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The Relative Importance of Predators for the Control of Nephotettix Spp. on Rice

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The rice green leafhoppers, *Nephotettix* spp. (*Homoptera: Cicadellidae* is one of the most devastating pests of rice throughout the rice growing areas of Asia [1-4]. They act as an efficient vector of rice tungro virus, one of the most menacing disease of rice [1]. Alam and Islam [5] reported that rice crop losses due to the hoppers might be 50-80% in Bangladesh. Around 45 genera from 15 families of spiders inhibited the rice fields [6] and they prey 2-15 green leafhoppers per day and both the adults and larvae of ladybird beetles fed on *Nephotettix's* eggs, nymphs and adults [7] Damselflies also prey on leafhoppers [4,8]. The present experiment was undertaken with 21 varieties/lines of rice of find out their effect on the abundance of *Nephotettix* spp. and interrelationships between leafhoppers and their natural predators.

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, Phillippne, Kladoma,BR10, Nizershyl, BR11, Katari, BR25, BR22, Sarnagu, BR4, BR5and BR23, at the experimental fields of Haji M. 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 experiment was laid out in a factorial randomized block design with three replications. The unit plot sizes were 5 m 4 m. Rice seedlings (25 days old) were transplanted in 12/3 seedlings per hill maintaining the distances 20 cm between rows and 20 cm within the rows. The plots were treated with 60 kg N_2 40 kg P_2O_5, 40 kg K_2O and 10 kg S per hectare. No pesticides were used into plot during present crop period. Interculture operations were done as per recommendation for rice.

Sampling of *Nephotettix* spp. and their five predators (Predatory grasshopper or *Conocephalus* spp. (Tettiginidae, Orthoptera). Long-headed Spider or *Tetragnatha* spp. (Tetragnathidae, Araneae), Lady bird beetle or *Micraspis* spp. (Coccinellidae, Coleoptera), Linx spider or *Oxyopes* spp. (Oxyopidae, Araneae) and Damselfly or *Agriocnemus* spp. (Coenagrionidae, Odonata) was done by taking 10 random sweeps diagonally from each plot with a sweeping net (having a diameter of 30 cm) on the top portion of the plants as well as close to the basal region, as far as possible. The sweeps were taken five times at 7 days intervals, the first one being 25 days after transplantation 25(DAT). The sample populations of leafhoppers and all predators were counted. The

TABLE 1. CORRELATION MATRIX BETWEEN *NEPHOTETTIX* SPP. ABUNDANCE AND THEIR PREDATORS.

Variable	Agriocnemus	Conocephalus	Tetragnatha	Oxyopes	Micraspis
Nephotettix	0.0626	0.1559*	0.1275*	-0.390	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.

TABLE 2. STEP-UP-WISE REGRESSION EQUATIONS FROM EACH STEP FOR FINDING OUT RELATIVE INFLUENCE OF PREDATORS ON *NEPHOTETTIX* ABUNDANCE.

Step/Regresion equation	R^2	F value computed
Step I:		
$Y = 1.113 + 0.194^{*} X1$ (0.064)	0.029	9.166*
Step II:		
$Y = 0.991 + 0.171^{*} X1 + 0.154^{*} X2$ (0.064) (0.064)	0.046	7.508*
Step III:		
$Y = 0.924 + 0.157^{*} X1 + 0.140^{*} X2 + 0.096^{*} X3$ (0.065) (0.065) (0.064)	0.053	5.775*
Step IV:		
$Y = 0.992 + 0.167^{*} X1 + 0.147^{*} X2 + 0.096 X3 - 0.081^{*} X4$ (0.065) (0.065) (0.064) (0.062)	0.058	4.774*
Step V:		
$Y = 0.923 + 0.165^{*} X1 + 0.153^{*} X2 + 0.091 X3 - 0.086 X4 + 0.078^{*} X5$ (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* spp., X1 = *Micraspis*, X2 = *Conocephalus*, X3 = *Tetragnatha* X4 = *Oxyopes*, X5 = *Agriocnemus*

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

Character	Indirect effects through					Total correlation with *Nephotettix* abundance
	Agriocnemus	*Conocephalus*	*Tetragnatha*	*Oxyopes*	*Micraspis*	
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.*, Significant at 5% level.

TABLE 4. EFFECTS OF DIFFERENT VARIETIES OF RICE AND PLANT AGE ON THE ABUNDANCE OF *NEPHOTETTIX* SPP. AND THEIR PREDATORS.

Variety/ Date	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
BR 14	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	0.93ab	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 coulmn, the figures having common letter(s) do not differ significantly at 5% level of probability. DAT = date after transplantation.

collected data were transferred using a square root ($Y=\sqrt{X+0.50}$) transformation and analyzed statistically and mean differences were adjudged with Duncan's Multiple Range Test [9] in the department of Biology, University of Southampton, England using micro-computer facilities. To determine the extent of interrelationship among the rice green leafhoppers and their predators, correlation matrix was worked out [10] and correlation coefficients were further partitioned into components of direct and indirect effects by path coefficient analysis by taking all the characters into consideration [11]. The data on the abundance of *Nephotettix* as influenced by different rice varieties/lines and predators are presented in Table 4. Interrelationships among *Nephotettix* and their predators are presented in Table 2-4.

Quantitative relationships. Simple correlation coefficients among different predators and green leafhopper have been given in Table 1. The abundance of *Nephotettix* population showed positive correlations with most of the predators. Khan *et al.* [12] reported that predator populations showed significant positive correlations with the prey population in case of aphids. The present result support the view of them.

The estimated correlation coefficient among *Nephotettix* and their predators tested were partitioned into direct and indirect effects and have been presented by path-coefficient analysis in Table 3. The result of path-coefficient analysis indicated the maximum direct effect of *Micraspis* on the abundance of *Nephotettix* followed by *Conocephalus*. The high residual factor (0.968) suggests that many parameters which influence on the abundance of *Nephotettix*, such as effects of climate, fertilizer, irrigation, were not included in this experiment.

Relative influence of Predators. Following the step-upwise regression programme, *Nephotettix* abundance was regressed separately with each predator [11] . Selection of the first pest was then accomplished by employing the criteria of coefficient of determination (R^2) and F-test (Table 2).

Results revealed that the maximum control capabilities on Nephotettix was made by *Micraspis* (2.85%) following by *Conocephalus* (1.74%)> *Tetragnatha* (0.69%). *Oxiopes* (0.52%) and *Agriocnemus* (0.44%). This result is in agreement with the Khan *et.al.* [12], where they found that lady bird beetle significantly highest influence on the prey.

From these results, it appeared that *Micraspis* was the most important of *Nephotettix* which made highly positive correlation association (0.169, $P < 0.05$) with *Nephotettix*, maximum direct effect (0.144) and maximum influences (2.85%) on abundance of hopper. The results indicate that the varietal difference and plant age played a significant role on the abundance of *Nephotettix*. Moreover, natural predators also helpful for the control of *Nephotettix*. Findings of Khan *et al.* [13] are in agreement with the present results where they showed that the plant age played a significant role on the abundance of mustard pests. Therefore, it may be concluded that the use of less susceptible variety of rice and encouragement of natural predators like *Micraspis, Conocephalus, Tetragnatha, Oxiopes, Agriocnemus* etc. may be helpful to control of *Nephotettix* in rice fields.

Key words: Nephotettix sp., Rice varieties, Predators.

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