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Research Article

Recent incidence of *Hieroglyphus oryzivours* (Hemiacridiane: Acrididae: Orthoptera) in various Districts of upper Sindh Pakistan

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Abstract

The present survey was carried out to know the incidence of *H. oryzivorus* in different agriculture fields in two forms of *H. oryzivorus* (Brachypterous form, Macropterous form) which are the vigorous pest of the paddy in Sindh. The investigation is being carried out from June 2020 to November 2022. A total of 2072 specimens were collected from different agricultural zones of seven districts of Sindh from different crops and grasses. The incidence was highest in district Khairpur at 17.9 % followed by district Kashmore at 16.03%. The Ghotki was infested by 15.63% While Shikarpur was recorded as 14.14%. The incidence in Larkana was recorded as 13.17%. Sukkur and Jacobabad were less infested in a district with a percentile of 11.87% and 11.25%. Regarding the host plant, the highest number was collected from Sarkanda (*Saccharum bengalese*) and paddy fields.

Keywords: Kashmore, Macropterous, Brachypterous, *Hieroglyphus oryzivorus*, Paddy.

Introduction

Sindh is a very fertile province in Pakistan due to the abundant supply of river Indus water, it is the center of cultivation for Rice, Wheat, Cotton, Maize, Gram, Pea, and many other wild types

of grass including Sarakanada (*Saccharum Bengalese*) and many other vegetables and different fruits. Its diverse habitat includes the river Indus bank, plains, forests including Nara, and the Thar parker desert, due to its unique topography and diversity in flora it is populated by major orthopteran fauna including the Hemiacrdinae family. The agriculture fields of this area are infested by different pests including *Hieroglyphus oryzivorous*. This is a serious pest of sugarcane, rice millet, and also maize in the whole of Pakistan though most defoliation of paddy crops from all (Sultana and Wagan 2015). The attack of this insect was reported in two different states of India including Gujrat as well as Rajasthan (Roonwal 1976). The ecosystem and classification of this insect group were studied from Jharkhand, Bihar, and Uterpardeh from India (Roonwal 1978). In Pakistan, *H. oryzivorus* is distributed in the Dadu, Jacobabad, Khairpur Nathan shah of Sindh, and Baluchistan plains (Sultana and Wagan 2008). Previously it was reported from east Pakistan (Nowadays Bangladesh) (Ahmed 1980). The primary host of this serious pest is paddy fields, but secondary hosts may be Banana, Jowar, Sugarcane, and maize in many countries. After hatching the nymph first attacks the buds of the rice plant but when the pest population is in full swing, they may eat the midrib the whole leave is completely due to this plant becomes weak yield is reduced and the former faces million rupees losses (Sultana and Wagan 2010). This insect occurs in two different morphological forms i.e., Brachypterous form and Macropterous form. The Macropterous form is more dangerous and abundant in Hybrid rice varieties, if the cultivation of the Hybrid variety is continued in Pakistan it can provide a favorable habitat to produce the future swarm (Jakhrani and Sultana 2018). It is a primary and serious pest of paddy (Mason, 1973) They inhabit in lush green cultivated fields and feed on all parts of plants but leaves are more infested by the pest (Sultana and Wagan 2015) The species is abundantly found on the paddy and other grass in various regions of India i.e. Amrister, Hoshiyarpor, Jalaldarpur, Haryana, and Amballa (Kumar and Usmani 2015). This species was reported as a pest of sugarcane, jowar, and paddy in Andhra Pradesh, Chhateesghar, west Bengal, Orissa, Ragistan, and Himachal Pradesh India (Rafy and Usmani 2014), and a new species of this genus was discovered by (Swaminathan, 2017). *H. oryzivorus* pose considerable damage to maize, rice and other grasses(Sawar *et al.*, 2023). The nymphs of family Hemiacridiane cause Sevier loss to paddy fields due to nonfunctional wings (Akhtar .H.M *et al* 2014*)*, Members of this family are polyphagous, and they cause heavy loss to millet, sorghum, Gram, and sugarcane, maize and paddy (Akhtar *et al* 2014). This species is distributed in Jamu

