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Diversity of insect fauna associated with different winter crops cultivated at Dhapa area, Kolkata, West Bengal, India

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Abstract
A preliminary survey of the insect fauna was conducted from November 2023 to February 2024, with bi-weekly sampling sessions occurring twice daily at agricultural fields in the East Kolkata, Dhapa Mathpukur area. A total of 45 insect species, representing 27 families across 7 orders, were recorded. Among these, Coleoptera was the most prevalent order, accounting for 37.6% of the species, followed by Lepidoptera (30.7%) and Diptera (10.4%). The majority of the recorded species were identified as pests, although predators, pollinators, and parasitoids were also observed. It was noted that the insects predominantly favoured *Solanum melongena*, *Cucurbita pepo*, *Beta vulgaris L.*, *Brassica nigra*, and *Spinacia oleracea* as host plants. The insect diversity documented in this study represents a first-time report for the Dhapa Mathpukur area.

Keywords: Insect fauna, diversity, winter crops, Dhapa

Introduction

Rabi crops, also referred to as winter crops, are cultivated during the winter season, typically after the monsoon rains have ceased, with their growing period spanning from October to April. These crops are predominantly grown in dry regions and require frequent irrigation to thrive, as the monsoon rainfall is no longer available. Common examples of rabi crops include wheat, barley, mustard (rapeseed), oats, gram, and linseed. Due to the cooler temperatures of the winter months, these crops grow effectively and are harvested before the onset of the intense summer heat. Insects represent the most diverse, successful, and dominant taxon within the animal kingdom, with a presence in nearly every habitat across the globe. Their success can be attributed to their varied body sizes, diverse behaviour, high fecundity, different modes of respiration, and wide range of dietary preferences. These characteristics have enabled insects to become a crucial component of ecosystems. Their impact is significant in various sectors, including agriculture, human health, and the management of natural resources.

Rabi crops are susceptible to damage from a range of insect pests throughout their growth stages. Various pests, along with their natural predators—such as ladybugs, dragonflies, and red pumpkin beetles—have been identified as potential agents of biological control. Dhapa is a locality situated on the outskirts of East Kolkata, India, known for its landfill sites where the solid waste generated by the city of Kolkata is disposed of [12]. The practice of "garbage farming" is prevalent in these landfill areas, where crops are cultivated using the waste as a medium. Over 40 percent of the green vegetables available in Kolkata's markets are sourced from these lands. The area consists of four sectors designated for waste disposal, each receiving approximately 2,500 tonnes of waste per day. The objective of this study was to evaluate the population dynamics of these insect pests and their natural antagonists, particularly in relation to economically significant crops such as vegetables and paddy crops, including cauliflower, cabbage, and others [9]. Additionally, the study aimed to assess the economic impact of the insect pests affecting these crops. Earlier very few works on the insects' diversity have been observed in Kolkata and surroundings areas [1-5,10-11], but no research works are available on the insect fauna associated with winter crops cultivated at the from Dhapa area. To address this gap, a study was conducted to investigate and document the insect fauna of the region.

Materials and Methods

Study area and sampling site

The present study was conducted in Dhapa Mathpukur area with GPS Coordinates 22.543333°N 88.39725° E. Dhapa is situated near Parama Island along the Eastern Metropolitan Bypass, on the eastern side of Kolkata (Fig.1). It is bordered by Beleghata and Tangra to the west, Basanti Highway and Bantala to the south, and Chingrighata to the north. Dhapa is a significant contributor to the city's agricultural sector, supplying over 40% of the fresh vegetables. Additionally, it hosts one of the largest rice markets in the region. Collection trips were conducted once in a week for two times in a day during November 2023 to April 2024, on various winter crops cultivated at agricultural fields of Dhapa.

Survey Method

The present survey was conducted for 16 weeks from November 2023 to February 2024, once in a week for two times a day. The insects were observed using aerial net and handpick method. The handpicked collected specimens were preserved in 70% alcohol and some of the insects which were under Order Lepidoptera and Family Apidae (Order Diptera) are collected and killed by killing jar which is made of white cement slot and acetone. The immature stages of the insects recorded on the plants were collected and reared to adult stage in the laboratory.

