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Biodiversity of Grasshopper in Cholistan Desert, Punjab, Pakistan

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Abstract:

The study was planned to estimate the diversity, distribution, and seasonal variations of grasshoppers in croplands of the Cholistan Desert, Punjab, Pakistan. The seasonal variations were assessed by sampling 0a6 randomly selected sites fortnightly during 2020-2021. And following species were collected i-e *Acrida exaltata* (Walker, 1859), *Oxya hyla hyla* (Audinet-Serville, 1831), *Chrotogonus Species* (Blanchard, 1836) and *Poekilocerus pictus* (Fabricus, 1775) were collected and identified their morphology & morphometry was analysis along with detail descriptions. In addition to these a simplified taxonomic key based on the external morphology have been prepared for the separation of tribes, genera, and species of Orthoptera.

Keywords: Cholistan Desert, Grasshoppers, *Acrida exaltata*, *Oxya hyla hyla*, *Chrotogonus Species, Poekilocerus pictus*, Biodiversity.

Introduction

Grasshoppers are common insects in grasslands and are important members of trophic chains as they are not only herbivores but also play their role as omnivores, bio indicator balcing role between prey and predator and the cycling of nutrients. They live in a variety of habitats, such as bushes, agricultural grasslands, and rice fields. They actively participate in the cycles of energy and nutrients across a variety of landscapes, which makes them vital contributors to the ecological balance due to their versatility (Song et al., 2018). The Cholistan Desert, which is located in Pakistan's Punjab province's southeast, is a distinct and fascinating ecosystem distinguished by its harsh climate and arid landscapes. Incredibly rich in biodiversity, the Cholistan Desert supports a wide range of plant and animal species, including grasshoppers, despite its severe climate. Cholistan's grasshoppers are vital to the delicate balance of this ecosystem, impacting not only the larger food web but also the plant life.

Pakistan with other neighbouring countries in South Asia relies on agriculture and farming (Aryal et al., 2020). One of its irrigated desert is Cholistan desert which is of highly importance due to its arid to semiarid climate which is situated in sub-tropical area starting from Bahawalpur to Thar and Nara deserts of Sindh which is about 112m above sea level comprising 26,000 km^2, lies between latitudes 27◦ 42 N and 29◦ 45 N and longitude 69◦ 52E and 75◦ 24E (Farooq et al., 2022).

Especially in insects, a high level of biodiversity is made possible by the diversity of habitats. Due to their significant contribution to grassland biodiversity, insects—particularly grasshoppers— play a crucial role in food webs as primary herbivores and a plentiful supply

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of food for other animals, including birds and reptiles (Lockwood, 1997). A lot of grasshopper species are also considered pests because they can seriously harm crops and agricultural land. Nevertheless, even in isolated areas, the number of Orthoptera species has been drastically decreasing, despite the fact that some species are harmful (Hodjat et al., 2019). It is crucial to have databases of the fauna in the area to identify such declines. But despite their economic significance as pests and their significance for the food web, orthopteran diversity is still poorly understood in many areas, including Cholistan.

Grasshoppers are common herbivores that exhibit a wide range of morphological ones such, as biological, and behavioral variations. They can be found in grazing land, deserts, semi-aquatic, alpine, and tropical forest habitats (Cigliano et al., 2000). Though they may cause waste everywhere, only a small number of species are economically significant. These species defoliate grasses by either directly feeding on the leaves, stem, as well as tissues, or by chopping off the leaves along with the stem and head while feeding. On rangelands, dense populations of grasshoppers have the potential to severely damage implant crowns, rendering many plants incapable of recovering. Furthermore, grasshoppers can quickly consume large amounts of foliage, stop the development of roots, and limit the amount of nutrients that can be absorbed for several days when more than 50% of the growing grass from the lawn is consumed. Additionally, consuming over sixty percent of the growing grass at one point during the growth period can reduce the length of the entire root system by 30% or more. Finally, when herbage is regularly defoliated, it will become weak and eventually die within a few years (Campbell et al., 2001).

