7), and *Thysanoptera* (1). *Lepidoptera* is the most abundant order, while *Thysanoptera* is the least abundant. The abundance of insects varies across different growth stages of rice. 67% of insects function as pests and predators, with 21% identified as insect pests and the remaining 12% categorized as visitors to the paddy field. The minimal use of pesticides and insecticides fosters a diverse population of pest insects, allowing predators to function as effective biological control agents, resulting in high crop yields for farmers.

Akhilandeshwari et al. (2022) executed an extensive investigation encompassing 11,094 participants from 39 households and 10 orders, utilizing three traps for data acquisition. In Telangana, the order *Hemiptera* was recorded with eight families, *Coleoptera* with seven families, *Lepidoptera* with six families, and *Hymenoptera* with five families. *Orthoptera* and Diptera each had four families, whereas Odonata featured two families. The orders *Dermaptera*, *Mantodea*, and Neuroptera were each represented by one family (D).

In 2012, Md. Humayoon Akhtar and colleagues identified a total of twenty-six species of grasshoppers, which belong to 14 genera across 2 families, 8 subfamilies, and 12 tribes. The family Acrididae exhibits the highest diversity, encompassing 22 species, which accounts for 85% of the overall total. The family in question is *Pyrgomorphidae*, comprising 4 species, which accounts for 15% (Figure 1). The subfamily Oedipodinae encompasses the highest diversity of species, succeeded by *Oxyinae*, *Pyrgomorphinae*, *Hemiacridinae*, *Acridinae*, *Catantopinae*, *Eyprepocnemidinae*, and *Spathosterninae*.

As reported by Ramanathan Arulprakash et al. (2017) the diversity assessment conducted in the five rice-growing areas of Pattukkottai identified 19 species of Odonata, comprising 12 from *Anisoptera* and 7 from *Zygoptera*, categorized under 16 genera across three families: *Libellulidae* (12 species), *Coenagrionidae* (6 species), and Lestidae (1 species),

Amin Setyo Leksono et al. (2019). Reported 67 Arthropod specimens were collected from six replications, comprising 166 individuals from Refugia blocks and 101 individuals from the control group. The samples indicated that Refugia blocks were frequented by 26 families of Arthropods, whereas the grasses were frequented by 20 families. The *Formicidae* has prominently featured in the sample within the refugia block;

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The investigation of trap captures indicated the identification of 40 species across 10 groups within Lepidoptera throughout the season (Kharif 2014). The collection that exhibited the highest species count comprised the family *Noctuidae*, showcasing 12 distinct species. The subsequent findings included Erebidae with 8 species, *Arctiidae* with 5 species, *Geometridae* with 4 species, *Sphingidae* with 3 species, and *Pyralidae*, *Lymantriidae*, *and Lasiocampidae*, each represented by 2 species. Each of the families *Nymphalidae* and *Crambidae* was represented by one species. The results correspond with the work of Chitra et al. (2000), who documented 28 species of short-horned grasshoppers in the rice fields of Coimbatore. SK Meena (2018). In the Kharif season of 2015, a comprehensive survey revealed a total of sixty-two insect species across 11 orders and 34 families. Based on the number of species collected, the largest collection was represented by the order *Lepidoptera*, 19 species (30%), followed by the order *Coleoptera*, 13 species (21%); *Hemiptera*, 12 species (20%); *Orthoptera*, 5 species (8%) and *Hymenoptera*, 5 species (8%) in descending order respectively. Yogendra Mishra et al (2017).Two species of insects were observed from the families *Cicadellidae*, *Delphacidae*, *Pentatomidae*, and *Gryllidae*. A. Sheela (2022) reported three species of insects were documented from the families *Grambidae* and *Noctuidae*, while a single species was noted from the families *Pseudococcidae*, *Alydidae*, *Pyralidae*, *Nymphalidae*, *Chrysomelidae*, *Scarabidae*, *Curculionoidae*, *Coccinellidae*, *Acrididae*, *Gryllotalpidae*, *Ephydridae*, *Cecidomyidae*, *Thripidae*, *and Trichogrammatidae*.

Conclusion:

The collected insects comprises of 9 orders, 21 families, and 33 species (191individuals). The orders and number of individuals include *Diptera* , *Hemiptera* , *Mantodea*, *Orthopteran* , *Lepidoptera*, *Hymenoptera*, *Odonata*, *Thysanoptera* and *Coleoptera*. Quadrant method is used to study insect communities where different indices were used like Index of dominance=2.0638, Index of frequency: =0.9961, Shannon Index of general diversity=277.954 and Index of species diversity=69.10. Rarity Indices of *Diptera* sp-0.07, *Hemiptera* sp-6.25, *Mantodea* sp-66.66, *Orthopteran* sp-12.82, *Lepidoptera* sp-3.546, *Hymenop* *Thysanoptera*.

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Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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