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ABUNDANCE OF RICE GREEN LEAFHOPPERS, *NEPHOTETTIX* SP. (HOMOPTERA: CICADELLIDAE) IN DIFFERENT RICE VARIETIES AND THEIR INTERRELATIONSHIPS WITH NATURAL PREDATORS

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Abundance of green leafhoppers, *Nephotettix* sp. and interrelationship between green leafhoppers and their natural predators was studied on 21 rice varieties/lines. The variety Kladoma and line BG-915 showed minimum and maximum susceptibility to green leafhopper attack. The highest leafhopper population was recorded 35 days after transplanting and thereafter a gradual density decline on plant age occured. Out of five predators namely, *Conocephalus, Tetragnatha, Micraspis, Oxyopes* and *Agriocnemus*, predator *Micraspis* is the most important which made highly positive correlation (0.169), maximum direct effects (0.144) and maximum influences (2.85%) on the abundance of green leafhoppers.

Key words: Green leafhoppers, Rice varieties, Predators.

Introduction

Green leafhoppers, *Nephotettix* are devastating pests of rice [1-4]. They cause direct damage by sucking cell sap and by ovipositing on the leafsheath and more importantly they are vectors of rice tungro virus, one of the most menacing disease of rice in Asia [1]. Rice crop losses due to leafhopper damage might be 50-80% in Bangladesh [5].

Varietal resistance has been identified against the insect and the virus [6]. Natural enemies are often important biological control agents of leafhoppers in nature. Aswani & Pawar [7] reported 45 genera from 15 families of spiders inhabiting rice fields. Shepard *et al.* [8] reported that spiders prey on 2-15 green leafhoppers per day. Adults and larvae of ladybird beetles fed on eggs, nymphs & adults of green leafhoppers. Damselflies (*Agriocnemus* sp.)and predatory grasshoppers (*Conocephalus* sp.) have also been reported as abundant predators in rice fields [4,9,10]. The objective of this experiment was to study leafhopper varietal preference and identify green leafhoppers natural enemies.

Materials and Methods

A field experiment was conducted with 21 rice varieties/lines (*viz.*, IR-33380-7-2-1-3, BG-915, BG-850-2, BR14, Magurshyl, Kalom, Shapar, kalijira, Pajam, Philippine, Kladoma, BR10, Nizershyl, BR11, Katari, BR25, BR22, Sarnagu, BR4, BR5 and BR23) at experimental fields of Hajee Mohammad Danesh Agriculture College, Dinajpur, Bangladesh during the aman season of 1992. The experiment was laid out in a factorial randomized block design with three replications. The unit plot size was 5m x 5m. Twenty days old rice seedlings were transplanted (2-3 seedlings per hill 20 x 20 cm). The plots were fertilized with 60 kg N_2, 40 kg P_2O_5, 40 kg K_2O and 10 kg S per hectare. No pesticides were used. Interculture operations in the rice field were done as per recommendation for rice.

Ten random sweeps were diagonally taken from each plot with a sweeping net (diameter 30 cm) on the top portion of the plants. The sweeps were taken five times at 7 days intervals, the first one being 25 days after transplantation (25 DAT). Samples were transported to the laboratories and counted. The collected data were analysed statistically after their conversion into square root ($Y = \sqrt{X + 0.50}$). The mean values were adjudged with Duncan's Multiple Range Test [11]. To determine the extent of interrelationship among the green leafhoppers and their predators, correlation matrix was worked out [12] and correlation coefficients were further partitioned into components of direct and indirect effects by path coefficient analysis, taking all the characters into consideration [13]. Green leafhoppers were considered as dependent variable.