Number of species of Cholistan desert is still unidentified. Like other orthopterans, Caelifera contains a significant diversity of tropical species, and some species have been identified from the desert climate zone. Due to its high temperatures and abundance of grasslands, the temperate zone has the most diversity of Caelifera (Grasshoppers). Regarding global climate shifts and temperature variations in the temperate zone and tropical regions, Caelifera has a varied distribution (Prince et al., 2022). Biodiversity of Cholistan desert seems still none discovered but 25 species of Orthoptera including grasshoppers, crickets and tree crickets are reported in recent surveys (Kumar et al., 2021).

The potential insights into the methods of adaptation of these insects to the harsh conditions of the arid environment make the exploration of grasshopper biodiversity in the Cholistan region Desert particularly important. Because they are herbivorous insects, grasshoppers are important indicators of the ecological condition of the desert ecosystem because of their close relationship to the local vegetation. Comprehending the variety, range, and ecological functions of the grasshopper species in Cholistan advances our comprehension of the region's biodiversity as well as the general understanding of how living things survive in arid conditions.

Materials and Methods

Samples Collection and Field Surveys

The aim of this study was to gather as many Orthoptera specimens as possible, particularly from the order Caelifera, by scanning several regions of the Cholistan desert in Punjab, Pakistan. The material, which includes desert trails, maize, cotton, shrubs, herbs, grasses, and semi-desert areas, will be gathered from the Cholistan Desert, often referred to locally as Rohi, which is about 25 to 35 km from Bahawalpur, Punjab, Pakistan. Most of the specimens were collected by hand picking, pounding, trapping, sweeping insects, night trapping, and aerial netting, depending on where they were located. The taxonomic material was carefully

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stored in insect-preserving boxes, which were fastened with the use of insect-fixing pins. To ward off parasite insect attacks, naphthalene bolls were utilized, and mounted insects had tags and given names. To track the habitats and distributions of Caelifera species, we also carried out field surveys.