and Kashmir, Budgam and Doodhpathri. A single generation in the year, the *H. oryzivorus* feed on available grasses near the forest but their population number is higher at paddy fields (Baba Taj Mahal *et al* 2022). (Kumar and Sultana 2015) noted the infested specimens of *H. oryzivorus* by fungus from Dadu, Larkana, and Badin. Family Hemiacridanae along with seven other families of Caelifera was catalogued in Pakistan with its two overlapping boundaries (Sultana and Song 2024). Orthopteran subfamily Gryllinae poses a considerable threat to the main agriculture area of Sindh Pakistan (Naila and Sultna, 2024). The biodiversity of Mehranu forest Khairpur merus hold the special attention due to two diverse families and seven species (Bozdar and Sultana 2024) Gryllidae family was keenly observed with the discerption of a new species and four new records in Sindh Pakistan (Sultana and Surya, 2021). The recent outbreak of locust damaged all types of crops in South Asia including Sindh and Pakistan (Sultana and Kumar 2021). The desert area of Pakistan with a special focus on the has been studied by (Kumar and Sultana 2022) they report 25 species of grasshoppers including Caelifera and Ensifera The molecular study from Khairpur district is done by (Sultana and Soomro 2021) with a special focus on family Pyrgomorphidae.The outbreak of the next generation of desert locusts can be controlled by entomophagy (Sameju and Sultana, 2021). The biogeographical study of Orthoptera is done in Sindh Pakistan which reconfirms the presence of family Eumeninae (Tariq and Sultan 2020).The presence of Katydids of 12 species within 5 genera was studied by (Sanam and Sultana 2021) in Sindh.The nymphs of many species of Oxyinea can damage the wheat, rice, sugarcane, and other fodder crops in Sindh (Sultana and Soomro, 2021) The egg pods of species of oxya hatch during June and July at the end of August the hatching stops (Sultana and Soomro 2020).The desert area of Sindh is home to a new genus of ensifera (Sultana 2019).The hopper bands of *Schistocerca gregaria* are the consumers of wild vegetation which reduces the food supply for other animals (Sameju and Sultana 2019).The largest family Tettigoniidae in orthroptera live in the dry and open spaces of Sindh (Sultana and Panhwar, 2017). A new species of the genus *Hieroglyphus* was discovered in Sindh and Pakistan (Sultaa and Wagan 2012).The *Hieroglyphus* is naturally controlled by several parasites and predators including the red mite *Eutrombidium trigonum* (Sultana and Yawar, 2012). Chemical control is the only solution when the pest infestation is higher. The Thiodine 35CE provides the best result in the species of *Hieroglyphus* in laboratory conditions (Sultana and Wagan, 2011). The *Hieroglyphus perpulita* is shows a higher growth rate by feeding of Sarkanda plant *S.*

bengalense) the sugarcane and rice under laboratory conditions. This genus is a pest of rice, sugarcane, and wheat in Pakistan (Sultana and Wagan, 2010). The weight of egg pods of *H. oryzivorus* is 1.30±0.03 g (Sultana and Wagan 2009). The *H.nigrorepletus* is distributed in Sindh and first time reported in the Thar Parker desert (Wagan and Soomro 2007)

Martial and methods

Study area

The planes of Sindh are the home of crops where a variety of fodder is grown including maize, sugarcane, wheat, and paddy, and many types of grasshopper species are found in diverse habitats including *H. oryzivorus*. The river Indus flows in the agricultural land making it more unique than other parts of Pakistan. The Nara desert of Khairpur makes it special for Grasshopper breeding. The hot summer and cold weather are in winter. The temperature in the hot season is 35 to 45 C.

