Diversity and Abundance of Macro-invertebrates in Rice Field of Faisalabad

Muhammad Azhar Mukhtar, Nazia Ehsan, Hafiz Muhammad AbuBakr, Muhammad Nadeem

MSC Zoology from Agriculture University of Faisalabad
M.Phil. in Zoology from Agriculture University of Faisalabad
M.Phil. in Zoology from GC University of Lahore
MS Zoology from Virtual University of Pakistan

DOI: 10.29322/IJSRP.9.06.2019.p90120
http://dx.doi.org/10.29322/IJSRP.9.06.2019.p90120

***Abstract*- Background:** Agricultural sector plays an important role in the economy of Pakistan. In the field of agriculture Rice is an important cereal crop after wheat. Rice grains are big source of carbohydrate. Rice grain has, 3.5% iron, 8.5% protein, 4.9% fiber and highest amount of antioxidants. The diversity and abundance of macro-invertebrates in agro-ecosystem depend on providing the basic survival needs.

Objective: Current study was conducted to check out the abundance and diversity of macro-invertebrates in rice crop.

Material and Method: The data was collected from district Faisalabad. Collected samples were preserved, identified and analyzed. All the specimens were studied and identified by the using of keys as provided Borer and Delong.

Results: A total of 5 orders of macro-invertebrates were identified including 9 families and 17 species. Shannon Weiner Diversity index (H) was used to analyze the data. These were the values which were calculated. There were 115 specimens, 17 species and value of Shannon index (H 2.383) calculated.

Conclusion: Shannon Wiener diversity index was applied to find out the overall diversity of macro- invertebrates in rice field. It shows high diversity H"=2.383 and Dominance D = 0.8913. Abundance and diversity of macro-invertebrates was not much different in different selected sites of rice field of Sargodha road Faisalabad. All the comparisons made between different selected sites show non-significant differences in distribution of macro-invertebrates.

I. Introduction

Rice, a yearly grass (Germaine), has a place with the sort *Oryza* that incorporates twenty wild species and two developed species, *Oryza sativa* (Asian rice) and *Oryza glaberrima* (African rice). *O. sativa* is the most generally developed species throughout the rice-developing world today. In Asia, O.sativa is separated into three subspecies in light of geographic conditions; *indica, javanica* and *japonica*. Indica alludes to the tropical and subtropical assortments developed all through south what's more, Southeast Asia, southern China. Javanica assigns the bulu (awed) and gundil (aweless) rice's with long panicles and intense grains developing close by of lists in Indonesia. Japonica alludes to the short and roundish grained assortments of the calm zones of Japan, China and Korea (1).Rice farming is main way for the income of millions people in the world. It is a most cultivated crop worldwide and has main activity. About 11% of world's cultivated land is occupied by rice field. As the cultivation of rice has positive value it has also negative impacts on the areas where it is grown. In the East rice are used as basic diet, but overall in the world 50% people use rice as a diet. 5, 86,787 thousand tons of rice produced in 1999-2000 in the world but it is affected by macro-invertebrates which reduces the production of rice in the world. Different kinds of invertebrates occupied the area of rice ecosystem which badly affected the vegetation of rice plants (2).

In Pakistan, rice occupies an essential position in harvest farming. The reason is that it has brief period for development and gives higher yield. The world wise rural extension is suspected to debilitate biodiversity world wise in following couple of decades. Biodiversity is a constriction of term natural differences which alludes to the assortment inside of the living scene. The word lavishness demonstrates the quantity of species present in an assigned zone for the wealth of different species (3).In spite of the fact that rice fields do not have the basic and floristic differences of regular wetlands, they can be vital for protection activities, especially in regions where regular wetlands have declined. For illustration, rice fields in California are consistently overflowed to help the deterioration of rice straw, and these winter flooded fields shape critical natural surroundings for some water bird species (4) Rice stem borers having a place with two Lepidopteran groups of Pyralidae and Noctuidae can plague rice plants from seedling to development. Pyralid borers are the most normal and damaging of every stern borer and generally have a high level of host specificity. The noctuid borers are polyphagia and as it were every so often cause monetary misfortunes (5).The white stem borer is additionally a noteworthy bug of rice in Pakistan. The grown-up WSB is like the YSB in appearance. The grown-up moths of WSB are comparable in appearance. The white moth with an orange butt-centric tuft is generally found in the field particularly in the early phases of the yield. The grown-up female has a wingspan of 26-30 mm what's more, the male of 18-24 mm. Female moth normally laid eggs in group of 70-260 on the underside of youthful clears out. The egg mass is secured with luxurious hairs from the butt-centric bit of the female moth and is like that of the yellow stem borer. Hatchlings incubate from the eggs in 4-9 days. The youthful hatchlings enter the leaf sheath and drills down into the stem. Hatchlings are smooth white and develop to a length of 25 mm. The larval stage changes from 19-31 days. The full-

