



# Long Term Studies on the Role of Parasitic Nematode *Hexamermis* Sp. in Controlling Brown Planthopper in Farmer's Rice Field of West Bengal, India

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## ABSTRACT

On farm, trials were carried out at rainfed rice growing areas of West Bengal, India during Kharif(rainy) season 2003-04 and an average population of parasitic nematode *Hexamermis* sp. counted from the same field during 2003-04 to 2018-19 in Birbhum. A similar set of experiment was conducted during boro(summer) season 2008-09 in Bankura and average population of *Hexamermis* sp. was also calculated from the same field during 2008-09 to 2018-19. Each trial comprised three treatments viz (i) Natural Biological Control (NBC) with no pesticide application throughout the crop season (ii) Need based protection (NBP)- judged by periodic monitoring of brown planthopper population and (iii) Schedule treatment (ST)- involving application of insecticides following usual package of practices. The study revealed that NBC resulted in maintaining highest level of parasitism of Brown Plant hopper by this parasite Nematode as compared to NBP and ST. Identical results were also obtained from 15 years and 10 years average data from Birbhum and Bankura during kharif (rainy) and boro(summer) season rice respectively..

**Key Words:** Brown planthopper, *Hexamermis* sp., Natural Biological Control, Need Based protection, Scheduled treatment, Parasite, Pest

## INTRODUCTION

India is the second largest producer of rice in the world. Rice being the principal crop occupied 66% of the gross cropped area of eastern India particularly in West Bengal. Brown plant hopper *Nilaparavata lugens* Stål has been recognized as the major biotic stress responsible for significant reduction in yield of rice in west Bengal (Satpathi et al. 2005, Katti et al. 2006) and about 30% of the natural control of brown plant hopper in eastern India are due to parasitic nematode (Satpathi et al. 2008). Farmers of eastern India have been relying mostly on chemical pesticides for the management of brown plant hopper, however their indiscriminate use has led to the destruction of the natural parasites. Hence on farm trials were conducted by National Agricultural Technology Project (NATP) and National Agricultural Innovative project (NAIP) during kharif 2003 & 04 and Boro 2008 & 09 to generate the information on the effect of different treatment

on *Hexamermis* sp population (Fig-1) in rain fed rice of west Bengal.



**Figure 1:** *Hexamermis* sp. emerged out from adult brown planthopper in Birbhum.

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## MATERIALS AND METHODS

Field trials were conducted in 2 villages spread across Birbhum and Bankura districts of West Bengal during kharif (rainy) season of 2003 & 04 and boro (summer) seasons of 2008 & 09. In each village, 3 hectare field was selected in farmer's field, where there were three treatment blocks viz (i) Natural Biological Control (NBC) with no pesticide application throughout the crop season (ii) Need based protection (NBP)- judged by periodic monitoring of brown planthopper population and (iii) Schedule treatment (ST)- involving application of insecticides where all the other agronomic Practices are common to three treatments and followed as per recommended package of practices. The population of brown planthoppers were recorded randomly

from 50 hills in each sub plot at weekly interval. For estimation of parasitism the mummified adult and nymphs were collected at regular interval and released on potted plant for laboratory study. The infected hopper pests were split horizontally and kept in containers with small quantity of water and was collected and retained for examination. Maintaining the identical treatment procedure, the data were collected from one acre area at the same locality for last 15 years from 2004-2005 to 2018 -19 during Kharif (rainy) and 10 years from 2009-10 to 2018-19 during rabi (summer) seasons to estimate the population level of *Hexameris* sp. in farmer's field of rain fed rice growing areas of West Bengal. The treatments are applied in each plot is given in Table-1.