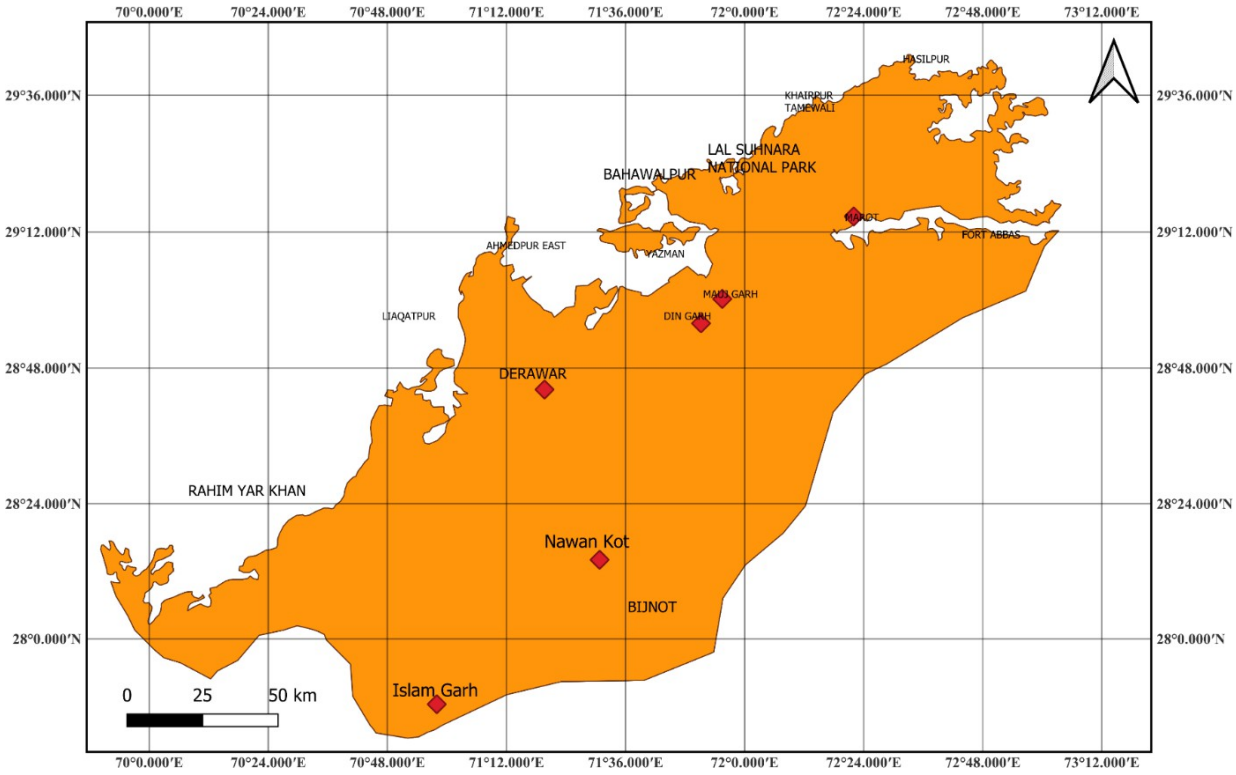

Fig 1. The cholistan map representing the sampling sites

Killing & Preservation

Material were delivered to the Cholistan University of Veterinary and Animal Sciences' Department of Zoology in Bahawalpur. The killing technique were modified by (Riffat & Wagan 2015). Specimens were killed for five to ten minutes in conventional entomological death bottles using either chloroform or potassium cyanide. Samples were not kept for too long since doing so might cause the specimen's color to change. The Department of Zoology were conserve fully dried insects and identify them with the name of the collector, the habitat, the date of collection, and the locality. Balls made of naphthalene were inserted into boxes to keep other insects out.

Identification

The specimen was identified using a stereoscopic dissecting binocular microscope using keys and descriptions found in books and on the Orthoptera Species File Online website (http://www.orthoptera.org).

Results and Discussion

A Survey from different localities of South Punjab, cholistan, Rohi Bahawalpur, Pakistan was conducted from January 2021 to December 2021; Special attention was paid during rainy season. The total 1225 specimens of Caelifera were collected from different localities of

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Cholistan e.g., Derawar Fort, Islam Garh Fort, Mouj Garh, Din Garh, Marot and Nawan Kot. During present survey 523 specimens were males and 702 were females. The maximum specimens were collected from Din Garh which was 304. The minimum specimens collected from Nawan Kot which was 123. The number of samples collected from Derawar Fort, Isalam Garh Fort, Mouj Garh, and Marot 175, 193, 282, 148 respectively.

The species of Caelifera collected during present work were *Peokilocerus pictus* 225 with 170 female and 55 male, *Oxya hyla hyla* 335 with 299 female and 36 male, *Acrida exaltata* 394 with 325 female and 69 male, *Chrotogonus Species* 271 with 255 female and 16 male. The maximum population of *Acrida exaltata* 394 and minimum populations of *Peokilocerus pictus* 225 were observed in above species. The table 1 show the general classification of collected species and table 2 show the classification of plant species present in the collections sites.

Table 1. Classification of collected species

Order	Family/Sub Family	Species
Orthoptera	Acridinae	*Acrida exaltata*
	Oxyinae	*Oxya hyla hyla*
	Pyrogomorphidae	*Chrotogonus Species*
	Pyrogomorphidae	*Poekilocerus pictus*

Table 2. Plant species in the sampling sites

Sr. n	Common Name	Scientific Name	Family	Total
1	Pilu/ Jhal	*Salvadora Oleoides*	Salvadoraceae	Herb
2	Khavi/ Kittran	*Cymbopogon Jwarancusa*	Poaceae	Herb
3	Sewan/ Ghorka	*Lasiurus Scindicus*	Poaceae	Herb
4	Phog	*Calligonum Polygonoides*	Polygonaceae	Herb
5	Kali Lani	*Suaeda Fruticosa*	Chenopodiaceae	Herb
6	Akk	*Calotropis Procera*	Asclepiadaceae	Herb