developed hatchling pupates inside the stem in the wake of making a leave gap for the moth to develop (6).Yellow stem borer are nighttime, emphatically phototropic and solid fliers, are diurnal and rest in the shade when not effectively flying. Moths more often than not develop in the early hours of night. The female moth is greater than male and its forewings are splendid yellowish darker with particular dark spot in the inside. The guts are wide, the tip being secured with tufts of yellowish hairs (7).The male moth of yellow stem borer is light yellow; the mid-region is slim and the back end has a thin shaggy covering dorsally. Spots on male moth wings are not discernible. Mating for the most part happens between 7 to 9 p.m. The sex of yellow stem borer in view of light trap gets has been accounted for as for the most part more females than guys. The female moths lay eggs early during the evening in little masses close to the tip of leaf edge. A female moth is fit for laying 100-150 eggs (5).Moths are nighttime and in splendid sunshine cover up themselves under surface of leaves and on stems. Amid the early morning hours, moths are regularly dynamic but their movement goes down as light spreads. The moths are pulled in to light. Grown-up moths are yellowish darker ii shading, little and are 10-12 mm long with a wing growing to 13-15 mm. The wings take the state of an equivalent side triangle when very still. The forewings have three oblique lines of differing lengths. The rear wings have an expansive a range. The tibiae are tufted with dark hairs, which are unmistakable in the male moth however not in female (8).The pink stem borer is for the most part the slightest harming stem borer species. The grown-up moth is stoop, the forewings being tan with dull dark colored markings from a focused point in the forewings. Dim dark lines transmit at the wing tips finishing in a thin terminal line of dim spots. There are tufts of hairs on pronotum. The rear wings are white. The wing range is 30-35 mm in female and 20-30 mm in the male. Female moth laid around 400 eggs. Eggs are rich white to dull and are stripped and bring forth in seven days' opportunity. The hatchling has an orange-red head case furthermore, its body is purplish pink dorsally and white ventrally. The head is moderately substantial contrasted with whatever remains of the body. Hatchlings regularly leave one stem and drill into extra stems, subsequently obliterating a few plants. The hatchling turns out to be full-developed in 4-5 weeks, experiencing 5-7 sheds. At this stage, it is 20-26 mm long. Pupation happens inside the larval passage inside the stem yet every so often happens outside the stem between the leaf sheath and the stem (6).

Normally chose development rehearses and safe assortments accomplished the conventional types of rice development adjustment to bothers. In late decades the requirement for improved rice generation in Pakistan and worldwide has cleared out to the selection of more serious generation frameworks. It has created increments in irritation assault and a more noteworthy dependent on substance pesticides as the real type of control. Achievements in novel approaches of control as could be expected under the circumstances be that as it may, their effect on rice creation is dubious are surely dubious. At present, there is much more potential to make strides bother administration by completely using the control systems and practices at present accessible. Pesticides and different agrochemicals utilized as a part of traditional rice developments can change the common physical–chemical conditions of water, which may change macro invertebrate population (Viale *et al*., 2012).

For the control of harmful organisms which attacks the rice crop and reduces its productivity agrochemicals are used. These chemicals support the production of rice. As these chemicals have benefits but in same case they usually cause huge problems. Because these are very toxic they have an adverse effect on human health (9).

