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A survey on the biological control of leafhoppers and planthoppers, injurious to rice plants by Pipunculids (Diptera)

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Abstract: The project aim of the research is to find out different species of Pipunculids, natural enemies of rice leaf hoppers and plant hoppers in Indo- Nepal region in order to contribute towards the basic study of taxonomy of Pipunculids and biological control of these pests. In the present work eight specimen of Pipunculids were collected in which two species are new ones (Eudoryllas *curvibellata* sp. nov. and Pipunculus (Cephalops) *Pokharensis* sp. nov.) Simultaneously several leaf hoppers were collected and examined in different seasons and in different places. The percentage of parastism by Pipunculids in leaf hoppers was about 27.5%. It was also concluded that fencing of field with flowering plants saves crops because it was observed that the average parasitism was 46.5% in fencing field with flowering plants in comparision to the non-fencing field where the average parasitism was only 13%. Biological control of these pests will offer scope to contribute to better rice pest management.

Key words: Biological control; Leafhoppers; Planthoppers; Pipunculids

Introduction

Biological control is the utilization of natural enemies to reduce the damage caused by noxious organisms. Leaf hoppers and plant hoppers have been an important menance to rice in Asian countries. Their severe damage is not only due to their abundance, but also of their ability to transmit viral diseases in these food plants. Pipunculids are of very high economic importance as they play an important role in controlling population of paddy pests, rice leaf hoppers (Hirashima *et al.,* 1979) and plant hoppers. Pipunculid have been found quite effective in suppressing rice leafhopper population. In rice green leaf hopper, Nephotettix *cincticeps* Uhler in Japan, 65% parasitization of a Pipunculus species was observed (Esak *et al.,*1936). Four Pipunculid species were reported parasitizing rice green leaf hopper in Japan (Koizumi, 1959). Ten Pipunculid species associated with rice leaf hoppers from the Oriental region was reported (Hardy, 1971). Four Pipunculid species on N. *cincticeps* in Japan was reared (Shimada, 1972). The parasitization of common rice leaf hoppers and plant hoppers due to Pipunculid flies in Sarawak was reported (Wan, 1972). Eight species of Pipunculid flies as natural enemies of N. *cincticeps* and Nilaporvata *lugens* in Taiwan was found (Liu, 1974). In a study, the seasonal fluctuations of the green rice it was concluded that the Pipunculids, Tomosvaryella *javaensis* and T. *oryzaetora* were greatly responsible in reducing the population of N. *cincticeps* (Hsich, 1975). Some common Pipunculid species namely E. *roralis*, E. *javaensis*, T. *oruzactora* and T. *subvirescens* were reported as effective parasitoids of rice leaf hoppers in the Philippines. 36% parasitism in green leaf hoppers in dry land field and 33% in wet lands irrigated fields was found (Chandra, 1978). In a survey of the paddy field in Malaysia 3 Pipunculids T. *oryzaetors*, T. *subvirescens* and E. *multillatus* parasitizing the nymphs of N. *virescens*, N. *nigropictus*, N. *malayanus* were found (Kathirithamby, 1978). Eight species of Pipunculid were found in the rice field of Thailand (Yano, 1979). It was found that the various Pipunculid species could be effective utilized by bio control agents of rice leaf hopper (Greathead, 1983). 10% parasitization in Nephotettix sp. due to various Pipunculid species in Sarawak was reported (Anonymous, 1985). A study was conducted on biological control of rice leaf hopes and plant hoppers in Andhra Pradesh (Gupta *et al.,* 1989). It was found that spiders also suppressed the population of hoppers (Akhtar, 2013). It was also found that beetles were suppressed the population of rice pests (Chowdhary *et al,* 2015). There is a need to explore the importance of Pipunculid flies because these flies are largely neglected in India and very few work has been done on these flies. These flies are investigated for the biological control of paddy pests. As far as the taxonomy of these flies is concerned, it is largely neglected in India hence the aim of our study is to reveal species richness of Indo-Nepal region as well as the biological control over rice leaf hoppers and host parasite interaction. Present work can be of great help for such future agro-adavancement in India and Nepal.