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Pilu/ Jhal

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Sewan/ Ghorka

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Kali Lani

Akk

Fig 2. Floristic Fauna of Cholistan Desert

Fig 3. Field Survey & Lab work

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Table 3. Numbers of specimens (sex-wise)

S.no	Locality	Male ♂	Female ♀	Total
01	Din Garh	119	185	304
02	Mouj Garh	115	167	282
03	Islam Garh	89	104	193
04	Derawar Fort	79	96	175
05	Marot	67	81	148
06	Nawan Kot	54	69	123
Total		**523**	**702**	**1225**

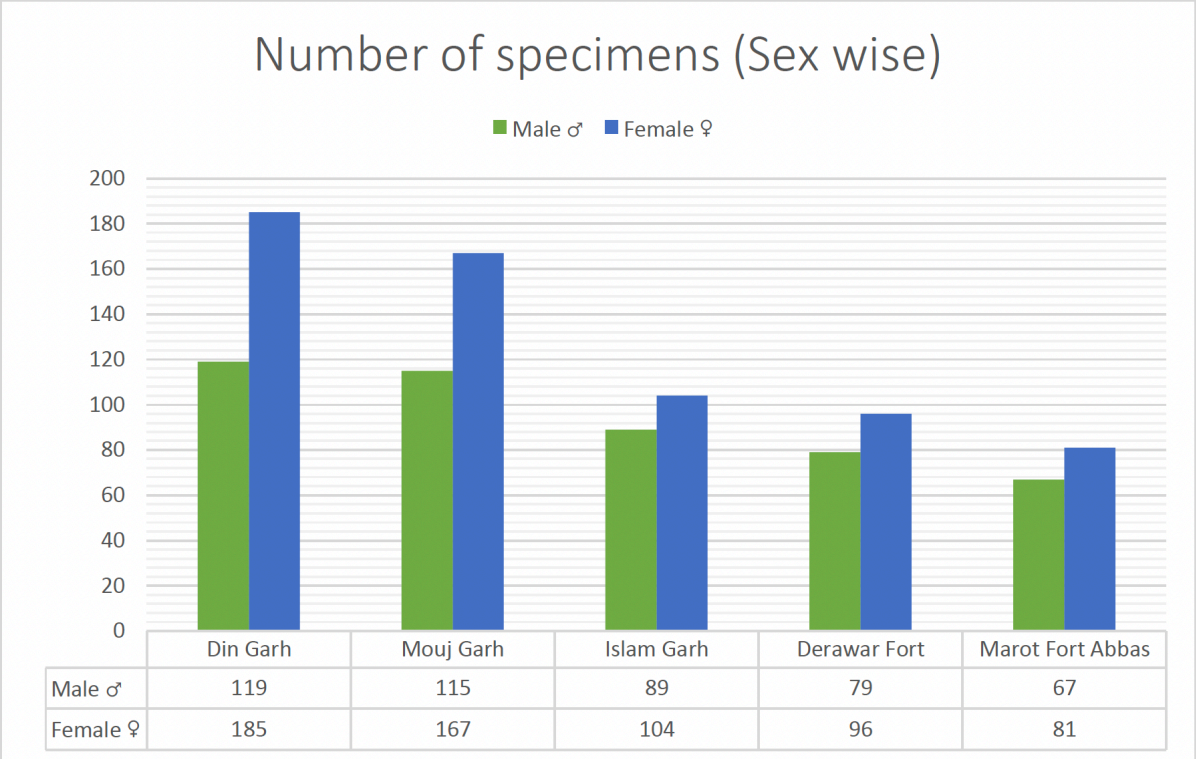

Fig 4. Graphical representation of Sex wise insect collection

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Table 4. Number of Species individuals collected from different localities