Materials and Method

Faisalabad is situated in Rechna Do-aab, located between the Chenab and Ravi rivers, 73.08’E, 31.25’N and at an altitude of 214m above mean sea level. The mean annual maximum and minimum temperature of the area is 48±2oC and 10± 2oC respectively and average annual precipitation is 550 mm. The city is densely populated district of Punjab with a population of more than 4 million and an area of about 1280 Sq. Km. Faisalabad District, covering an area of 5,856 km2 in the Central Punjab, Pakistan, was the study area (31.4180° N 73.0790° E) where mixed cropping pattern is dominant. Rice, sugarcane, maize, fodders (alfalfa and sorghum), vegetables (cauliflower, cucurbits, and tomato), and a few citrus orchards are the major agronomic and horticultural crops. Present study was carried out from October to December (2016).

Sampling Sites:

Three separate rice growing areas at Sargodha road Faisalabad were selected as experimental sites in the wet season. Three villages were selected named as Ram Diwali, Chak No.2JB, Arfa krimabad for the sampling from rice field. There are 2, 2 samples were collected from every village.

Sampling method:

Sampling of macro-invertebrates fauna was done in a rice crop from October to December 2016. Rice field was divided into five equal plots. Sampling was done fortnightly by installing two pitfall traps 10 m apart in the center of each divided plot, totaling ten pitfall traps per crop field. The pitfall traps were plastic containers 10 cm in diameter and 15 cm in depth, buried in the soil with its upper end leveling the ground to allow uninterrupted fall of macro-invertebrates in the pits.

Preservation:

The specimens were preserved in the glass jars containing 10% formalin with few drops of glycerin and were brought to Bio control laboratory, Department of Zoology, Wildlife and Fisheries, University of Agriculture, Faisalabad. Each specimen was studied in controlled condition of temperature of 25.

Identification:

The specimens were identified with the help of available literature and keys given fauna of British India, as well as already identified specimens which are preserved in the insect Museum, Department of Entomology, and University of Agriculture Faisalabad.

Analysis of data:

The relative abundance of every specie was determined to check their abundance in respective crop.

Shannon Diversity index:

Research was often driven by the need to develop management strategies for such insects. However, many utilized indices of diversity to measure biodiversity richness. In many such studies, specimens are sorted based on phenotypes (termed recognizable taxonomic units) to obtain diversity indices for different study.

While this method allows for the comparison of plants and animal richness, it does a little to enable the understanding of biological and ecological system. Data were analyzed statistically to determine species diversity H, species richness and species evenness with Shannon Weiner diversity index Shannon. Diversity index was calculated using the following equation:

$$H = \frac{NlnN - \sum nlnn}{N}$$

The magnitude of H is not affected by the distribution of the data but also the number of categories. Evenness is calculated as:

$$E = H/lnS$$

II. Results

There are a lot of differences in paddy fields of the significant rice creating nations. Most prominent differences of rice nuisances were seen to be in Faisalabad in view of their tremendous land territory. Plant containers (Brown plant container and white-upheld plant container) furthermore, leafhoppers (green leafhopper, crisscross leafhopper) were observed to be generally appropriated in paddy fields of real rice makers. These bugs are in charge of tremendous monetary misfortunes to rice yields. Faisalabad being the greatest maker has sufficiently grown genomic techniques to keep their rice bugs beneath limit level in their rice fields. During sampling period 3 months the total no. of specimens collected were 115, 9 families and 17 species were identified in rice field. Richness and diversity of macro-invertebrates was significantly higher in the rice crop at the edge even in the center of the field.

Table No.1: Diversity of macro-invertebrates in rice field during first sample

Sr.	Order	Family	Species	Sample 1
1	Lepidoptera	Pyralidae	*Scirophaga incertulas*	2
2			*Scirophaga innotala*	1
3			*Chilo suppressalis*	2
4			*Chilo partellus*	1
5			*Cnaphlocrocis medinalis*	1
6		Noctuidae	*Spodoptera litura*	3
7			*Spodoptera cilium*	1
8	Homoptera	Cicadellidae	*Sogetella furcilera*	5
9			*Cofana spectra*	4
10			*Nephotettix nigropictus*	4
11			*Cicadulina bipuntella*	6
12		Acriididae	*Oxya multidentata*	3
Total	2	4	12	33

This table shows the diversity and abundance of macro-invertebrates in first sampling. In this table 12 species of macro-invertebrates are showed, which were identified. Total specimens which were collected in this sampling are 33. The most abundant specie observed *C. bipuntella* belonging to the family Cicadellidae has 6 specimens and least abundant specie is *S. innotala* belonging to the family Pyralidae has only 1 specimen.