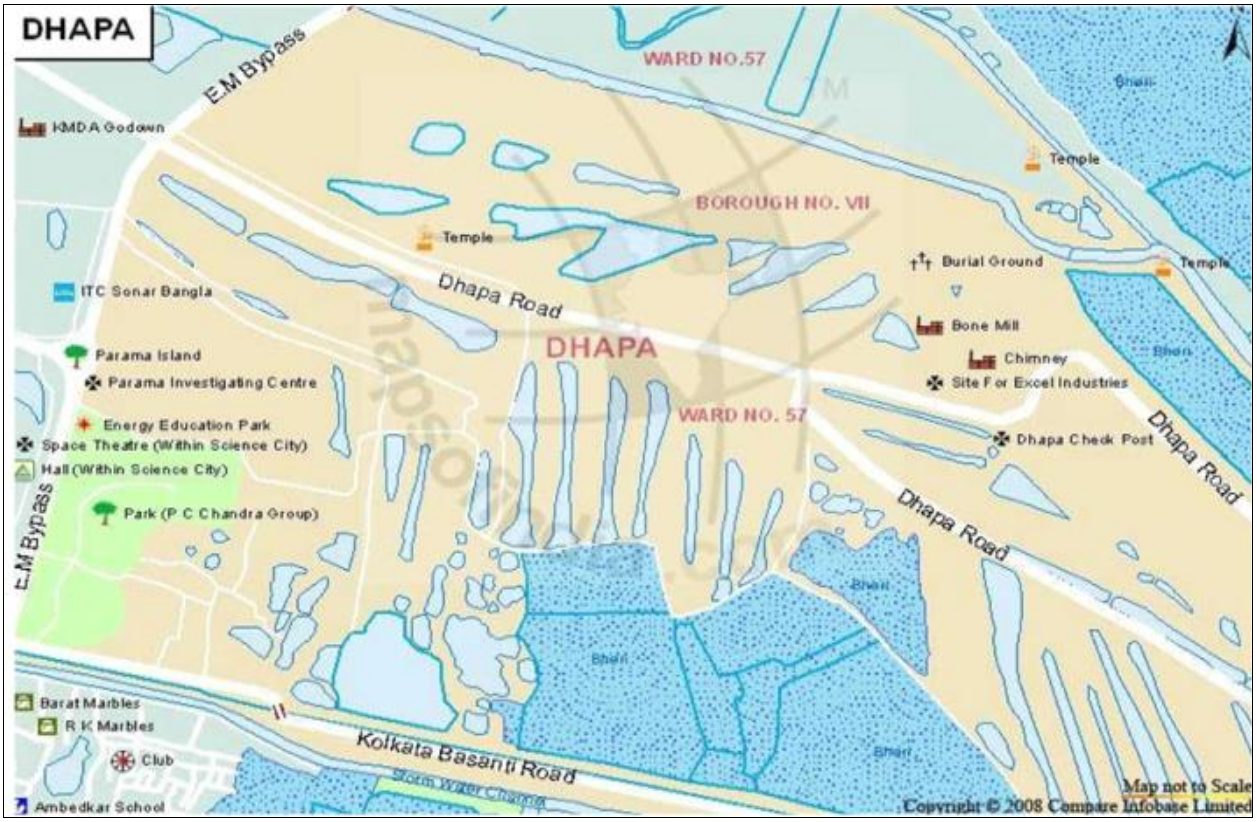

Fig 1: Map of sampling area

Rabi crops surveyed

The Rabi crops on which the present work was conducted includes:

a. Pumkin (*Cucurbita pepo*)
b. Brinjal (*Solanum melanogena*)
c. Corn (*Zea mays*)
d. Spinach (*Spinacia oleracea*)
e. Lettuce (*Lactuca sativa*)
f. Cauliflower (*Brassica oleracea var. botrytis*)
g. Onion (*Allium cepa*)
h. Beet (*Beta vulgaris L.*)
i. Coriander (*Coriandrum sativum*)
j. Tomato (*Solanum lycopersicum* L.)
k. Mustard [*Brassica nigra* (L.) W.D.J. Koch]
l. Daikon Radish (*Raphanus sativus* L.)

These crops were examined for the occurrence of pollinators, phytophagous, predatory and parasitoid insects of order Coleoptera, Hemiptera, Diptera, Hymenoptera and Lepidoptera etc.

Identification and documentation

Insects were photographed using a Canon EOS 700D DSLR camera. The identification of these insects was carried out with the assistance of standard reference materials and literature**.**

Statistical data analysis

During the present study the community structure of insect species were analysed in terms of relative abundance and species percentage using the Microsoft Word Version 2010.

