Sindh Univ. Res. Jour. (Sci. Ser.) Vol. 48 (1) 01-04 (2016)

SINDH UNIVERSITY RESEARCH JOURNAL (SCIENCE SERIES)

Lethal effect of Entomopathogenic fungi on the Grasshoppers (Acrididae: Orthoptera) with special reference to its body size

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Received 15th September 2015 and Revised 20th January 2016

Abstract: Lethal infections of entomopathogenic fungi and their host range on many grasshopper's species was studied from three different ecological zones of Sindh Pakistan that were categorized into three sides that include: Khairpur, Sukkur and Ghotki (1st site),Kashmor and Jacobabad (2nd site) and Shikarpur and Larkana(3rd site).Total No. of specimens were collected 2028 from this sampling 43%, 36% and 32% were found contaminated with various pathogenic fungi from these selected areas. It was observed that mostly the entomopathogenic fungi belonging to class Deuteromycetes. Beside this, it was noticed that smaller size individual were more infected with pathogen compare to large size.

Keywords: Lethal, infection, grasshopper, entomopathogenic fungi, deuteromycetes.

1. INTRODUCTION

Large numbers of pathogenic microorganisms are available for evaluation against grasshopper and locust in the world. Microorganism's priority is given to the entomopathogenic fungi and entomopoxvirus and is stable for prolonged period of storage and application. According to (Jankevica 2004) about 400 species of entomopathogenic belonging to 35 genera cause lethal infection in insect and can regulate their population in nature by epizootics. Nevertheless, about 1800 association between fungi and different insects have been reported.Actually fungi having great ability to penetrate into host external skeleton denotes contact activity other microbial pathogens have to be ingested current finding on utilization of entomopathogenic fungi against locust and grasshopper suggest that this microbial pathogen is very importance of hitting the target.

Earlier, Samson and Evans (1985), Samson *et al*. (1988) Shah *et al*. (1994, 1997), Welling *et al*.(1995) have briefly reported about the entomopathogenic infection on different Acridids species. And stressed on the utilization of this bio-control agent against insects population in field. Interest in the biological control of locusts and grasshoppers has increased in the past decade. Special emphasis has been given to the exploitation of entomopathogenic fungi (Prior and Greathead (1989) and Kumar *et al*. (2013 and 2014 a,b). Chemical control is not only often environmentally infected. In 1987 chemical pesticides failed to control an outbreak of grasshoppers in the world. Entomopathogenic fungi which are so called mycoinsecticides having great potential in control of locust and grasshopper, beetles, whiteflies and aphids population. (Roditakis *et al.* 2000) that's was reason present attempt has been made to adopt biological control measure against pest by using the mycoinsecticides from this region for the first time.

2. MATERIAL AND METHODS

2.1. *Survey area:*

For the collection of grasshoppers weekly visit of many agricultural field that include maize, sugar cane, cotton, wheat fodder crops from various localities of Sindhi-e Khairpur, Sukkur, Ghotki, Kashmor, Jacobabad Shikarpur and Larkana Sindh Pakistan were carried out during the year 2013-2014. Beside this, green houses, orchards, gardens and fields were inspected daily for collection of more host species. The techniques for the survey and collection of insects adopted from Kooyman and Shah (1992) and Shah *et al.* (1997).

2.2. *Collection of infected samples:*

For the collection of infected insects keen observation were made in field and only those insects were collected which having clear symptoms of mycosesviz: (1) insect don't move fast, (2) change its color from original one, (3) cuticle fully covered with fungal mycelia (4) insects very sluggish and found very easy to pick up. Beside this, infected insects look with red, dry and powdery appearance. Infected specimens were picking with large forceps. Collected species brought into laboratory and all were sorted out into different host species.

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2.3. *Isolation of entomopathogenic fungi:*

For the isolation of different entomopathogenic fungi. They were made either by aseptically removing chlamydospore masses from host cadavers and streaking them onto agar media or by shaking the cadavers directly over the exposed agar plates containing dexos agar.