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Results and Discussion

Effects of varieties and plant age. Line BG-915 was found to be more susceptible to green leafhopper attack followed by BR11, whereas, cv. Kladoma was the least susceptible followed by BR23 (Table 1). In relation to plant age, the highest significant hopper population (1.62/plot) was recorded 35 days after transplantation (35 DAT), followed by 28 DAT (1.48 $plot^{-1}$). Thereafter, a gradual and significant decreasing trend was observed for hopper abundance with the advancement of plant age. In a field experiment with

TABLE 1. RELATIVE ABUNDANCE OF *NEPHOTETTIX* SP. AND THEIR PREDATORS IN 21 RICE LINES

Variety/ Date	Number of insects/plot through ten sweeps					
	Nephotettix	*Conocephalus*	*Tetragnatha*	*Micraspis*	*Oxyopes*	*Agriocnemus*
Variety:						
IR-33380	0.80 bcdef	0.53 bcde	0.60 bcde	0.60 bcd	1.13 a	0.53 a
BG-915	1.73 a	0.80 abc	1.33 a	0.47 bcd	0.60 a	0.80 a
BG 850-2	1.27 abc	0.73 abc	0.80 abc	0.73 abc	0.87 a	0.53 a
BR14	1.40 ab	0.47 bcde	0.33 bcde	0.73 abc	0.33 a	0.47 a
Magurshyl	0.80 bcdef	1.27 a	0.73 abc	0.93 abc	0.80 a	0.87 a
Kalom	0.73 bcdef	0.67 abcd	0.07 e	1.07 ab	0.67 a	0.60 a
Shaphar	0.87 abcdef	0.93 abc	0.93 ab	1.33 a	1.13 a	0.53 a
Kalijira	0.93 bcdef	0.67 bcde	0.60 bcde	0.67 abc	0.87 a	0.27 a
Pajam	0.40 cdef	1.00 ab	0.60 bcde	0.73 abc	0.73 a	0.67 a
Philippin	0.93 abcdef	0.67 bcd	0.47 bcde	0.80 abc	0.80 a	0.67 a
Kladoma	0.13 f	0.20 cde	0.33 bcde	0.00 d	0.33 a	0.53 a
BR10	1.07 abcde	0.20 cde	0.80 abc	0.27 cd	0.20 a	0.87 a
Nizershyl	0.33 ef	0.73 abc	0.13 de	0.27 cd	0.60 a	0.40 a
BR11	1.53 ab	0.07 de	0.87 abc	0.20 cd	1.07 a	0 53 a
Katari	0.60 bcdef	0.33 bcde	0.40 bcde	0.40 cd	0.80 a	0.40 a
BR25	0.40 def	0.40 bcde	0.40 bcde	0.53 bcd	0.60 a	0.33 a
BR22	0.87 bcdef	0.27 cde	0.53 bcde	0.27 cd	0.93 a	0.80 a
Sarnaragu	1.07 abcde	0.00 e	0.27 cde	0.27 cd	0.87 a	0.73 a
BR4	1.20 abcd	0.07 de	0.53 bcde	0.33 cd	0.33 a	0.60 a
BR5	0.73 bcdef	0.40 bcde	0.73 bcd	0.47 bcd	0.60 a	0.47 a
BR23	0.33 ef	0.27 cde	0.67 bcd	0.40 cd	0.87 a	0.47 a
Date:						
28 DAT	1.48 a	0.86 a	0.33 c	0.681 ab	0.54 b	0.29 d
35 DAT	1.62 a	0.68 a	0.79 b	0.620 ab	1.10 a	1.00 a
42 DAT	0.92 b	0.63 a	1.25 a	0.791 a	0.65 b	0.70 ab
49 DAT	0.22 c	0.17 b	0.33 c	0.440 bc	0.70 b	0.57 bc
56 DAT	0.08 c	0.19 b	0.17 c	0.190 c	0.62 b	0.32 cd

In a column, the figures having common letter(s) do not differ significantly at 5% level of probability.
DAT = date after transplantation.

mustard,Khan *et al.* [14] showed that abundance of sap-sucking insects like leafhoppers,aphids, bugs varied with the age of the host plant.These results are in agreement with Khan *et al.*[14].Predator population are also related to plant age. It might be due to the variation of green leafhopper population in the experimental fields.

Quantitative relationships. Simple correlation coefficient among different predators and green leafhoppers are given in Table 2. The abundance of green leafhopper population showed positive correlations with most of the predators. The highest positive correlation (0.16, P<0.05) was observed with *Micraspis* spp. followed by *Conocephalus* (0.15, P<0.05) and *Tetragnatha* (0.12, P<0.05), which suggested that *Micraspis* was the most consistent predator of green leafhoppers. The results revealed that the abundance of predators fluctuated with the abundance of green leafhopper population. Khan *et al.* [15] reported that aphid predator populations showed significant positive correlations with prey population. Our results support their findings.