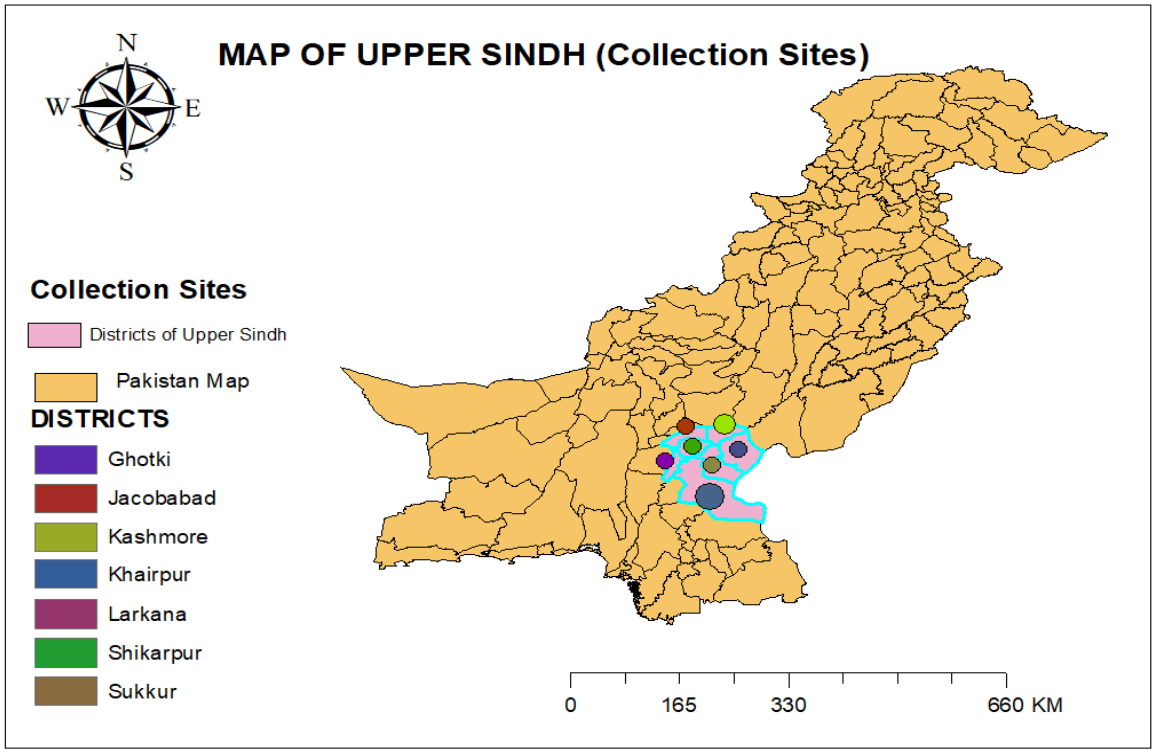


Figure1. The map of site area where insects were collected

Sampling

Sampling was made from June 2021 to November 2022 every month from different districts of Sindh, (Figure: 1), especially the major agricultural regions. Sindh River Indus banks were more

concentrated due to their diversified habitat. Most sampling was made from rice, wheat, grasses, bushes, maize, and grasslands. Besides this, a frequent survey was made at all possible habitats. The collected material was brought to the laboratory for further analysis.

Killing and preservation

The collected specimens were killed using potassium cyanide in the standard entomological bottles or by chloroform after pinning of the specimen they were stretched on the stretching board and attention was paid to the position of antenna wings pads and legs to display important taxonomic characteristics. The fully dry specimen was removed from stretching boards and was stored in the insect boxes with labels showing the locality, date, and collector's name**.** The taxonomic material was properly mounted, labeled and important taxonomic characters were noted, and photographs were taken out. Identification of the samples was done by the following scheme (Mason .GB 1973), (Sultana and Wagan 2012) and (Kumar and Usmani 2015) with slight modification was followed.

Results

During the present study, a total of 2072 specimens were collected from different agricultural areas. Especially seven districts of upper Sindh were more visited due to diverse crops, more freshwater availability, and the presence of the Nara desert. It was noted that the incidence of *H. oryzivorus* was highest in the Khairpur district due to diversity in crop production and the presence of the Nara desert and possibly deforestation was the major cause. According to local people, for two decades most of the concentrated trees were cut down which increased the bare land and bushes which provided the best breeding place for the pest. The infestation rate of this district was highest as compared to others districts by the 17.9%. The infestation rate in district Kashmore was recorded as 16.03 %. The incidence of the pest was recorded in 15.63 %. in Ghotki and was 14.14% in Shikarpur district in three years of survey. In Larkana district 13.17% was noted to overall infestation rate. The lowest infestation was noted in Sukkur and Jacobabad as 11.87%. and 11.25 % respectively. During the present survey the more concentration was given diverse habitat. We have collected the fair number species from the Sarkanda plant (*Saccharum bengalines*) It was noted that first the pest feed on rice plants, after the harvesting of the rice the insect moved to the Sarkanda plant for protection from predators, and excellent camouflage as well as a safe site for oviposition of eggs for next year. When pesticides are