2.4. *Identification of fungal isolates:*

During the present study identification of fungal isolated mainly based on conidia shape and size described by de Hoog, (1972); Domsch, *et al.,*(1980); IMI, (1983); Balazy, (1993) and Humber, (2012).

3. RESULT AND DISCUSSION

During the present study a total of 2028 specimen of various grasshoppers collected from 03 sites i.e 873 from Site-I, 432 from Site-II and 723 from Site-III (their breakup has been provided in Table I). It was observed that *Oxya hyla hyla* (Serville) was dominated in these 3 site followed by *Acrida exaltata* (Walker) and *Oxya velox* (Fabricius) in addition to this *Poekilocerus pictus* (Fabricius) was also dominate in Site-III. Significant high percentage of infection in Site-I was reported for *Truxalis exmia exmia* (Eichwald) i-e 69.8% and *P.pictus*i-e 66.6 % opposing to this least percentage was noted 47.5% for *Truxalis grandis fitzgeraldi* (Drish) i-e 47.5% contaminated with *Aspergillus* as for as Site-II is concerned maximum infection was noted 80.9% for *Schistocerca gregaria* (Forskal) followed by 66.6% for *Sphingonotus rubescens rubescens* (Walker) in addition to this maximum infection of *Aspergillus* in Site-III was reported in *S.gregaria* i.e77.1% followed by 76.1% in *Conocephalus maculates* (Le Guillou). Grasshoppers were considered to have died of mycosis if a sporulating layer of *Aspergillus* developed on the cadaver under condition of high humidity.

Street and Henry (1990) stated that efforts to artificially propagate the fungus in grasshopper have largely been disappointing undoubtedly because of moisture level requirements but in recent year several commercial firms in the U.S and Europe have developed improved culture techniques which have led to the selection of strains that are more active against grasshoppers. Henry *et al.* (1985) reported some unidentified fungi from *Oedaleus senegalensis* (Krauss), *Aiolopus thalassinus* (Fab.) and *Anacridium* sp. from West Africa. At the present we have reported the infection of *Aspergillus*along with 03 unidentified fungi on 13 species of grasshoppers.

Latvijas (2004) reported 66 ecological associations between entomopathogenic fungi and important agricultural pest that include: flies, aphid, thripses, cabbage, butterflies, moth, grasshopper etc. In addition to this; he also identified 16 species of entomopathogenic fungi 10 belongs to class Zygomycetes (Entomophtorales) and 06 species of class Deuteromycetes (Moliniales) however, during the present study all observed fungi mostly *Aspergillus* and unidentified fungi belonging to class Deuteromycetes. Our present results correlate with finding of Henery *et al*., (1985).This is a first lab demonstration of effectiveness of *Aspergillus* and other fungi as a microbial control agent of grasshoppers the significant reduction in population density and the prevalence of infection in field collections confirms the potential use of dry *Aspergillus* spores to kill grasshopper's population. During the present study it was noted that entomopathogenic disease may also have sub lethal effects that contribute to crop protection through reduction in feeding and reproductive activity. Present study recommends that this microbial agent must be used on commercial level.

Table. I. Showing No. of Grasshopper species caught from three sites of upper Sindh in the year 2013-2014.

