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Incidence of *Mermis nigrescens* Dujardin (Mermithida: Mermithidae: Nematoda) in paddy grasshoppers

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Abstract: Paddy (rice) is considered the most precious crop in Pakistan including Badin. But, unfortunately many pests are responsible for the reduction of this cash crop among the number of pest, grasshoppers are important factor. At the present a total of 983 specimens of 15 grasshoppers species penetrating to 8 sub families were found infected with *Mermis nigrescens*. However, parasitism ratio was reported ten times greater in flooded rice fields than in grasslands. It was also reported that maximum infection of *Mermis* was reported in the population of *Oxya hyla hyla* i-e 12.40% followed by 10.76% and 10.21% for *Oxya velox* and *Poekilocerus pictus* respectively. However, infection percentage of *Hieroglyphus perpolita* was noted 9.48% and significant least infection was noted in the sampling of *Eyprepocnemus alaris alaris* 2.91% and 3.83 and 3.81% was noted for *Truxalis exmia exmia* and *Heteracris illustris* respectively
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Keywords: Rice, Crop, Pests, *Mermis nigrescen*, Parasitism, *Oxya Hyla Hyla*

1. INTRODUCTION

Rice (*Oryza sativa*) is the world's most important food crop second to wheat feeding over 2 billion people in Asia alone. On this continent about 90% of the world's rice is grown (IRRI 1993). The rice crop not only provides food for people, it also a host to over 800 species of insect herbivores. In Pakistan rice is an important food crop as well as commercial crop. The national average yield in Pakistan is about half the yields in most of the developed countries (FAO 2004). The yield trend shows that the ecological conditions of Sindh are relatively more favorable for rice production as compared to other parts of the country. Badin is considered the major rice growing district of lower Sindh (Riffat *et al*., 2013). But, unfortunately many pests including grasshoppers are responsible for the reduction of this cash crop, annually; millions of acres of land are sprayed with insecticides to reduce pest attack (Solangi *et al.*, 2014).

Mermis nigrescens Dujardin is believed to play an important natural role in suppressing grasshopper's populations (Christie, 1937). It occurs widely in North and South America, Europe and Asia including the Island of Tasmania. However, it is not yet found in continental Australia, though other *Mermis* species and related genera occur there, and can be quite important in population regulation of some grasshoppers. Using *M. nigrescens* to control grasshoppers may be advantageous in that it should selectively kill grasshoppers without harming beneficial insects. Since severe parasitism by *M. nigrescens* is associated with damp habitat it might be possible to introduce the nematode as a biological control in moist areas where grasshoppers are pests. It should be possible that best use *Mermis* at wider rang eradicate the chemicals use to large level. Thoroughly review of literature clear showed that nematodes of the genus *Mermis* parasitize many species of grasshopper (Stephanie and Hirondelle, 2005; Fonseca *et al.*, 2008) in which they disrupt host reproduction and eventually kill the immature or adult pests (Presswell *et al.*, 2014). The United States Bureau of plant industry has used *Agamermis decaudata* and *Mermis* in an effort to control grasshopper populations. It was therefore, felt necessary and an attempt was made to estimate the incidence and intensity of nematode parasitism of various grasshoppers occupying different ecological niches in Badin district.

2. MATERIAL AND METHODS

Collection *of samples:*

For the propose study many extensive survey have been carried out from the seven different localities of district Badin during the year 2012- 2013 in various months of the years. Mostly the specimens were collected from rice field which were surrounding by different vegetations and other plantation **(Table-I)**. The specimen were collected by insect net (9.1 cm diameter and 52.2 cm in length) sometime by hand picking then the collected material was kept in small plastic jars and brought into laboratory for rearing and further analysis.

Rearing of the specimens:

Collected host species of grasshoppers were identified by keys and photographs available in the literature then were maintained under laboratory

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condition in crowded manner in wooden cages which is 17.2 cm long and 14.2 cms in width beside this, some were also cultured in glass-jars for individual analysis at room temperature where temperature range between 28±2 C^0 and 38±2 C^0) and relative Humidity was 30±5% to 50±5%. Fresh leaves of rice were provided to all grasshoppers population maintained in cages and glass-jars after the every 6 hrs fresh water were also sprayed on the leaves in order to keep them fresh all the time. For the proper hygienic condition all the cages and glass-jars were cleaned then kept in sunlight for some time (about 15 Minutes) in every morning.

