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Population dynamics of zigzag leafhopper in rice ecosystems and its role on carryover of the tungro viruses

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Observations on the population dynamics of zigzag leafhopper (*Recilia dorsalis* Motsch.) were made in four consecutive cropping seasons and interseasonal periods of 1995 and 1996 by using various methods like, light trap,. sweeping net yellow sticky trap etc. In light trap one peak appearance of this insect was observed in April - May and second one in October - November in West Bengal. In April and May of 1996 an average 46.33 and 51.34 insects per yellow sticky trap were recorded while a total of 128 and 463 insects were found in light trap respectively. *Nephotettix virescens* and *N. nigropictus* are more efficient vectors of Rice Tungro Virus (RTV) and *R. dorsalis* less efficient one to some extent, its presence in seedbeds is expected to play a vital role on the carryover of the virus.

Key words : Zigzag leafhopper (*Recilia dorsalis*), population dynamics, Rice Tungro Virus (RTV), vector

INTRODUCTION

Zigzag leafhopper (*Recilia dorsalis* Motsch) belongs to the family Cicadellidae and derived the name due the greyish colouration with brownish marking on the tegmen. This insect is found in rice field irrespective of seasons in West Bengal. The population of *R. dorsalis* in West Bengal is comparatively lower than rice green leafhopper (GLH) namely *Nephotettix virescens* and *N. nigropictus*, the most important vector of rice tungro viruses (RTV). Information on the population biology of this insect and its role on the transmission of rice tungro disease in respect of this rice growing state is limited although *R. dorsalis* has been established (Rivera *et al*, 1969) as a vector of rice tungro virus (RTV) from Philippines and some other south east Asian countries.

RVT disease is one of the important rice virus diseases of many Asian countries (Ling, 1972 ; Hibino, 1989 ; Chen and Othman, 1991) including India (Mukhopadhyay and Chowdhury, 1970). Occurrence of RTV is periodic and in the past it caused severe loss in production in many rice growing areas of India. Incidence of RTV disease primarily depends on the source of inoculum and timely appearance of efficient vector. *N. virescens* (Distant), *N. nigropictus* (Stål) and *R. dorsalis* (Motsch) are the components of the leafhopper fauna of the rice field in West Bengal. Besides the transmission of tungro and a few more rice virus diseases (Hibino and Cabunagan, 1986), they also cause significant loss to rice crop by feeding damage.

Elaborate studies on the biology and ecological aspects of GLH have been made (Mukhopadhyay *et al*., 1986) but no such information is presently available for *R. dorsalis*. As a vector it is considered a less efficient virus transmitter (Hibino and Cabunagan, 1986) in comparison to GLH. Nevertheless it could play a vital role in carryover of virus inoculum between the two consecutive rice growing seasons specially in absence of the principal tungro vector, *N. virescens* in rice field (Chowdhury and Mallick, 1997).

This study was made with an objective to know the population distribution of *R. dorsalis* in comparisons to GLH under intensive rice ecosystem and its possible role on the carryover of RTV.

MATERIALS AND METHODS

Monitoring of zigzag leafhopper

The insect population was monitored in four consecutive cropping seasons and interseasonal periods of 1995 and 1996 by using various methods to estimate the size of insect population in the rice field in intensive rice growing areas of West Bengal. The methods included light trap, sweeping net, and yellow sticky trap etc. The light trap of ordinary Rothamsted type already installed was utilized for this study. The light trap fitted with a 100 watt ordinary bulb was switched on every day at 6 PM and switched-off at 6 AM next day. Total catch of the night was collected and separated for daily count for two consecutive years (1995 and 1996).

Sweeping was done by a sweeping net made with fine nylon of 30 cm diameter of conical shape fitted with iron ring having a handle of 60 cm long. In all cases one stroke of sweep denotes total 10 movements (i.e. five left and five right direction) if not mentioned otherwise. Number of sweep in each plot for every time was the same and for the big sized plot a 'W' pattern of sweeping direction was followed to obtain a picture of the insect population of the entire field. Total number of the three types of vector species were collected by an aspirator for counting. During the time of peak population of vectors, trapped insects were killed with insecticides (Malathion @ 1.0 ml / litre) and then preserved in desiccator for further counting.

Yellow sticky traps were prepared by spreading and adhering sticky materials (Mapco product, Stikem special, Michael and Patton Co., Emeryville, California) on the surface of yellow iron plates of 15.5 cm × 15.5 cm size having 60 cm long stands attached on the trap to fix the trap at plant height. The insects flying on the fields were attracted by yellow colour and got adhered with the sticky substance on the iron plate. Every day at a fixed time counting of desired insects were done by removing them and the traps were refixed for the next day trapping and counting.