Results

A total of 45 distinct insect species were collected using various sampling methods. These specimens represented 30 families across 8 different orders. Of these 45 species, Hemiptera, Lepidoptera, coleoptera was the most diverse orders. 7 families under the order Hemiptera (Pyrrhocoridae, Membracidae, Lygaeidae, Coreidae, Dinidoridae, Reduviidae, Berytidae), 5 families under the order Lepidoptera (Lycaenidae, Erebidae, Pieridae, Plutellidae, Crambidae),5 families under the order Coleoptera (Curculionidae, Staphylinidae, Chrysomelidae, Coccinellidae, Tenebrionidae), 4 families under the order Diptera (Empididae, Syrphidae, Tephritidae, Calliphoridae), 3 families under the order Hymenoptera (Pemphredonidae, Apidae, Ichneumonoidea,), 2 families under the order Odonata (Coenagrionidae, Platycnemididae), 1 family under the order Orthoptera (Triogonididae) were recorded.

The pollinators diversity was from the order Lepidoptera (71.42%), Diptera (14.28%), and Hymenoptera (14.28%). The most prevalent pest orders were from the order Lepidoptera (35%), Hemiptera (20%), Coleoptera (15%), Diptera (15%), Orthoptera (7.5%) and Hymenoptera (5%) respectively (Table 1).

The insect predators as well as natural enemies' population diversity varies according to the elevations. The most prevalent predator orders were from Odonata, Coleoptera and Hymenoptera respectively. The natural enemies' diversity orders were from Odonata (57.14%), Coleoptera (28.57%) and Hymenoptera (14.28%) as shown in Fig 2.

Table 1: Checklist of pollinator and pest insects collected from East Kolkata, dhapa Mathpukur area**.**

Sl. No.	Order	Family	Scientific name	Host	Feeding status	Grade	Number Of individuals	Relative Abundance
1.	Hymenoptera	Apidea	*Apis flore*a (Fabricius,1787	*Solanum melanogena, Cucurbita pepo, Beta vulgaris L, Brassica nigra*	Pollinator	4	219	51.77
2.	Lepidoptera	Crambidae	*Spoladea recurvalis (Fabricius1775)*	*Cucurbita pepo, Solanum melanogena, Spinacia oleracea, Brassica oleracea var. botrytis, Beta vulgaris L, Brassica nigra*	Pest	4	823	33.15
			Hellua undalis (Fabricius 1794)	*Cucurbita pepo, Solanum melanogena, Spinacia oleracea, Brassica oleracea var. botrytis, Beta vulgaris L, Brassica nigra*	Pest	4	453	18.25
			Diaphania indica (Saunders,1851)	*Cucurbita pepo*	Pest	0	1	0.04
		Plutellidae	*Plutella xylostella*	*Cucurbita pepo, Solanum melanogena, Spinacia oleracea, Brassica oleracea var. botrytis, Beta vulgaris L, Brassica nigra*	Pest	4	811	32.67
		Lycaenidae	*Pseudozizeeria maha* (kollar,1844)	*Cucurbita pepo Spinacia oleracea Lactuca sativa*	Pest	0	180	7.25
		Erebidae	*Amata cyssea*	*Beta vulgaris L.*	Pest	0	11	0.44
		Pieridae	*Eurema blanda (Bosisduval,1836)*	*Cucurbita pepo*	Pest	0	3	0.12
3.	Hymenoptera	Pemphredonidae	*Polemistus sp.*	*Cucurbita pepo Solenum melanogena Spinacia oleracea Lactuca sativa Beta vulgaris L Brassica nigra*	Pest	1	120	28.36
4.	Hemiptera	Pyrrhocoridae	Dysdercus cingulatus (Fabricius,1775)	*Hibiscus rosa-sinesis*	Pest	1	13	3.48
		Berytidae	*Metacanthus pertenerus (Breddin)*	*Cucurbita pepo*	Pest	0	5	1.34
		Reduviidae	Unidentified	*Beta vulgaris L*	Pest	0	1	0.26
		Dinidoridae	Coridius janus (Fabricius,1775)	*Hibiscus rosa-sinesis*	Pest	0	2	0.26
5.	Coleoptera	Chrysomelidae	*Aulacophora indica*	*Cucurbita pepo, Solanum melanogena, Spinacia oleracea, Lactuca sativa, Beta vulgaris L, Zea mays*	Pest	4	220	9.94
			unidentified	*Cucurbita pepo*	Pest	1	70	3.16
			Phyllotreta cruciferae	*Solanum melanogena*	Pest	0	3	0.13
		Tenebrionidae	*Alphitobius sp.*	*Cucurbita pepo*	Pest	0	5	0.22
6.	Diptera	Syrphidae	*Episyrphus balteatus* (De Geer,1776)	*Zea mays Solenum melanogena Allium cepa*	Pest	3	256	38.15
			Orthonevra brevicornis	*Cucurbita pepo Solenum melanogena Spinacia oleracea Lactuca sativa Beta vulgaris L Brassica nigra*	Pest	2	120	17.88
			Eristalis tenax (Linnaeus,1758)	*Solenum melanogena Allium cepa Brassica nigra*	Pest	2	98	14.60
		Calliphoridae	*Chrysomya marginalis*	*Cucurbita pepo Solenum melanogena Spinacia oleracea Lactuca sativa Beta vulgaris L Brassica nigra*	Pest	2	200	29.80
		Tephritidae	*Bactrocera cucurbitae*	*Beta vulgaris L Brassica nigra*	Pest	1	54	8.04
		Empididae	Unidentified	*Solenum melanogena*	Pest	1	45	6.70
7.	Odonata	Platycnemididae	*Prodasineura verticalis* (Selys,1860	*Cucurbita pepo Solenum melanogena Spinacia oleracea Lactuca sativa Beta vulgaris L Brassica nigra*	Pest	2	280	53.33
8.	Hymenoptera	Apidae	*Apis Dorsata* (Fabricius,1793	*Cucurbita pepo Solenum melanogena Spinacia oleracea Lactuca sativa Beta vulgaris L Brassica nigra*	Pest	3	350	82.74