Sr.n	Species	Din Garh	Mouj Garh	Islam Garh	Derawar Fort	Marot	Nawan Kot	Total
01	*Acrida exaltata* (Walker, 1859)	95	88	61	59	50	41	394
02	*Oxya hyla hyla* (Audinet-Serville, 1831)	81	79	53	49	39	34	335
03	*Chrotogonus Species* (Blanchard, 1836)	69	60	42	38	33	29	271
04	*Poekilocerus pictus* (Fabricus, 1775)	59	55	37	29	26	19	225
Total		**304**	**282**	**193**	**175**	**148**	**123**	**1225**

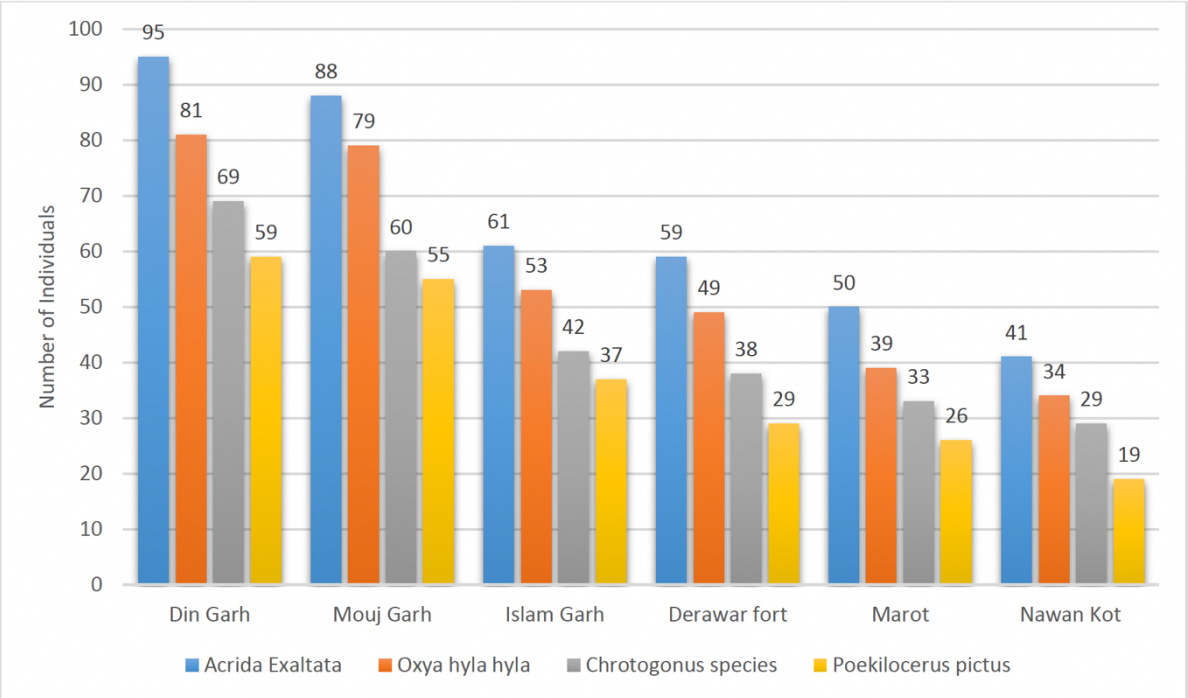

Fig 5. Graphical Number of Species individuals collected from different localities

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Diagnostic Feature

***Acrida exaltata* (Walker, 1859)**

Body large, elongate, almost stick-like, green throughout. Antenna acneiform, about 18 segmented, shorter than head and pronotum together. Head longer then pronotum. Fastigum of vertex parallel sided, with slightly indicated median carina, in the anterior prition only. Pronotum elongate with acute posterior margin. Tegmina and wings fully developed. Tegmina with or without a row of white spots in the central part, pointed apically. Hind tibia with 25- 29 black tipped spines on either side.