Dissection of samples and isolation of nematodes:
Adult grasshoppers (15 specimens) were taken from experimental cages as well as from jars were dissected ventrally carefully and the numbers of males and females infected with nematodes were isolated. Upon detection of different stages of juveniles of *mermis,* it was carefully isolated from host body by "0" number brush and then moved to a microscope slide beneath a glass cover slip. For further, analysis and for preservation of *mermis* samples glycerine and lactophenol was used.

Identification of host species*:*
Mermis nigrescens were identified by adopting the terminology of Nickle (1971 and 1973) and Baker and Capinera (1997) through its internal organization and it is also determined if it is a mature form with ovaries or testes or an undifferentiated juvenile form where as immature forms may be sort out by identifying (rhabditoid) or long (filaroid).

Material examined:
Host species of grasshoppers were collected from following localities of district Badin:
Matli 12.viii.2012 51♀ 40♂ (Riffat and Azra), Talhar 11.vii.2013 37♀ 43♂ (Azra, and Nuzhat), Suleman Shah 26.xi.2013 49♀ 50♂ (Azra and Santosh), Mian Pota17.ix.2012 63♀ 50♂ (Azra and Riffat.) Dolat Laghari 30.x.2012 43♀ 50♂ (Azra and Riffat.); Rip 20.vii.2012 57♀ 48♂(Azra and Riffat), Jhalar 24.vi.2013 55♀ 52♂ (Azra, and Riffat), Haji Saleh Junejo 24.viii.2013 45♀ 52♂ (Azra and Zaheer) Sareja 20.xi.2012 51♀ 36♂ (Azra and Zaheer) same but 22.vii.2013 49♀ 62♂(Azra, and Waheed)

3. RESULTS AND DISCUSSION

At the present a total of 983 specimens penetrating to 8 sub families were found infected with *Mermis nigrescens*. However, parasitism ratio was reported ten times greater in flooded rice fields than in grasslands. It was also reported that maximum infection of *Mermis* was reported in the population of *Oxya hyla hyla* i-e 12.40% followed by 10.76% and 10.21% for *Oxya velox* and *Poekilocerus pictus* respectively. However, infection percentage of *Hieroglyphus perpolita* was noted 9.48% and significant least infection was noted in the sampling of *Eyprepocnemus alaris alaris* 2.91% and 3.83 and 3.81% was noted for *Truxalis exmia exmia* and *Heteracris illustris* respectively **(Table: I a,b).** It was also observed that super-parasitism caused by *M. nigrescens* in different host subfamilies of many grasshoppers was significantly greater in Month of June in Pyrgomorphinae i-e 22.61% followed by 20.60% in Oxyinae, besides this infection of Oxyinae was also noted greater i-e 24.12% in July followed by Oedipodinae and Hemiacridinae i-e 20.72 and 20.52% respectively. In addition to this, infection of *Mermis* was reported significantly greater i-e 23.58% and 23.07% for Conocephalinae and Cyrtacanthacridinae respectively in the month of July and least infection i-e 14.96% was calculated for Acridinae. Similarly, there was maximum parasitism of *Mermis* was noted 34.61% for Cyrtacanthacridinae followed by 30.06% for Eyprepocnemidinae , 29.13% for Acridinae and 26.41% for Conocephalinae **(Table: 2)** During present study it was found that *Mermis nigrescens* caused significant infection among the grasshoppers, *Mermis* reduced the survivability and reproduction capabilities of host species.

Table:I :- Showing the collection of grasshoppers from different localities of district Badin during the year 2012 - 2013
(a)

Localities	Host sub-families				
	Oedipodinae	Hemiacridinae	Oxyinae	Pyrgomorphinae	% of collected specimen
	(n= 111)	(n=151)	(n=199)	(n=84)	(Total n=545)
Matli	20	30	32	15	17.79%
Talhar	17	27	29	13	15.77%
Suleman Shah	9	18	33	12	13.21%
Mian Pota	18	13	28	9	12.47%
Dolat laghari	11	8	19	5	7.88%
Rip	6	11	9	4	5.50%
Jhalar	7	16	8	7	6.97%
Haji saleh Junejo	9	15	13	8	8.25%
Sareja	14	13	28	11	14.53%