Table No.2: Diversity of macro-invertebrates in rice field during second sample

Sr.	Order	Family	Species	Sample 2
1	Lepidoptera	Pyralidae	*Scirpophaga incertulas*	1
2			*Chilo suppressalis*	2
3		Noctuidae	*Spodoptera cilium*	1
4	Homoptera	Acriididae	*Oxya multidentata*	3
5		Cicadellidae	*Sogetella furcilera*	2
6			*Cofana spectra*	3
7			*Nephotettix nigropictus*	4
8			*Cicadulina bipuntella*	2
9		Pseudococcidae	*Ripersia oryzae*	1

10	Hemiptera	Alydidae	*Leptocprisa acute*	1
Total	3	6	10	20

This table shows the diversity and abundance of macro-invertebrates in second sampling. In this table 10 species of macro-invertebrates are showed, which were identified. Total specimens which were collected in this sampling are 20. The most abundant specie observed *N. nigropictus* belonging to the family Cicadellidae has 4 specimens and least abundant specie is *S. incertulas* belonging to the family Pyralidae has only 1 specimen.

Table No.3: Diversity of macro-invertebrates in rice field during third sample

Sr.	Order	Family	Species	Sample 3
1	Lepidoptera	Pyralidae	*Scirpophaga incertulas*	1
2			*Chilo suppressalis*	2
3	Homoptera	Acriididae	*Oxya multidentata*	4
4		Cicadellidae	*Sogetella furcilera*	2
5			*Cofana spectra*	2
6			*Nephotettix nigropictus*	2
7			*Cicadulina bipuntella*	2
8		Pseudococcidae	*Ripersia oryzae*	1
Total	2	4	8	16

This table shows the diversity and abundance of macro-invertebrates in third sampling. In this table 8 species of macro-invertebrates are showed, which were identified. Total specimens which were collected in this sampling are 16. The most abundant specie observed *O. multidentata* belonging to the family Acriididae has 4 spcimens and least abundant specie is *R. oryzae* belonging to the family Pseudococcidae has only 1 specimen.

Table No.4: Diversity of macro-invertebrates in rice field during fourth sample

Sr.	Order	Family	Species	Sample 4
1	Lepidoptera	Pyralidae	Scirpophaga incertulas	1
2			Chilo suppressalis	2
3		Noctuidae	Spodoptera cilium	1
4	Homoptera	Aphididae	Rhopalosiphum maidis	1
5		Cicadellidae	Sogetella furcilera	2
6			Cofana spectra	3
7			Nephotettix nigropictus	4
8			Cicadulina bipuntella	2
9		Pseudococcidae	Ripersia oryzae	1
Total	2	5	9	18

This table shows the diversity and abundance of macro-invertebrates in fourth sampling. In this table 9 species of macro-invertebrates are showed, which were identified. Total specimens which were collected in this sampling are 18. The most abundant specie observed *N. nigropictus* belonging to the family Cicadellidae has 4 specimens and least abundant specie is *R. maidis belonging* to the family Aphididae has only 1 specimen.

Table No.5: Diversity of macro-invertebrates in rice field during fifth sample

Sr.	Order	Family	Species	Sample 5
1	Lepidoptera	Pyralidae	*Scirpophaga incertulas*	2
2			*Chilo suppressalis*	1
3		Noctuidae	*Spodoptera cilium*	1
4	Homoptera	Acriididae	*Oxya multidentata*	2
5		Cicadellidae	*Sogetella furcilera*	1
6			*Cofana spectra*	2
7			*Nephotettix nigropictus*	2
8			*Cicadulina bipuntella*	1
Total	2	4	8	12

This table shows the diversity and abundance of macro-invertebrates in fifth sampling. In this table 8 species of macro-invertebrates are showed, which were identified. Total specimens which were collected in this sampling are 12. The most abundant specie observed *C. spectra* belonging to the family Cicadellidae has 2 specimens and least abundant specie is *S. cilium belonging* to the family Noctuidae has only 1 specimen.