TABLE 2. CORRELATION MATRIX BETWEEN *NEPHOTETTIX* SP. ABUNDANCE AND THEIR PREDATORS

Variable	*Agriocnemus*	*Conocephalus*	*Tetragnatha*	*Oxyopes*	*Micraspis*
Nephotettix	0.0626	0.1559*	0.1275*	-0.0390	0.1687*
Agriocnemus		-0.0622	0.0618	0.0668	0.0288
Conocephalus			0.1604*	0.0935*	0.1496*
Tetragnatha				0.0339	0.1700*
Oxyopes					0.1343*

*Significant at 5% level of probability

The estimated correlation coefficient among the studied green leafhoppers and their predators were partitioned into direct and indirect effects and have been presented by path coefficient analysis in Table 3. The direct effects of *Micraspis* was highest positive (0.144) on the abundance of leafhoppers, followed by *Conocephalus* (0.133) and *Tetragnatha* (0.080). The indirect effects of *Micraspis* via *Tetragnatha* (0.014),

Conocephalus (0.020) and *Agriocnemus* (0.002); *Conocephalus* via *Micraspis* (0.022), *Tetragnatha* (0.013); *Tetragnatha* via *Micraspis* (0.024), *Agriocnemus* (0.004) were positive. On the other hand *Oxyopes* had negative effects (-0.078) on leafhoppers. The result of path coefficient analysis indicated that *Micraspis* had the maximum direct effects on the abundance of leafhoppers followed by *Conocephalus*. Similar result was obtained by Khan *et al.* [15] in case of mustard aphids, where they found that lady bird beetle had maximum direct effects on prey. The high residual factor (0.968) suggests that many parameters which influence the abundance of leafhoppers, such as effects of climate, fertilizer, irrigation, were not included in this experiment.

Relative influences of predators: Following the step-wise regression programme, green leafhopper abundance was regressed separately with each predator [13]. Selection of the first pest was then accomplished by employing the criteria of coefficient of determination (R^2) and F-test (Table 4). The relative importance of influencing predator was *Micraspis* (XI) as per step I. Its relative importance against leafhopper population was 2.85%. According to step II, *Conocephalus* (X2) was the next important predator influencing the abundance of leafhoppers in the presence of *Micraspis*. According to step III, *Tetragnatha* (X3) was entered as third important predator among the tested predators in the presence of *Micraspis* and *Conocephalus*. *Oxyopes* (X4) was entered as fourth important predator, according to step IV, in the presence of *Micraspis*, *Conocephalus* and *Tetragnatha*. *Agriocnemus* (X5) was the last in the order of importance, as revealed by step V. F-test showed that the contributions of *Micraspis* and *Conocephalus* were found significant at 5% level. Results revealed that the maximum control on green leafhoppers was made by *Micraspis* (2.85%) followed by *Conocephalus* (1.74%), *Tetragnatha* (0.69%), *Oxyopes* (0.52%) and *Agriocnemus* (0.44%). This result is in agreement with the Khan *et al.* [15], where they found that lady bird beetle had significantly

TABLE 3. PATH COEFFICIENT ANALYSIS OF VARIOUS PREDATORS INFLUENCING *NEPHOTETTIX* SP. ABUNDANCE.

	Indirect effects through					
Character	*Agriocnemus*	*Conocephalus*	*Tetragnatha*	*Oxyopes*	*Micraspis*	Total correlation with *Nephotettix* abundance
Agriocnemus	0.0669	-0.0083	0.0050	-0.00521	0.0041	0.0626
Conocephalus	-0.0042	0.1330	0.0129	-0.0073	0.0215	0.1559
Tetragnatha	0.0041	0.0213	0.0802	-0.0026	0.0244	0.1275
Oxyopes	0.0045	0.0124	0.0027	-0.0780	0.0193	-0.0390
Micraspis	0.0019	0.0199	0.0136	-0.0105	0.1437	0.1687

Residual effect = 0.9683, Underlined figure denotes the direct effect of the characters on the yield of rice.