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Material and Methods

The Pipunculids, leaf hoppers and plant hoppers are generally caught by sweeping with net method randomly over flowers, garden, grassfields, paddy fields, herbs and shrubs in sun shine and non windy day. Insects sweeped are put into killing bottle along with the net for some time. As soon as insects were killed they were removed from the killing bottle and all the sweeped insects were put on the white paper and desired insects Pipunculus and hoppers were selected safely with the help of fine twiser and first put on specimen bottle. Later on Pipunculus were pinned through the right side of above the middle of thorax, whereas hoppers were collected in specimen tubes filled with 70% alcohol. The pinned insects were properly arranged in the insect box so their body parts such as antennae, legs, head, wings and was properly studied. The insect boxes were kept in dry places with Napthalene balls to avoid any infections. Finally, insects were properly examined and labelled. Then the performance of natural enemy (Pipunculids) was determined by collecting Pipunculids and leaf hoppers in different seasons and in different places. Then percentage of parasitism was determined by the formula P = a/b*100, where P = Percentage of parasitism, a = The no. of host attacked by Pipunculids and b = The no. of host observed (Soediji, 2014).

Table 1: Percentage of parasitism by pipunculids at different location and in different month

S. No.	Month of collection	Location	Number of hoppers parasitized by Pipunculids	Total no. of hoppers examined	Percentage of parasitism	Average percentage of parasitism
1.	October 2014	2 Km south of Hatauda near hilly stream	16	62	25.5%	27.5%
2.	December 2014	4 Km north of Proper Surkhet	6	28	21.5%	
3.	December 2014	1.5 Km east of Bhimphedi	33	96	34%	
4.	March 2015	3 Km north of Hatauda	23	72	32%	
5.	March 2015	1 Km south of Pokhra	6	21	28.5%	
6.	October 2015	2 Km south of Hatauda	17	73	23%	

Later on a project experiment was conducted in Hetauda made by selecting two plots of 500 sq. ft. distantly separated. In plot no. 1 local rice were cultivated with a boundary of flowering plants and in plot no. 2 local rice were cultivated without any boundary of flowering plants (Khan *et al.* 2008). The percentage of parasitism were analysed quite different in two plots by method of Soediji, 2014.

Research is implemented in one season of planting in 2015, either from July to November 2015. The present experiment was conducted to find out percentage of parasitism by pipunculids. In each plot insects were captured by sweeping with net. The capturing period was once a week and then captured insect was identified by book introduction of insect and natural enemy of rice pest (Borror *et al.,* 1991).

Table 2: Plot 1 fencing with flowering plants showing average percentage of parasitism by pipunculids

S. No.	Month of collection	No. of hoppers examined	No. of hoppers parasitized	Percentage of parasitization	Average percentage
1.	August, 2015	58	28	48%	46.5%
2.	September, 2015	32	13	40.5%	
3.	October, 2015	65	37	57%	
4.	November, 2015	44	18	41%	

Table 3: Plot 2 without fencing with flowering plants showing average percentage of parasitism by pipunculid

S. No.	Month of collection	No. of hoppers examined	No. of hoppers parasitized	Percentage of parasitization	Average percentage
1.	August, 2015	68	13	19%	13%
2.	September, 2015	42	4	9.5%	
3.	October, 2015	38	3	8%	
4.	November, 2015	52	8	15%	

Results and Discussion

In the table 1, The performance of natural enemy is determined by analyzing the ability of predator to consume the pest insect and analyzing the ability of parasite to parasitized the pest insect in different locations and in different places. The ability of natural enemy is measured by counting the percentage of how much prey is consumed and how much host is infected. These percentage were counted by P = a/b*100.

In the table 2 as the plot no. 1 was surrounded by flowering plants invited Pipunculids in large number, hence average percentage of parasitism is high which is 46.5%. In table 3, Plot no. 2 was not surrounded by flowering plants invited Pipunculids in less number so percentage of parasitism in this plot is less which is 13% only. It was found that insect diversity in the field nearby the forest is counted to higher individuals in comparison to the field distantly to the forest (Rizazi *et al.,* 2002).

Conclusion

Economically Pipunculids are very important group of dipterous insects and exclusive endoparasite of various families of order homoptera including Cicadellidae, Delphacidae and Fulgoridae. Performance of this natural enemy is shown by the quantity of species, the abundance and the ability of parasitoid. However, the ability of parasitoid and predator species is still not comprehensively understood. Therefore, complete information may only be obtained through further research on both these host and predators. However, it is advisable that fencing of field with flowering plants saves crop.

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