applied or the crop is harvested the insect quickly moves to the Sarkanda plant, because the Sarkanda is naturally not cut down nor harvested and no pesticide is applied, the second reason is that Sarkanda provides excellent camouflage and protection against natural predators due to spike and green yellowish color, And finally the last oviposition was recorded in Sarkanda plant, next watering season may provide the best habitat for hatching and quick movement of nymph to paddy. Table no: 1 shows that the paddy fields were more concentrated followed by the Sarkanda plant the author collected 350 specimens from the field which shows Sevier attack of the pest, the insect was eating new buds from the paddy plant (*Oryza sativa)* which resulted in low photosynthesis and the plant was unable to form mature leaves for photosystem. Collection was also made from the wheat (*Triticum*) field by collecting 342 specimens. The Infestation in cotton (*Gossypium*) was also recorded by collecting 279 specimens and 278 specimens from the Maize (*Zea mays*). The lowest numbers were collected from Pea (*Pisum sativum*) 194 and the lowest were recorded as 139 in the Gram (*Cicer arietinum*) field. This insect occurs in two body forms i.e., short and nonfunctional wings (Brachypterous), long and functional wings (Macropterous). In the present survey both forms were recorded and more numbers of long and functional winged (Macropterous) insect were recorded. The functional winged insect a tends to fly from one field to another field which shows a very tense situation because the deserted area of Khairpur i.e., Nara desert is extending due to deforestation and growth in human population making this pest more available habitat for oviposition and production of future swarm The results show that the pest is becoming a serious and major pest of paddy and other crops and wild plants, possibly the cause may be climate change. The author personally collected some specimens from Sarkanda in November 2020. Normally during November, the *H. oryzivorus* dies due to cold weather.