Table 2: Checklist of parasitoids and predator insects collected from East Kolkata, dhapa Mathpukur area**.**

Sl. No.	Order	Family	Scientific name	Host	Feeding status	Grade	Number Of individuals	Relative abundance
1.	Hymenoptera	Ichneumonoidea	*Ischnojoppa luteator*	*Solanum melanogena, Zea mays, Beta vulgaris L, Brassica nigra*	Parasitoid	1	73	17.25
2.	Odonata	Coenagrionidae	*Ceriagrion coromandelianum* (Fabricius,1798)	*Cucurbita pepo Solenum melanogena Spinacia oleracea Lactuca sativa Beta vulgaris L Brassica nigra*	Predator	2	222	42.28
3.	Coleoptera	Coccinellidae	*Coccinella transversalis*	*Cucurbita pepo, Solanum melanogena, Spinacia oleracea, Brassica oleracea*	Predator	4	658	29.73
			Coccinella septempunctata	*Cucurbita pepo, Solanum melanogena, Spinacia oleracea, Brassica oleracea var. botrytis, Beta vulgaris L, Brassica nigra*	Predator	4	427	19.29
			Chilocorus nigritus (Fabricius,1798)	*Cucurbita pepo, Solenum melanogena, Spinacia oleracea, Lactuca sativa, Beta vulgaris L, Brassica nigra*	Predator	4	417	18.84
			Delphastus (Casey,1899)	*Cucurbita pepo, Solenum melanogena, Spinacia oleracea, Lactuca sativa, Beta vulgaris L, Brassica nigra*	Predator	3	320	14.46
			Cycloneda sp.	*Cucurbita pepo, Ssolenum melanogena, Zea mays, Spinacia oleracea, Lactuca sativa*	Predator	3	220	9.94
			Cheilomenes sexmaculata (Fabricius 1781)	*Solanum melanogena, Cucurbita pepo, Beta vulgaris L, Brassica nigra, Lactuca sativa, Zea mays, Spinacia oleracea, Coriandrum sativum*	Predator	3	189	8.5
		Curculionidae	*Lixus concavus*	*Solenum melanogena, Allium cepa, Brassica nigra*	Predator	0	2	0.09
		Chrysomelidae	*Zygogramma bicolorata*	*Coriandrum sativum*	Predator	1	123	5.55
			Unidentified	*Cucurbita pepo*	Predator	1	70	3.16
			Cassida circumdata (Herbst,1799)	*Raphanus sativus*	Predator	0	1	0.04
		Staphylinidae	*Paederus littoralis (Gravenhorst,1802)*	*Cucurbita pepo, Solenum melanogena, Spinacia oleracea, Lactuca sativa, Beta vulgaris L, Brassica nigra*	Predator	1	70	3.16
4.	Odonata	Coenagrionidae	*Ceriagrion coromandelianum (Fabricius,1798)*	*Cucurbita pepo, Solenum melanogena, Spinacia oleracea, Lactuca sativa, Beta vulgaris, L Brassica nigra.*	Predator	2	222	42.28
			Desmometopa singaporensis	*Cucurbita pepo, Solenum melanogena, Spinacia oleracea, Lactuca sativa, Beta vulgaris L, Brassica nigra.*	Predator	0	23	4.38
5.	Orthoptera	Triogonidiidae	*Metioche vittalicollis*	*Spinacia oleracea, Allium cepa*	Predator	1	40	100
6.	Hemiptera	Lygaeindae	*Graptostethus servus (Fabricius,1787)*	*Hibiscus rosa-sinesis*	Predator	0	10	2.68
		Coreidae	*Ceraleptus (Costa,1847)*	*Hibiscus rosa-sinesis*	Predator	0	2	0.53
		Membracidae	*Oxyrachis tarandus*	*Beta vulgaris L*	Predator	0	1	0.26