Note: Total No. of collected specimen from another 04 sub families = 438

(b)

Localities	Host sub-families				% of collected specimen
	Conocephalinae	Acridinae	Eyprepocnemidinae	Cyrtacanthacridinae	
	(n=106)	(n=127)	(n=153)	(n=52)	(Total n=438)
Matli	15	20	22	11	15.52
Talhar	16	23	18	8	14.84
Sulema n Shah	12	15	14	5	10.50
Mian Pota	11	18	15	3	10.73
Dolat laghari	13	14	9	6	9.58
Rip	8	7	12	4	7.07
Jhalar	10	6	17	7	8.90
Haji saleh Junejo	12	16	27	3	13.24
Sareja	9	8	19	5	9.36

Note: Total No. of collected specimen from 04 host sub-families = 545

Table: :-Showing the infection of *Mermis* from the total collected population of grasshopper during the year 2012 – 2013

Species	Total (n=983)	Infected (n=548)	Uninfected (n=435)	Infected %
Aiolopus simulatrix (Walk)	52	35	17	6.38%
A.thalassinus (Fab.)	59	30	29	5.47%
Hieroglyphus nigrorepletus (I.Bolivar)	72	43	29	7.84%
H. perpolita (Uvarov)	79	52	27	9.48%
Oxya velox (Fab.)	97	59	38	10.76%
*O. hyla hyla (*Serville)	102	68	34	12.40%
Eyperpocnemus alarris alarris (Uvarov)	36	16	20	2.91%
Poekilocerus pictus (Fab)	84	56	28	10.21%
Conocephalus maculates (Le-Guillou)	61	24	37	4.37%
Euconocephalus pallidus Redtenbacher	45	18	27	3.28%
Acrida exaltata (Walker)	69	36	33	6.56%
Truxalis exmia exmia (Eichwald)	58	21	37	3.83%
Heteracris illustris (Rembur)	63	36	27	6.56%
H. adspersa (Redtenbacher)	54	21	33	3.81%
*Schistocerca gregaria (*Forskal)	52	33	19	6.02%

Note: Total No. of collected specimen = 983 among these 548 was found infected

Earlier, Denner (1968) reported that population of *H. viridis pratensis* was significantly effected by *M.nigrescens* and unable to produce egg during entire life. Opposing to this *M.bivittatus* was slightly infected by *M.nigrescens*. Presently we reported significantly high parasitism in *Oxya hyla hyla* i-e 12.40 % followed by 10.76% in *Oxya velox* species it might be due to effect of environmental conditions of the regions which promoted high infection of *M.nigrescens*. Beside this high degree of parasitism in Acridinae prior to June/ July months correlated with abundant early monsoon rains this supports the findings of previous workers Presswell *et al.,* (2014) and Welch and Rubtsov (1965) also suggested that moist habitat is related to high infection. During the present study it has been found that ovaries of host species were reduced but not destroyed completely as stated by Christie (1936) and Gordon *et al.,* (1979). Furthermore, Christie (1937) stated that *Mermis* was considered strictly a parasite of grasshopper from many parts of the world while studying their infection he observed 09 host species mostly belonging to Tettigoniidae and Acrididae were infected. As for as collection of nematodes species is concerned earlier, Nickle (1973) reviewed the Mermithidae species and have described *Agamermis. decaudata* for the first time. Beside this, Poinar (1975) has listed 82 host species of grasshopper affected by 27 species of nematodes. Additionally, Irshad (1977a,b) recorded infection of *M. nigrescens* from 8 host species of grasshopper from northern areas of Pakistan. Dujardin (1942) reported that 02 species of mermithids i-e *M.nigrescens* and *A. decaudata* gave significant result against grasshopper reduction. Baylis (1947) and Crowcroft (1948) reported that *M. nigrescens* infect earwigs, Coleoptera and Lepidoptera species opposing to this Riffat *et al*.,(2013) reported the infection of nematode on the Acrididae species occurring in Pakistan. This study will be highly useful for those scientists who are interested in biological control. Chemical control which had been widely practiced in world including Pakistan is now under threat of default due to many inherent disadvantages. The alternate is biological control so; the present study might be very beneficial in the field of biological control in nearer future.

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