Species	Site – I (n= 873)		Site – II (n= 432)		Site – III (n= 723)	
	No. of Caught	Species Rank	No. of Caught	Species Rank	No. of Caught	Species Rank
Acrida exaltata Walker, 1859	138	DS^{+++}	48	MS^{++}	84	DS^{+++}
*Oxya hyla hyla*Serville, 1831	144	DS^{+++}	64	DS^{+++}	78	DS^{+++}
Oxya velox Fabricius, 1787	141	DS^{+++}	58	DS^{+++}	69	MS^{++}
Truxalis exmia exmia Eichwald 1830	105	LS^{+}	41	MS^{++}	52	MS^{++}
Truxalis grandis fitzgeraldi Drish, 1951	109	LS^{+}	46	MS^{++}	43	LS^{+}
Hieroglyphus orzivorus Carl, 1916	-----	-----	-----	-----	39	LS^{+}
Acrotylus insubricus Scopoli, 1786	108	LS^{+}	43	MS^{++}	41	LS^{+}
Trigonocorypha unicolor Stal, 1873	-----	-----	-----	-----	33	LS^{+}
Phaneoptera roseate Walker, 1869	-----	-----	-----	-----	37	LS^{+}
Conocephalus maculates Le Guillou, 1841	-----	-----	36	LS^{+}	45	LS^{+}
Sphingono tusrubescens rubescens(Walker) 1870	-----	-----	32	LS^{+}	59	MS^{++}
Schistocerca gregaria Forskal 1775	-----	-----	22	LS^{+}	65	MS^{++}
Poekiloceru spictus Fabricius 1775	128	MS^{++}	42	MS^{++}	78	DS^{+++}

Note: **Key to the species rank according to it pest status is under:**
Dominant Status (DS^{+++}), Moderate Status (MS^{++}) and Low Status (LS^{+})

Table.2 Lethal infection level of Entomopathogenic fungi in various species of grasshoppers collected from three sites of Sindh during year 2013-2014

Site - I						
Species	**No.of Incubated**	**No. of Sporulation**	**No. of *Aspergillus* Sporulation**	**Unidentified Sporulation**	**% of Infection**	
					Asp.	**Uni.**
Acrida exaltata	138	74	39	35	52.7	47.2
Oxya hyla hyla	144	65	34	31	52.3	47.6
Oxya velox	141	92	48	44	52.1	47.8
Truxalis exmia exmia	105	53	37	16	69.8	30.1
Truxalis fitzgeraldi	109	61	29	32	47.5	52.4
Acrotylus insubricus	108	64	35	29	54.6	45.3
Poekilocerus pictus	128	57	38	19	66.6	33.3
Site - II						
Species	**No.of Incubated**	**No. of Sporulation**	**No. of *Aspergillus* Sporulation**	**Unidentified Sporulation**	**% of Infection**	
					Asp.	**Uni.**
Acrida exaltata	48	24	13	11	54.1	45.8
Oxya hyla hyla	64	32	17	15	53.1	46.8
Oxya velox	58	35	24	11	68.5	31.4
Truxalis exmia exmia	41	27	13	14	48.1	51.8
Truxalis fitzgeraldi	46	30	18	12	60.0	40.0
Acrotylus insubricus	43	22	08	14	36.3	63.6
Poekilocerus pictus	36	17	10	07	58.8	41.1
Conocephalus maculates	32	20	11	09	55.0	45.0
Sphingonotus rubescens rubescens	22	12	08	04	66.6	33.3
Schistocerca gregaria	42	21	17	04	80.9	19.0
Site - III						
Species	**No.of Incubated**	**No. of Sporulation**	**No. of *Aspergillus* Sporulation**	**Unidentified Sporulation**	**% of Infection**	
					Asp.	**Uni.**
Acrida exaltata	84	46	24	22	52.1	47.8
Oxya hyla hyla	78	45	28	17	62.2	37.7
Oxya velox	69	32	21	11	65.6	34.3
Truxalis exmia exmia	52	24	15	09	62.5	37.5
Truxalis fitzgeraldi	43	19	11	08	57.8	42.1
Hieroglyphus orzivorus	39	17	05	12	29.4	70.5
Acrotylus insubricus	41	16	10	06	62.5	37.5
Trigonocorypha unicolor	33	13	06	07	46.1	53.8
Phaneoptera roseate	37	14	08	06	57.1	42.8
Conocephalus maculates	45	21	16	05	76.1	23.8
Sphingonotus rubescens rubescens	59	30	19	11	63.3	36.6
Schistocerca gregaria	65	35	27	08	77.1	22.8
Poekilocerus pictus	78	40	24	16	60.0	40.0

Note: *Asp*. = *Aspergillus,* Uni.= Un-identified fungi

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