Distribution of total number of pests, predators, pollinators and parasitoids

From the above table we can conclude that the number of pests is found in maximum number (4,124), followed by the predators which are 3,017 in number. The number of pollinators observed are much less up to 219 and parasitoids being the least in number which are 73 in number (Table 1).

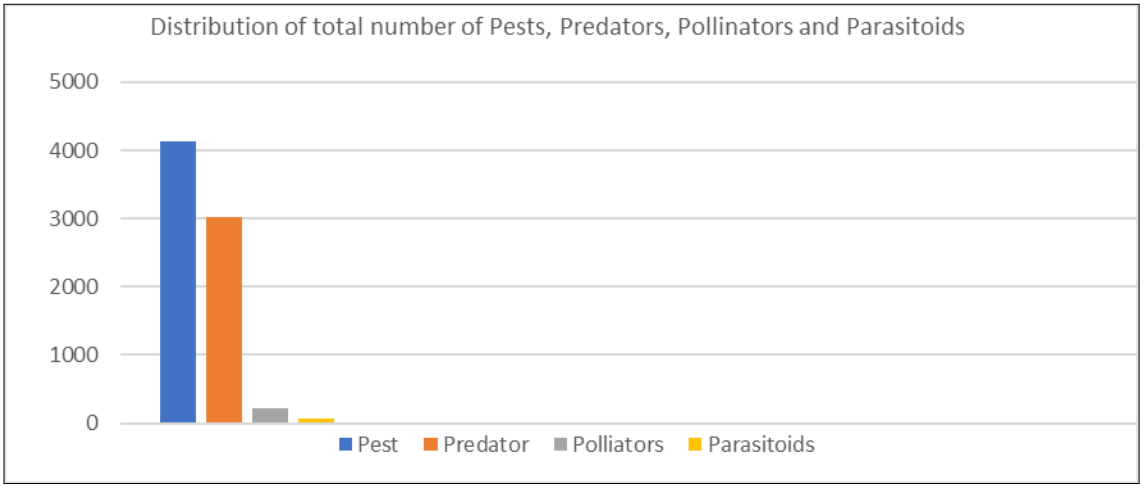

Fig 2: Distribution of total number of Pests, Predators, pollinators and Parasitoids

Distribution of species based on their orders

Based on the data presented in Tables 1, the order *Coleoptera* exhibits the highest species abundance, comprising a total of 2,795 individuals. This is followed by Lepidoptera with 2,282 individuals, Diptera with 773 individuals, and Odonata with 525 individuals. The order Hymenoptera accounts for 292 individuals, while Orthoptera and Hemiptera represent the smallest counts, with 40 and 34 individuals, respectively (Fig 3).