**Table 1: Lay out of experiment at Birbhum(rainy season) and Bankura(summer season).**

Location	Birbhum	Bankura
Season	2003 -2004 to 2018-2019	2008 – 2009 to 2018-19
Natural Biological Control (NBC)	No insecticide application through the crop growth	No insecticide application through the crop growth
Schedule Treatment (ST)	Seed Treatment with thiram (fungicide) @2g / Kg of seed.  Application of Butachlor 5g (Herbicide)@650 g a.i./ha during land preparation .  Application of Carbofuran 3G @1.0 kg a.i. /ha at 25 to 35 DAT.  Spray application of Chlorpyrifos 20%EC (Insecticide)@500 gm ai/ha and Hexaconazole 5% EC (Fungicide)@100 gm a.i./ha at 50 DAT.  Spray application of Chlorpyrifos 50%EC +Cypermethrin 5% EC (insecticide)@ 825 gm ai /ha and Propiconazole 25%EC (Fungicide) @ 250 gm a.i./ ha at 70 to 80 DAT.  Spray application of Imidacloprid 8.6%SL @75gm ai/ha at 80 to 90 DAT.	Seed Treatment with thiram (fungicide) @2g / Kg of seed.  Application of Carbofuran 3G @1.0 kg a.i. /ha at 25 to 35 DAT.  Spray application of Chlorpyrifos 50%EC +Cypermethrin 5% EC (insecticide)@ 825 gm ai /ha and Propiconazole 25%EC (Fungicide) @ 250 gm a.i./ ha at 70 to 80 DAT.  Spray application of Imidacloprid 18.6%SL @75gm a.i./ha at 80 to 90 DAT.
Need Based Protection (NBP)	Seed treatment with 2g/kg seed (fungicide).  Seed bed treatment with carbofuran 3g @ 1kg a.i. / ha at 2 days before transplanting.  Application of Butachlor 5gG (herbicide) @650 gm a.i./ha during land preparation .  Spray application of propiconazole 25 EC(fungicide)@250 gm a.i.ha at 65%DAT  Spray application of Cartap hydrochloride 500 gm ai/ha at 65 DAT.	Seed treatment with 2g/kg seed (fungicide).  Seed bed treatment with carbofuran 3g @ 1kg a.i. /ha at 2 days before transplanting.  Application of Butachlor 5gG (herbicide) @650 gm a.i./ha during land preparation .  Spray application of Triazophos 40 EC (insecticide)@600 gm ha and Tricyclazole 75 WP @750 gm a.i./ ha at 60 DAT (Fungicide).

## RESULT AND DISCUSSIONS

The fifteen years average(2004-18) data presented in Table-2 showed that at Birbhum district the percent of parasitisation was low 0.8 to 5.7 during the Kharif season 2008 at 60 DAT and the significant differences were there among the treat-

ments. However the percentage of parasitism was recorded up to 32.60% in NBC treatment showed significantly higher in the range of 18.60-32.60% compared to 1.44 to 4.66% in schedule treatment (ST) and 4.00 to 13.57% in Need Based Protection (NBP) during 70 to 130 DAT. The data confirmed the results of Satpathi et al. 2011 as given in Table-2.

**Table 2: Percentage of parasitism of brown planthopper by Hexameris sp. during kharif 2003 and average 2004-18**

Treatments	Birbhum (Kharif 2003 & average 2004to 2018)															
	Days after transplanting (DAT)															
	2003 60*	2004- 18 60	2003 70*	2004- 18 70	2003 80*	2004- 18 80	2003 90*	2004- 18 90	2003 100*	2004- 18 100	2003 110*	2004- 18 110	2003 120*	2004- 18 120	2003 130*	2004- 18 130
NBP	1.61	1.8	3.22	4.00	6.45	8.00	5.8	6.2	9.67	13.5	9.03	12.0	5.1	5.66	5.32	6.0
ST	0.7	0.8	1.44	2.00	2.83	4.00	2.56	3.0	4.25	5.00	3.97	4.66	2.24	2.66	2.34	3.0
NBC	5.6	5.7	10.0	15.0	20	26.0	18	23.3	30	32.6	28	30.0	16	18.6	16.5	20.0
CV%	6.72	-	2.58	-	12.8	-	14.3	-	8.5	-	9.11	-	15.3	-	1.57	-
CD at 5%	-	1.31	-	1.03	-	0.78	-	0.59	-	1.47	-	1.42	-	16.41	-	1.10

\*Source: Satpathi et al.2011

Although the percentage of parasitism of last 15 years (2005-19) was low at 60 DAT during kharif season in another study but the higher parasitism in the range of 16.00 to 34.00%, 2.00to5.50%,4.20 to 14.00 % were recorded in NBC, ST

and NBP during 70 to130 DAT respectively. Identical results were also obtained in the same field in 2003 which indicated that the parasitic nematode population drastically reduced due to the indiscriminate use of pesticides as given in Table-3.