Table No.6: Diversity of macro-invertebrates in rice field during sixth sample

Sr.	Order	Family	Species	Sample 6
1	Lepidoptera	Pyralidae	*Scirpophaga incertulas*	1
2		Noctuidae	*Spodoptera cilium*	1
3	Coleoptera	Chrysomelidae	*Dicladispa armigera*	1
4	Homoptera	Acriididae	*Oxya multidentata*	3
5		Cicadellidae	*Sogetella furcilera*	2
6			*Cofana spectra*	3
7			*Nephotettix nigropictus*	2
8			*Cicadulina bipuntella*	2
9		Pseudococcidae	*Ripersia oryzae*	1
10	Diptera	Muscidae	*Atherigona aoryzae*	1
Total	4	7	10	17

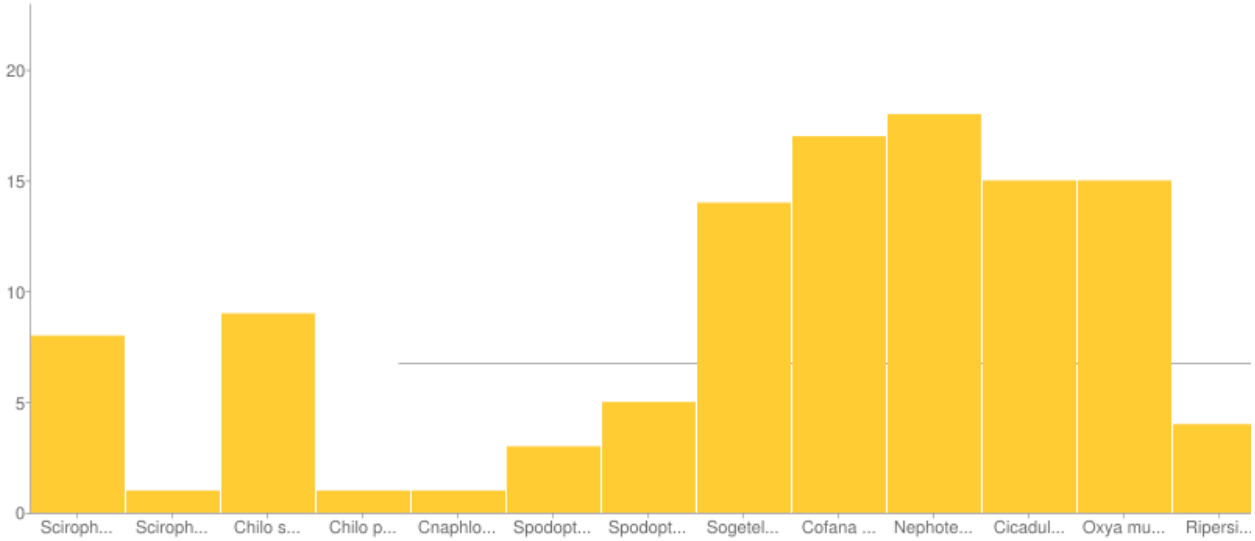
This table shows the diversity and abundance of macro-invertebrates in sixth sampling. In this table 10 species of macro-invertebrates are showed, which were identified. Total specimens which were collected in this sampling are 17. The most abundant specie observed *C. spectra* belonging to the family Cicadellidae has 3 specimens and least abundant specie is *A. aoryzae belonging* to the family Muscidae has only 1 specimen.

Table No.7: Shannon Diversity Index, Evenness and Dominance for micro-invertebrates abundance

S	N	Shannon Index	Simpson Index	Dominance
17	115	2.383	0.1105	0.8913

This table shows that the total no of specimens collected from rice fields of Faisalabad were 115. All specimens were studied and identified which were belongs to 17 species. The Shannon Index of macro-invertebrates is 2.383 and the evenness is 0.1105. Macro-invertebrates in rice field have dominance of 0.8913.

Graph no: 01 Graphical Representation of Species Population



Static chart for all species population which were identified

III. Discussion

The world rice product is assaulted by more than 100 types of creepy crawlies; 20 of them can bring about monetary harm. Creepy crawly bothers that can bring about critical yield misfortunes are stem borers, leafhoppers also, plant hoppers (which cause coordinate harm by nourishing and also by transmitting infections); rankle midges, a gathering of defoliating animal varieties (main1y lepidopteron); and a grain-sucking bug complex that sustains on creating grains. In present study the total collected specimens were 115, belonged to 17 species, 9 families and 5 orders. Out of the total 17 species observed, the most abundant specie was *Nephotettix nigropictus* with 18 specimens. This specie was highly abundant in rice crop of Faisalabad. This specie was also reported by many other authors (10).A total of 19 specimens of the family Cicadellidae were sampled from rice crop of Faisalabad during first sampling. It is also written in the collected table (1). Many specimens belongs to this family were reported by (11).