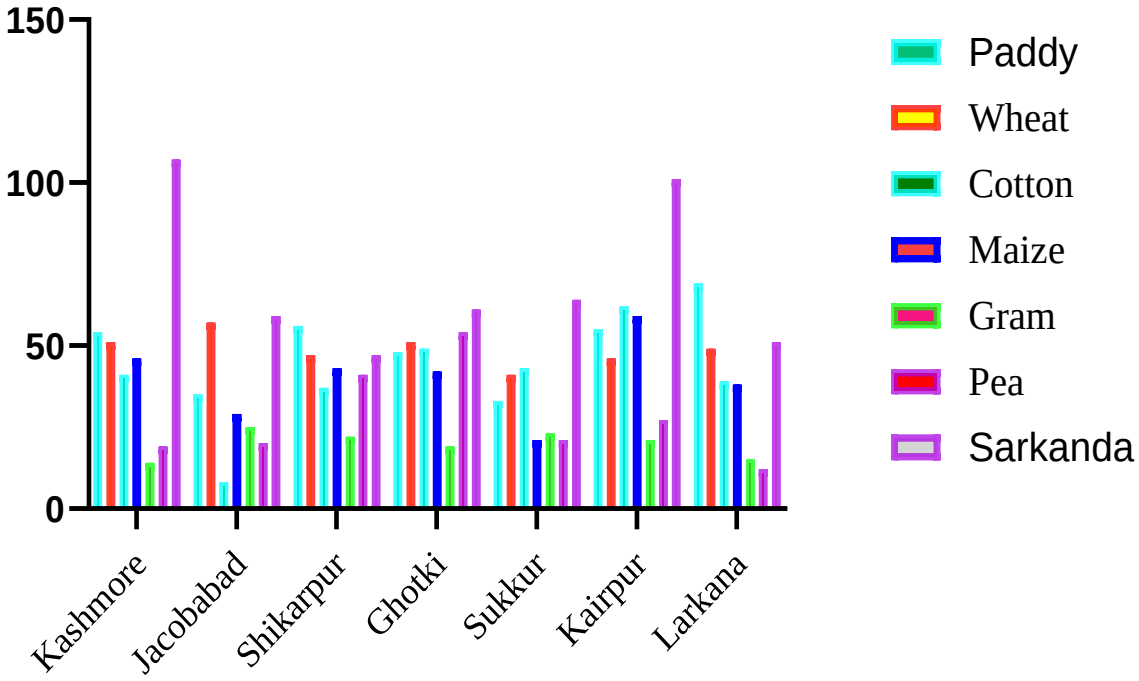
Discussion

Sultana and wagan (2008) noted that the specimen died off in November. According to Mason (1973) this pest feed on Mize, millet and paddy fields of India, in present survey we have noticed that this pest damages the fodder crops like wheat, rice, pluses and some cash crops like cotton. The incidence of this pest was recorded in the Indian states Rajasthan and Gujrat and also the ecosystem was studied by (Roonwal 1976 and 1978). In this investigation the insect was keenly observed in its natural habitat and noted that this pest is adapting to resist in end of

November and continually extending in upper Sindh regions of Pakistan. Ahmed (1980) noted this pest in East Pakistan but did not report the maximum damage, but current survey reveals this as serious pest of fodder and cash crops in Pakistan. Sultana and Wagan (2008 and 2010) reported this species from Dadu, Jacobabad, Khairpur Nathan Shah and Baluchistan we try to explore more district including Kashmore, Shikarpur, Khairpur, Sukkur and Larkana and also confirmed the presences of this pest in Jacobabad. The primary host of this pest is paddy fields, when the hatching of all nymphs completes their population rises and result in eating the midrib of leaves leaving the plant weak and fall. We observed that the hating of pests starts from the side grasses of paddy crops and the first instar make easy entry to the field and start feeding the leaves when they become mature, they move from field to field with functional wings and pose considerable damage to yield by cutting photosynthetic leaves making plant weaker and more vulnerable to disease. According to Jakhrani and Sultana (2018) that this insect occurs in two different forms Brachypterous forms and Macropterous forms and is found in Hybrid rice varieties the present research confirmed both body forms have identical damage including fodder and other cash crops. This pest is found in the High elevation of Kashmir, they hatch in forest grasses near paddy fields and move to paddy fields when mature Z.M Sarwar *et. all* (2023).The hatching and nymphs of this species in the current survey are observed in the Sarkanda plant (*Saccharum bengalines)* and they quickly move to paddy fields for further maturation and mating, a unique association was recorded of this insect with Sarkanda (*Saccharum bengalines)* it is naturally grow at the sides of cultivated fields it provide an excellent protection against predators like frog, crow and other local animals due to camouflage and presence of sharp spikes which make it very difficult to approach and due to same coloration they are not easily spotted. Finally, oviposition in late October and rare cases in the first Month of November was observed in the deep of the Sarkanda plant (*Saccharum bengalines)* which protects the eggs for the whole year and when the next watering season starts, they hatch the same cycle of life.

Table1. The collection of *Hieroglyphus oryzivorus* from 2020-2022 in different district of Upper Sindh with host

S.NO	Name of District	Year	Cultivated field							Percentage
		2020-2022	Paddy	Wheat	Cotton	Maize	Gram	Pea	Sarkanda	
1	Kashmore	332	54	51	41	46	14	19	107	16.03 %
2	Jacobabad	233	35	57	8	29	25	20	59	11.25%
3	Shikarpur	293	56	47	37	43	22	41	47	14.14%
4	Ghotki	324	48	51	49	42	19	54	61	15.63%
5	Sukkur	246	33	41	43	21	23	21	64	11.87%
6	Kairpur	371	55	46	62	59	21	27	101	17.9%
7	Larkana	273	69	49	39	38	15	12	51	13.17%



Incidence of *H.oryzivorus* in various host plant in different district of upper sindh