Fig 6. *Acrida exaltata* (Walker, 1859)

Table 5. Measurement of different body parts of *Acrida exaltata*

Measurement (mm)	Male (5)	Female (5)
Length of body	29-35	45-61
Length of antenna	10-11	13-15
Length of head	5.5-7	9-11
Length of pronotum	4-5	8-10
Length of tegmen	21-27	40-48
Length of hind femur	17-20	27-35
Length of hind tibia	16-19	25-31

***Oxya Hyla Hyla* (Audinet-Serville, 1831)**

Medium-sized, green to lighter green body color. Filiform, segmented antenna that is either slightly shorter or equal in length to the head and pronotum combined. More head than pronotum Pronotum rounded posteriorly and very little narrowed and flattened forward.Tegmina and wing fully formed. Male cercus compressed, subacute, or truncate, with an apex.

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Fig 7. *Oxya hyla hyla* **(**Audinet-Serville, 1831)

Table 6. Measurement of different body parts of *Oxya Hyla Hyla*

Measurement (mm)	**Male (5)**	**Female (5)**
Length of body	20-26	21-27
Length of antenna	7.5-8.5	8-9
Length of head	2.5-3	3-3.5
Length of pronotum	3.5-5	4.5-6
Length of tegmen	21-25	22-26
Length of hind femur	12-14	15-18
Length of hind tibia	10-11	12-14

Poekilocerus pictus **(Fabricus, 1775)**

The largest and brightest-colored species of insect was P. pictus. The fastigum of the vertex was triangular, roughly the same length as wide, and it was deeply sulcate from the uniformly rounded apex down to the frontal ridge. The interocular space was equal to the width of the eye, and the head was as long as wide, hardly raised above the pronotum. The frons in profile were shallowly concave frontal ridges, deeply sulcate with narrow, raised straight margins that only slightly diverged toward the clypeus and obliterate a short distance above it. The oval ratio of P. pictus's eye was greater than 3:4.

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Fig 8. *Poekilocerus pictus* (Fabricus, 1775)

Table 7. Measurement of different body parts of *Poekilocerus pictus*

Measurement (mm)	Male (5)	Female (5)
Length of body	50-50.5	50.5-52
Length of antenna	8-8.5	10-10.5
Length of head	8-8.5	10-10.5
Length of pronotum	11.5-12.5	13-13.5
Length of tegmen	33.5-34	34-34.5
Length of hind femur	23-23.5	24-24.5
Length of hind tibia	21-21.5	22-22.5

***Chrotogonus Species* (Blanchard, 1836)**

Not much larger in size, dull in color. Jumping grasshopper that is difficult to collect because it is camouflaged with soil color. Oval eyes present on lateral but slightly dorsal sides. Short antennas, mouth have chewing parts. Wings have teeths like structure pattern.Female is much larger than male. Can survive extreme conditions in the hot days of summer. Species of genus Chrotogonus are known as surface grasshoppers which are polyphagous pest, multi- verses, terricolous and one of the common pest for common vegetations.

Fig 9. *Chrotogonus Species* **(**Blanchard, 1836)

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Table 8. Measurement of different body parts of *Chrotogonus Species*

Measurement (mm)	Male (5)	Female (5)
Length of body	18-19.05	20.33-22
Length of antenna	4.03-4.40	5.5-6
Length of head	2.50-3	3.39-4.2
Length of pronotum	3.20-4	4.37-5
Length of tegmen	10.37-11.50	12.76-13.02
Length of hind femur	26-27	28-28.30
Length of hind tibia	27.05-28.04	29.24-30