A total of 84 specimens of the order Homoptera were sampled from rice crop of district Faisalabad. There is great similarity of collecting specimens of this order by another researcher Karim and Riazuddin, 1999. The present study shows that all the comparisons made between different selected sites show non-significant differences in distribution of macro-invertebrates. And this study will be helpful for agronomists in providing the basic information about the macro-invertebrates of rice crop in Faisalabad. This can be helpful in designing the biological control program to control insect species in the sustainability of agro-ecosystem. The measurements can be taken for the production of crop yield.

IV. Conclusion

Shannon Wiener diversity index was applied to find out the overall diversity of macro- invertebrates in rice field. It shows high diversity H"=2.383 and Dominance D = 0.8913. Abundance and diversity of macro-invertebrates was not much different in different selected sites of rice field of Sargodha road Faisalabad. All the comparisons made between different selected sites show non-significant differences in distribution of macro-invertebrates

References

[1] Reissig WH, E. A H, J. A , K M, L F, T.W M, et al. Illustrated Guide to Integrated Pest Management in Rice in Tropical Areas. Internation Rice Research Institue. 1986; 11: p. 373-386.

[2] Banwa TP, M. C. C B, H E, Z M. Rice terraces macroinverterbrates as indicator of water quality in indigenous communities of the Cordillera region North Luzon. Philippines Eur Scientific Journal. 2013; 4: p. 1857-7881.

[3] Ahmad M. Serious attack of Stem borers of rice crop at Gujjo Sind Pakistan. Pakistan Journal of Agriculture. 1987; 8: p. 355-355.

[4] Usmani M, M N, M A. Field Observations on the incidence of Grasshopper faunna(Orthoptera) as a pest of Paddy and pluses. Eur Journal of Exp Biology. 2012;: p. 1912-1917.

[5] Gangurde S. Above ground arthropod pes and predator diversity in irrigated rice (Oryza sativa) production systems of the Philippines. Journal of Tropical Agriculture. 2007;(45): p. 1-8.

[6] Karim S, Riazuddin. Rice insect pests of Pakistan and Their Control. A lesson from past for sustainable future integrated pest Management. Pakistan Journal of Biological Sciences. 1999; 2: p. 261-276.

[7] Riaz M, M A, A B. Screening rice varieties and lines for resistance to Yellow Stem Borer (YSB) based on Preferences or Non-Preference and Antibiosis. Internationa Rice Newslett. 1993;(18): p. 26-26.

[8] Joshi RC. The Leaf Folder of Rice. Antena. 1988; 12: p. 39-39.

[9] Hasegawa H, Furukawa , Kimura SD. On form assessment of organic amendments effects on nutrient status and nutrient use efficiency fo Organic riece fields in Northeastern Japan. Journal of Elsevier Science. 2005;: p. 350-362.

[10] Zahoor MK, A S, Z, Z I, A. Biodiversity of Scarb beetles (Scarbaeidae Coleoptera) in Agroforest area of Faisalabad. Pakistan Entomol. 2003;(25): p. 119-126.

[11] Wasim MP. A study of Rice in the major growing countries of the world their growth instability and world share. Pakistan Journal of Ecological Society. 2002; 2: p. 153-183.

AUTHORS:

First Author – Muhammad Azhar Mukhtar
MSC Zoology from Agriculture University of Faisalabad
Email id: azharmukhtar00786@gmail.com
Second Author – Nazia Ehsan
M.Phil. in Zoology from Agriculture University of Faisalabad
Email id: naziaeuaf@gmail.com
Third Author – Hafiz Muhammad Abubakr
M.Phil. in Zoology from GC University of Lahore
Email id: hafizabakr2310@gamil.com
Fourth Author – Muhammad Nadeem
MS Zoology from Virtual University of Pakistan
Email id: raza3552@gmail.com