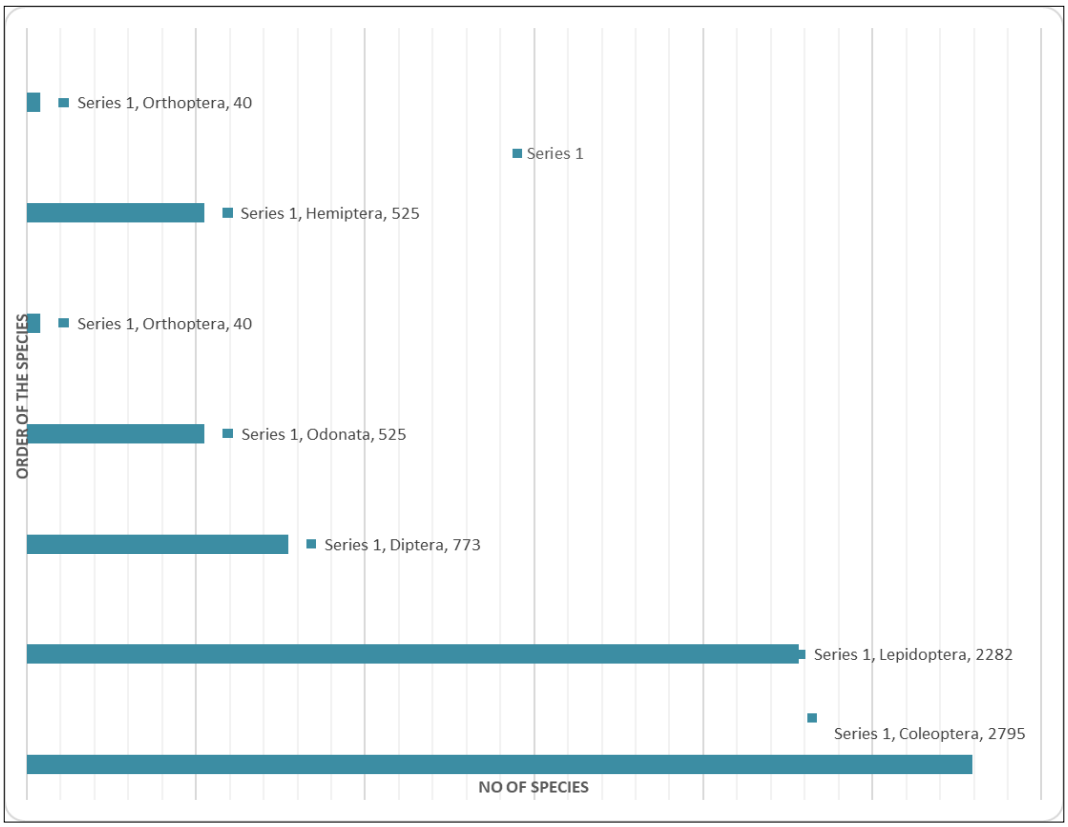

Fig 3: Distribution of species based on their orders

Distribution of orders based on species diversity

Based on the data presented in Table 1 and Fig. 2, it can be concluded that Coleoptera exhibits the highest species diversity, with a total of 14 species. This is followed by Lepidoptera and Hemiptera, each with 7 species, and Diptera, which includes 6 species. Hymenoptera shows a diversity of 4 species, while Odonata encompasses 3 species. Orthoptera has the lowest representation, with only 1 species identified (Fig 4).