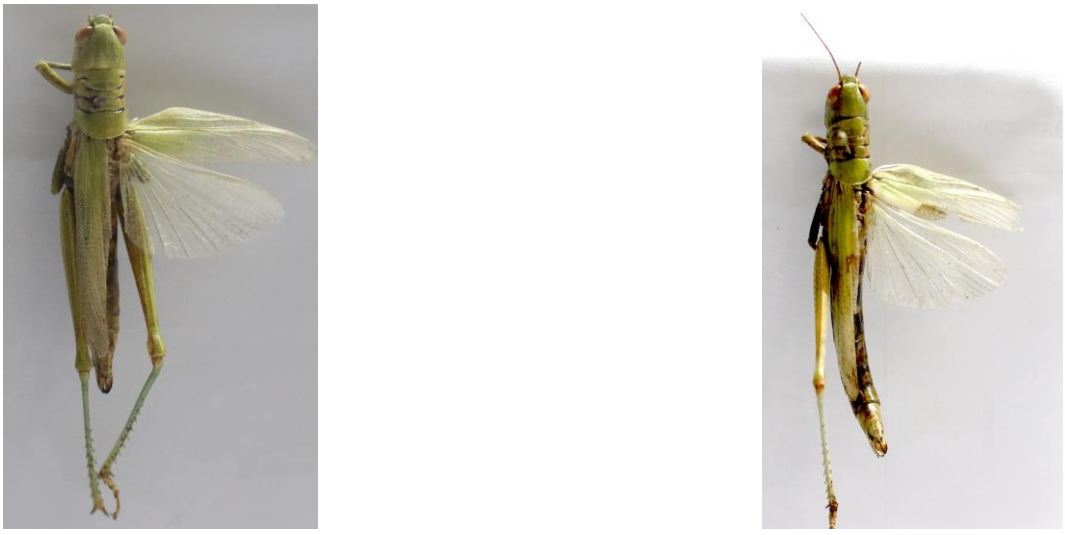
Figure 2. The graphical presentation of *H. oryzivorus* incidence in different host plants in the district of upper Sindh. Sarkanda (Saccharum *bengalines)* was highly infested and a lower rate of infestation was recorded in peas.

Table 2. Morphometric Measurement of *H. oryzivorus*

Measurements (mm)	♂		♀	
	Mean	S.D	Mean	S.D
Length of body	34.24	0.78	41.64	0.79
Length of pronotum	7.35	0.25	6.25	0.59
Length of tegmen	12.16 (brachypterous)	0.48	31.13 (macropterous)	0.77
Length of hind femur	16.19	1.03	17.25	0.46
Width of hind femur	2.23	0.21	2.16	0.11
Ratio of the mean length of tegmen to the mean length of pronotum	1.66		3.72	
Ratio of the mean length of tegmen to the mean length of hind femur	0.67		1.56	

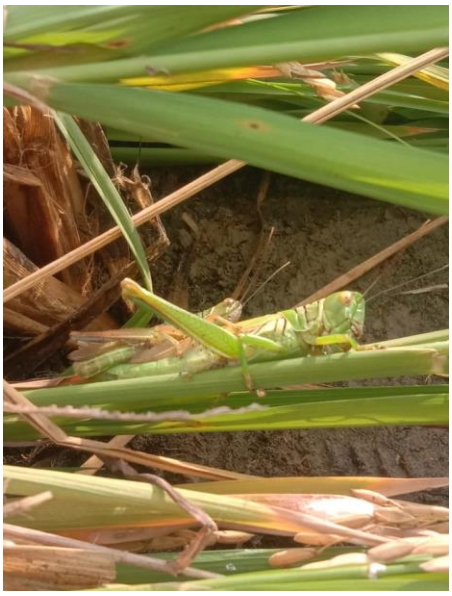
Conclusion

In present investigation it was noted that *H. oryzivorus* is serious pest of fodder and cash crops in southern Pakistan province of Sindh, which cause massive loss to formers and stakeholders of agriculture sector. There are several factors including deforestation, uncontrolled human population and depletion of natural resources and climate change is leading cause of extension of desert area in Khairpur. It is making more favorable habitat and uncontrolled growth and adaptation of pests. It is recommended to cut down Sarkanda (Saccharum *bengalines)* plant from the sides of paddy fields which are reservoirs of *H.oryzivorus* egg for next generation and maintain the natural ecosystem balance by reducing the effect of climate change .



(a) (b)

Figure 3. *H. oryzivorus* (a) Macropterous form (b) Brachypterous form.



(a)

(b)

(c)

(d)

Figure 4. Field observation of *H.oryzivorus* (a-b) Mating pairs are shown in natural field (c) Camoflagueld in sarkanada plant (*Saccharum bengalines)* (d) Insect in paddy field

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