**Table 3: Percentage of parasitism of brown planthopper by Hexameris sp. during kharif 2004 and average 2005-19.**

Treatments	Birbhum( Kharif 2004 & average 2005to 2019)															
	Days after transplanting (DAT)															
	2004 60*	2005- 19 60	2004 70*	2005- 19 70	2004 80*	2005- 19 80	2004 90*	2005- 19 90	2004 100*	2005- 19 100	2004 110*	2005- 19 110	2004 120*	2005- 19 120	2004 130	2005- 19 130
NBP	1.4	1.9	3.84	4.20	6.72	8.20	5.68	6.5	10.24	14.0	10.0	12.0	5.7	5.8	5.6	6.2
ST	0.62	0.9	1.62	2.00	2.95	4.10	2.49	3.0	4.5	5.5	4.4	4.8	2.53	2.4	2.45	3.2
NBC	5.07	6.0	12.0	16.0	21.0	28.0	17.75	25.0	34.0	34.0	32.0	32.0	18.0	20.0	17.5	22.0
CV%	8.4	-	21.4	-	12.2	-	0.29	-	7.95	-	8.72	-	14.2	-	1.97	5.55
CD at 5%	-	1.25	-	0.91	-	0.61	-	1.14	-	0.52	-	1.39	-	1.13	-	-

\*Source: Satpathi et al. 2011

At Bankura the ten years average data (2009-10 to 2018-19) on percentage of parasitism was very low in the range of 1.80 to 3.2 % in NBC treatment during boro(summer) season significantly higher as compare 0.32 to 0.35 % in ST and 0.5

to 1.00 in NBP during 90 to 110 DAT. The observation on average population on *Hexameris* sp. also confirmed the result of 2003 in the same field where the nematode population appeared for short period as given in Table-4.

**Table 4: Percentage of parasitism of brown planthopper by *Hexameris* sp during boro 2008 -09 and average 2009-10 to 2018-19**

Treatments	Bankura (rabi 2008-09 )& (average 2008-09to 2018-19)															
	Days after transplanting (DAT)															
	2008-09	2009-10 to 2018-19	2008-09	2009-10 to 2018-19	2008-09	2009-10 to 2018-19	2008-09	2009-10 to 2018-19	2008-09	2009-10 to 2018-19	2008-09	2009-10 to 2018-19	2008-09	2009-10 to 2018-19	2008-09	2009-10 to 2018-19
	60	60	70	70	80	80	90*	90	100*	100	110*	110	120	120	130	130
NBP								0.5	0.8	1.0	0.78	0.90				
ST								0.0	0.264	0.32	0.21	0.35				
NBC							1.5	1.8	2.56	3.0	2.4	3.2				
CV%								-	1.33	-	-	-				
CDat 5%								0.99	-	0.96		0.57				

\*Source: Satpathi et al. 2011

The result corroborated the study of previous workers from most of the rice growing areas round the world. Mention may be made of the natural incidence of parasitism by *Hexameris* sp on BPH was first reported in south India by Manjunath (1978) and in eastern india by Satpathi (1999). In addition to this Grewal et al. (2006) recorded it in Asia and Pena & Shepared (1985) recorded 50% parasitisation of BHP by *Hexameris* sp. in Phillippines. Heong (1983) also reported that an entomopathogenic nematode *Amphimeris unka* K&I caused high mortality of hoppers pest in China. Ramani, (2003) also reported that mermathrid *Hexameris* sp. was most important nymphal /adult parasitoid from India. Satpathi et al. (2008) studied in detail about the factor affecting abundance of parasitic nematode *Hexameris* sp. in eastern India where the nematode started to build up its population in the month of September starting with very low number of 3 to 4 per 100 brown plathopper and two distinct population peaks were observed with population level of 18.52 and 35.00 per 100 BPH. During first and last week of October respectively. From behavioral study with respect to the ecological niche of the host and parasite a relationship was drawn between *Hexameris* sp . and *Nilaparvata lugens* Stål in rice crop in Eastern India where it was recorded that peak population of this parasitic nematode was usually found a week after peak appearance of BPH in rice field but the temperature range of 25 to 30°C and relative humidity of 60 to 80% were conducive for population build up of both this host as well as parasite in the rice field ( Satpathi 2009). The

quantification of role of *Hexameris* sp in controlling brown planthopper was first initiated with respect to the different plant protection measured was fist initiated in West Bengal during 2003 to 2009 (Satpathi et al.2011) and this long term data may also taken as consideration for one of the component of biological control in most of the rice growing areas of West Bengal.

## CONCLUSION

From the intensive study of last fifteen years during kharif(rainy) season and ten years during boro(summer) season in rainfed rice growing areas of West Bengal, it is to be concluded that Natural Biological control (NBC) had shown the optimum result by exhibiting higher parasitism as compare with that of Schedule Treatment (ST) and Need Based Protection (NBP) due to the considerable reduction the number of application of insecticide. Both the Need Based Protection (NBP) and scheduled protection (ST)resulted in optimum build up of *Hexameris* sp population akin to that natural biological control (NBC) making it more environment friendly.

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