RESULTS AND DISCUSSION

Calculated population of *Nephotettix* spp. and *R. dorsalis* in different months of 1995 and 1996 as obtained by light trap are presented in Fig. 1. Subsequently for critical observation, population of *R. drosalis* has been presented in Table 1 on fortnight basis. The results showed that each year of observation, population of GLH were comparatively higher than zigzag leafhopper. Distribution of both types of leafhoppers followed the same pattern with the appearance of two peaks in a year. With the GLH the first peak was observed in between March and June and the second one in September to October for both the years. Correspondingly for the zigzag leafhopper the first peak appeared on April - May and the second one in October - November. For both years light trap data indicated that the rise in GLH population occurred ahead of zigzag leafhopper appearance.

Table 1 : Population of zigzag leafhopper (*R. dorsalis* Motsch.) in light trap at Plant Virus Experimental Field, BCKV, Kalyani, during 1995 and 1996

Month	No. of *R. dorsalis*					
	1st fortnight		2nd fortnight		Total	
	1995	1996	1995	1996	1995	1996
January	1	4	0	1	1	5
February	1	0	1	0	2	0
March	1	0	3	2	4	2
April	13	6	108	122	121	128
May	208	273	148	190	356	463
June	31	12	5	7	36	19
July	7	3	8	7	15	10
August	8	5	11	6	19	11
September	49	11	32	34	81	45
October	182	237	109	221	291	458
November	32	73	77	56	109	129
December	27	17	17	6	44	23

Distribution of GLH population in different months in West Bengal was thoroughly studied at different time (Mukhopadhyay and Chowdhury, 1973 ; Das, 1996) and the present results followed the same pattern with a marginal variation between the counts of different months of the two years. Such variation is quite expected being influenced by environmental and ecological factors. Population of zigzag leafhopper in summer months (April - May) for both years were high in irrigated rice ecosystem (Table 1).

R. dorsalis has been recognized as one of the RTV vectors (Hibino and Cabunagan, 1986) and it has also been suspected that this insect might also play a significant role on the interseasonal carryover of the RTV (Chowdhury and Mallick, 1997). *R. dorsalis* population started to increase from the month of September and reached its peak in October and sharply decreased in December and January. Presence of *R. dorsalis* even in low population in between the interseasonal phase of aman to boro might play a role on the carryover of the virus in addition to the small number of GLH in the field.

Population of zigzag leafhopper and green

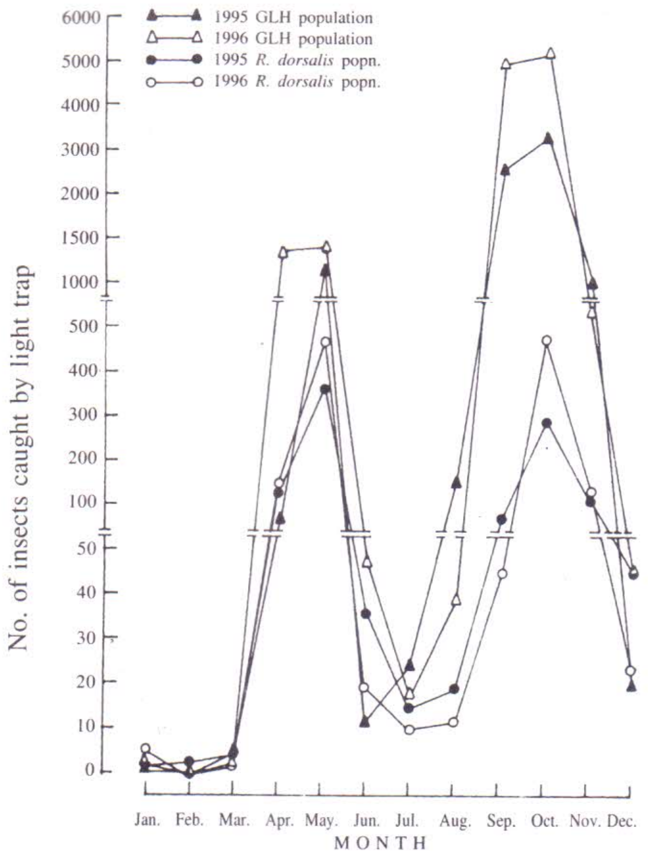

Fig. 1 : A comparison on the population of rice green leafhopper (*Nephotettix* spp.) and zigzag leafhopper (*Recilia dorsalis*) in lighttrap at PVEF, BCKV, Kalyani during 1995 and 1996.

leafhoppers in the seedbeds were recorded consecutively for two years in both wet season (WS) and dry season (DS) (Table 2) using sweeping net. Data on the population count showed comparatively higher incidence of *Nephotettix* spp. than *R. dorsalis*. Distribution pattern of the insects in seedbeds did not differ widely in different years of observations. Although the population of *R. dorsalis* was low when compared to GLH, never-the less their presence in the seedbeds might play an important role in the carryover of virus from the standing crop or stubbles to seedbeds. The densities of GLH population included both species of *Nephotettix* of which *N. virescens* was considered an important vector of tungro disease. Presence of *R. dorsalis* in seedbeds was also expected to play some role in the carryover of the virus.