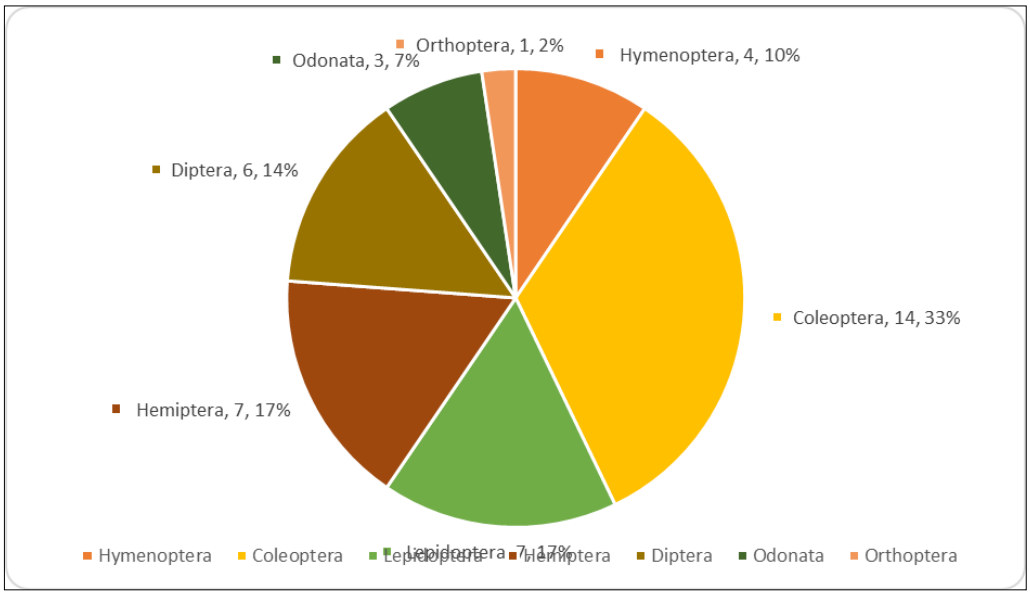

Fig 4: Distribution of orders based on species number

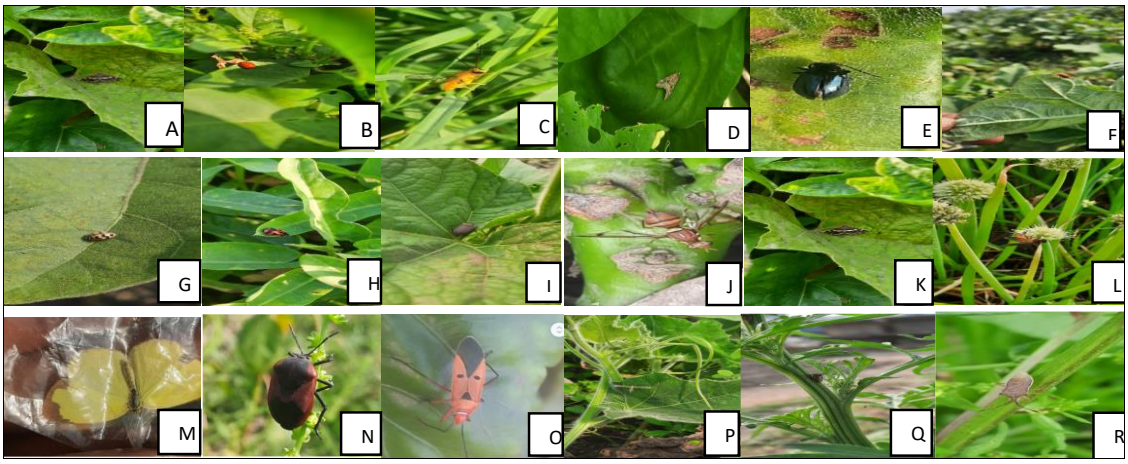

Fig 5: Pictures of some of the insects observed in Dhapa, Mathpukur A. *Spoladae recurvalis*, B. *Cycloneda sp.*, C. *Ischnojoppa luteator*, D. *Hellula undalis*, E. *Phyllotreta Cruciferae***,** F. *Aulacophora indica*, G. *Cheilomenes sexmaculata*, H. *Coccinella transversalis*, I. *Alphitibius sp.*,J. *Bactrocera cucurbitae*, K. *Spoladae recurvalis***,** L. *Apis dorsata, M. Eurema blanda*, N.*Coridius janus*, O. *Dysdercus cingulatus* P.*Stenoptilia sp.*, Q.*Oxyrachis tarandus*, R. *Ceraleptus lividus*.

Discussion

A total 44 different kinds of insects were documented during the present study from the Dhapa Mathpukur area. The checklist of the insects, their feeding status, abundance as well as other details are provided in the table 1 and 2. A total of 27 families from 7 total orders were collected. The present study provides a preliminary outline about the pests, predators, pollinators and parasitoids of various winter crops (Table 1; Fig.2-5). It was observed that the pest population is the most prevalent while predators are also found in abundance. Pollinators and parasitoids are in much less amount.

A total 7433 insects were collected. The most prevalent pest orders were Coleoptera (37.6%), Lepidoptera (30.7%) and Diptera (10.4) respectively. Most of the predators were found from the order Coleoptera (33.6%).

A total 219 polinators were collected from the order Lepidoptera 71.42%, Diptera 14.28% and Hymenoptera 14.28%(Table.1).

The occurrence of the above insect species from the winter crops of Dhapa area, West Bengal were also reported by earlier workers from India as well as Abroad [6-8].

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