TABLE 4. STEP-UP-WISE REGRESSION EQUATIONS FROM EACH STEP FOR FINDING OUT RELATIVE INFLUENCE OF PREDATORS ON *NEPHOTETTIX* ABUNDANCE

Step/Regression equation	R^2	F value computed
Step I: $Y = 1.113 + 0.194^* X\,1$ (0.064)	0.029	9.166*
Step II: $Y = 0.991 + 0.171^* X\,1 + 0.154^* X\,2$ (0.064) (0.064)	0.046	7.508*
Step III: $Y = 0.924 + 0.157^* X\,1 + 0.140^* X\,2 + 0.096^* X\,3$ (0.065) (0.065) (0.064)	0.053	5.775*
Step IV: $Y = 0.992 + 0.167^* X\,1 + 0.147^* X\,2 + 0.096\,X\,3 - 0.081^* X\,4$ (0.065) (0.065) (0.064) (0.062)	0.058	4.774*
Step V: $Y = 0.923 + 0.165^* X\,1 + 0.153^* X\,2 + 0.091\,X\,3 - 0.086\,X\,4 + 0.078^* X\,5$ (0.065) (0.065) (0.064) (0.062) (0.065)	0.062	4.116*

Figures in parentheses below the regression coefficients show the standard errors of the estimated value,* = Significant at 5%level, Y=*Nephotettix* sp., XI = *Micraspis*, X2 = *Conocephalus*, X3 = *Tetragnatha*, X4 = *Oxyopes*, X5 = *Agriocnemus*

highest influence on the prey.

From these results, it appeared that *Micraspis* was the most important predator of green leafhoppers which made highly positive correlation, maximum direct effects and maximum influences on the abundance of hoppers. The results also indicated that the varietal difference and plant age had significant role in the abundance of leafhoppers. Therefore, it may be concluded that the use of less susceptible variety of rice and encouragement of natural predators like *Micraspis, Conocephalus, Tetragnatha, Oxyopes, Agriocnemus* etc. may be helpful to control green leafhoppers in rice fields.

References

1. F.A. Talukder, M. Shahjahan, S. Sarker and S. Ahmed, Bangladesh J. Agric. Sci., **17**(2), 303, (1990).
2. S. Alam, Current Application Methods of Insecticides in Rice Farmer's Fields in Bangladesh (FAO/IRRI Workshop on Judicious Use of Pesticides on Rice, IRRI, Philippines, 1983).
3. E.A. Heinrichs, H.R. Rapusas, G.B. Aquino and F. Palis, J. Econ. Entomol., **79**, 437, (1986).
4. W.H. Reissig, E.A. Heinrichs and H.R. Rapusas, Philipp. Entomol., **6**(4), 398, (1985).
5. Z. Alam and A. Islam, Pak. J. Sci. Res., **2**, 20, (1959).
6. H.D. Catling, S. Alam, C.M. Nurullah and A. Alam, Literature Review of Insect Pests and Diseases of Rice in Bangladesh. (Bangladesh Rice Research Institute, 1977), pp. 131.
7. M.A. Aswani and A.D. Pawar, Plant Protection Bulletin (Faridabad), **44**(3), 32, (1992).
8. B.M. Shepard, A.T. Barrion and J.A. Litsinger, *Helpful Insects, Spiders and Pathogens* (International Rice Research Institute, Philippines, 1987), pp 136.
9. D. Bhardwaj and A.D. Pawar, Int. Rice Res. Newsl., **12**(4), 35, (1987).
10. E.G. Rubia and B.M. Shepard, Int. Rice Res. Newsl., **13**(3), 32, (1988).
11. D.B. Duncan, Virginia J. Sci., **2**, 171, (1951).
12. H.K. Hayes, F.R. Immer and D.C. Smith, *Methods of Plant Breeding* (Mc-Graw Hill Book Co. Inc., New York, 1995), pp. 551.
13. D.R. Dewey and K.H. Lu, Agron. J., **51**, 515, (1959).
14. A.B. Khan, S.B. Haq and F.A. Talukder, Bangladesh J. Agric. Sci., **18**(2), 215 (1991).
15. A.B. Khan, S.B. Haq and F.A. Talukder, Bangladesh J. Agric. Sci., **20**(1), 119 (1993).