Population densities of both types of leafhoppers inside the rice fields at tillering phase were counted using yellow sticky traps in DS crops of 1995 and 1996 (Table 3). The density of *R. dorsalis* was higher than GLH as observed in the yellow sticky trap count. In the first fortnight of March of both 1995 and 1996, the population of *R. dorsalis* was almost nil but afterwards it increased and recorded the maximum in April and May of both the years.

Pattern of population development for *R. dorsalis* was similar to those of *Nephotettix* species and this suggested that factors controlling the population development were common for both green and zigzag leafhoppers. The population dynamics, patterns of immigration, local movement and survival between cropping seasons are some of the most important criteria to study the epidemiology of tungro disease. Although much of the studies on the population dynamics have been done with *Nephotettix* species, no such detailed study has so far been made with *R. dorsalis*.

RTV disease is almost endemic in nature and usually it appears at a periodic cycle after 4-5 years.

Table 2 : Population of zigzag leafhopper (*R. dorsalis*) at rice seedbeds in different seasons at various locations of West Bengal

Cropping season	Month	Average number of insects / 10 sweeps				
		1st week	2nd week	3rd week	4th week	Average
DS, 1995	January '95	2.17 (8.80)	1.85 (5.90)	2.05 (3.50)	1.79 (1.40)	1.97 (4.90)
	February '95	1.67 (1.3)	1.67 (2.0)	1.33 (0.0)	2.0 (0.0)	1.67 (0.83)
WS, 1995	May '95	1.0 (2.91)	1.43 (3.73)	1.88 (3.33)	2.44 (7.50)	1.69 (4.37)
	June '95	1.71 (6.73)	1.20 (5.71)	1.58 (6.0)	1.20 (3.0)	1.42 (5.36)
	July '95	1.36 (7.37)	1.35 (6.0)	1.72 (12.5)	0.0 (16.0)	1.11 (1.04)
DS, 1996	January '96	0.80 (1.0)	1.58 (1.78)	1.20 (0.67)	1.11 (0.71)	1.17 (10.47)
	February '96	1.56 (1.38)	1.20 (2.47)	1.60 (1.33)	1.60 (1.75)	1.49 (1.73)
WS, 1996	May '96	1.50 (7.78)	0.67 (7.06)	1.33 (6.67)	1.20 (4.67)	1.18 (6.55)
	June '96	1.33 (13.64)	0.95 (6.43)	3.33 (14.17)	1.88 (6.36)	1.87 (10.15)
	July '96	1.92 (15.83)	1.82 (13.33)	3.0 (18.0)	2.22 (18.57)	2.24 (16.43)

Figures within the parentheses indicate the average population of GLH recorded by 10 sweeps at seedbeds.

Table 3 : Population of zigzag leafhopper (*R. dorsalis*) trapped by yellow sticky trap within rice fields at experimental farms of BCKV, West Bengal

Month of observation	Average number of insects / trap				
	1st week	2nd week	3rd week	4th week	Total
March '95	0 (0)	0 (0)	2.0 (0)	3.0 (0.33)	5.0 (0.33)
April '95	2.33 (0.33)	5.0 (1.67)	5.33 (1.0)	4.0 (1.33)	16.66 (4.33)
May '95	8.67 (1.67)	12.67 (7.0)	7.67 (0.33)	7.33 (0)	36.34 (9.0)
June '95	1.0 (0.33)	0.67 (0.67)	0 (0)	0 (0)	1.67 (0.99)
March '96	0 (0)	1.0 (0)	0.67 (0.67)	1.0 (1.33)	2.67 (2.0)
April '96	1.67 (3.0)	6.33 (4.0)	19.33 (18.33)	19.0 (12.0)	46.33 (37.33)
May '96	13.0 (9.33)	12.0 (7.33)	6.67 (9.67)	19.67 (1.67)	51.34 (28.0)
June '96	3.33 (0.67)	2.33 (0.33)	6.67 (0.67)	0 (0)	6.33 (1.67)

Figures within the parentheses indicate the average population of rice green leafhopper (GLH) trapped by the same trap.

Survival of the virus is more in intensive rice cropping areas mostly infecting rice and a few weedhosts in the rice fields (Anjaneyulu *et al.*, 1982 ; Khan *et al.*, 1991 ; Mallick *et al.* ; 1999). The carryover of the virus in rice fidds takes place only through the immigration of tungro infective vectors. The most efficient tungro vector, *N. virescens* is known to be monophagous on cultivated and wild species of rice, whereas *N. nigropictus* has a wider host range including rice and several species of graminaceous grasses (Viswanathan and Kalode, 1981). At present no detailed informtion on the host preference as well as on the role of virus transmission by *R. dorsalis* are available.

This study contributes information about *R. dorsalis* mostly on the population development, appearance in different cropping seasons and distribution patterns within rice fields. It emphasizes the need for more works to establish the relationship between the population of vector and host preferences along with both the vector transmission efficiency and incidence of RTV.

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