Table.9. Collection of insects during the year 2021

Order	Months	Species	Community	
			Agricultural	Desert
Orthoptera	January-March	*Acrida exaltata*	42	28
		Oxya hyla hyla	25	19
		Chrotogonus species	18	37
		Poekilcerus pictus	10	34
	April-June	*Acrida exaltata*	70	54
		Oxya hyla hyla	57	45
		Chrotogonus species	26	52
		Poekilcerus pictus	14	47
	July-September	*Acrida exaltata*	84	62
		Oxya hyla hyla	72	49
		Chrotogonus species	33	64
		Poekilcerus pictus	24	57
	October-December	*Acrida exaltata*	34	20
		Oxya hyla hyla	50	18
		Chrotogonus species	9	32
		Poekilcerus pictus	9	30
Total number of Grasshopper individual			**577**	**648**

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Table 10: Relative Abundance % of different species

Sr. n	Relative Abundance %	
	Species	**Percentage**
1	*Acrida exaltata*	32.163
2	*Oxya hyla hyla*	27.346
3	*Chrotogonus Species*	22.122
4	*Poekilocerus pictus*	18.367

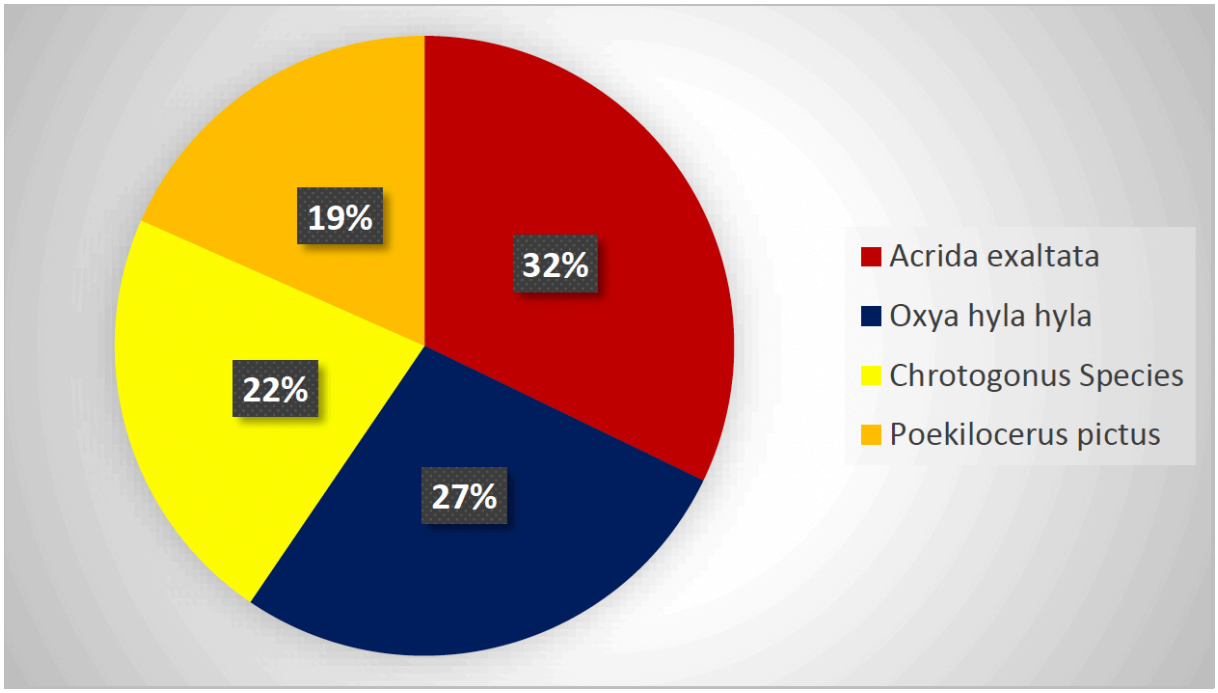

Fig 10. Pie Chart Representing the Abundance % of different species

Conclusion

At the present 4 pest species were reported which are considered the major pest for rice, sugarcane, maize, and vegetation. Beside this, one member *Poekilocerus pictus* feeds on akk plant which has some medicinal value. Further, surveys are in progress. It will increase the numbers of pests and information gathered through this will help us to make control planning tasks in near future.

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