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Comparative biology and prey preference of *Cyrtorhinus lividipennis* Reuter and *Tytthus parviceps* (Reuter) (Hemiptera: Miridae) on planthoppers and leafhopper of rice

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ABSTRACT: **Biology and host preference of *Cyrtorhinus lividipennis and Tytthus parviceps* and their predatory efficiency on rice planthoppers and leafhoppers were studied in the greenhouse. The fecundity, nymphal survival, body weight and body size of both *C. lividipennis* and *T. parviceps* were significantly higher on BPH oviposited plants compared to those on WBPH or GLH oviposited plants. There was no significant difference in the adult female and male longevity on different hosts. In general, the adults survived for 11-20 days. The pre-oviposition period ranged from 1.5 to 2.8 days on different hosts. Incubation and nymphal periods were prolonged on GLH oviposited plants compared to BPH and WBPH oviposited rice plants. In both choice and no choice tests, *C. lividipennis* and *T. parviceps* preferred and consumed more BPH and WBPH eggs than GLH eggs. *C. lividipennis* nymphs were better predators than adults whereas the predatory efficiency of nymphs and adults was similar in *T. parviceps*. It is evident that BPH is the preferred and primary host for both *C. lividipennis* and *T. parviceps* and they secondarily adapted to WBPH and GLH.**

KEYWORDS: Biology, *Cyrtorhinus lividipennis, Nephotettix virescens, Nilaparvata lugens,* prey preference, *Sogatella furcifera, Tytthus parviceps*

Cyrtorhinus lividipennis Reuter and *Tytthus parviceps* (Reuter) are the two sympatric species of mirid bugs acting as important egg predators of brown planthopper (BPH), *Nilaparvata lugens* (Stal), whitebacked planthopper (WBPH), *Sogatella furcifera* (Horvath) and green leafhopper (GLH), *Nephotettix virescens* (Distant) and keep the hopper populations at low levels (Chiu, 1979; Liquido and Nishida, 1983). These two mirid bugs co-exist in the rice ecosystem feeding on the same insect hosts. Some information is available on the biology and prey preference of *C. lividipennis,* but it is almost nil in *T. parviceps*. There are controversial reports about the host status of GLH to *C. lividipennis*. These two predators can be effectively used together if information is generated on the nature of co-existence between them i.e., either complimentary or competitive. Hence, the present investigation was undertaken to understand the biology and prey preference of the two predators.

MATERIALS AND METHODS

Rearing of rice plants and host insects

Rice plants of variety TN1 were grown in the greenhouse at 30±5°C and 60±10 percent relative humidity. Planthoppers and leafhoppers were reared on 40-day-old rice plants in wooden cages in greenhouse. Mirid bugs were reared on BPH

oviposited rice plants. The adult mirid bugs were confined to these plants for 2-3 days for oviposition and emerging nymphs were allowed for required period in separate cages to obtain nymphs or adults of specified age.

Biological parameters like pre-oviposition period, adult longevity, fecundity, nymphal instars and nymphal duration, body weight and body size, incubation period, nymphal survival, sex ratio and predatory efficiency were studied on the planthoppers and leafhopper on rice. The data were analyzed statistically after transformation wherever necessary.

Predatory efficiency of mirid bugs

One pair each of freshly emerged males and females of BPH, WBPH and GLH was released separately for oviposition on rice plants covered with mylar cages. Five freshly emerged females (or males) or 5 third instar nymphs of *C. lividipennis* and *T. parviceps* were released on oviposited plants and number of nymphs of host insects hatched were counted along with control plants without mirid bugs and each treatment was replicated 7 times. The percentage reduction in host insect nymphs over control was estimated and the analysis of variance was done after angular transformation. The preference tests were conducted under choice and no choice conditions.

RESULTS AND DISCUSSION

The data collected on different biological parameters of the mirid bugs are presented in Table 1. The fecundity of both *C. lividipennis* (169.1) and *T. parviceps* (178.7) was significantly higher on BPH infested and oviposited plants compared to that on WBPH (81.6 and 60.4) or GLH (13.4 and 59.6) infested and oviposited plants. Nymphal survival of both *C. lividipennis* and *T. parviceps* was the highest on BPH (69.4 and 60.5%) compared to that on WBPH (38.5 and 29.4%) and GLH (36.7and 17.7%). Adults emerged during nights. Mating took place throughout the day and copulation lasted for 15 - 30 minutes. Sex ratio or percent male emergence was similar on the three hosts. The percentage male in *C. lividipennis* was 44.48-51.45 and in *T. parviceps* it was 40.64-42.84. There was no significant difference in the female and male longevity on these different hosts. In general, the adults survived for 11-20 days. Pre-oviposition period ranged from 1.5 to 2.8 days on different hosts. Light greenish oval eggs were laid in the lower epidermis of the leaf sheath near the host eggs. After hatching the first instar nymphs were seen feeding on the eggs and first instar nymphs of host insects inside the plant tissue. Incubation period was 8-9 days and it was prolonged on GLH (9.87 and 9.45 days) compared to that on BPH and WBPH (8.83 and 7.8 days). There were 5 nymphal instars and nymphal period of *T. parviceps* was longer than that of *C. lividipennis*. It was short on BPH (11.5 and 13.8 days) and WBPH (11.6 and 13.4 days) compared to that on GLH (13.6 and 15.4). Adults of *C. lividipennis* and *T. parviceps* weighed more when fed on BPH oviposited plants than when fed on WBPH or GLH infested plants. The female *C. lividipennis* was 3.09 mm long and 1.02 mm wide.

Observations were recorded on body size of different nymphal instars *of C. lividipennis* and *T. parviceps* and they are presented in Table 2. In general, female mirid bugs measured more in both length and width than the male mirid bugs. *C. lividipennis* is bigger in size than *T. parviceps*. Both the males and females of *C. lividipennis* measured and weighed more on BPH oviposited plants than that of WBPH and GLH oviposited plants whereas *T. parviceps* did not exhibit any such differences.

The observations recorded on the prey preference of mirid bugs (Table 3) revealed that in both choice and no choice tests, *C. lividipennis* and *T. parviceps* preferred and consumed more BPH and WBPH eggs than GLH eggs. There was no significant difference in the per cent reduction of BPH and WBPH nymphs by predation of *C. lividipennis* in both choice and no choice tests indicating that BPH and WBPH are equally preferred by mirid bugs as prey. The percent reduction of GLH nymphs was significantly low in both choice and no choice tests indicating that GLH eggs are not preferred by mirid bugs. *C. lividipennis* nymphs consumed more number of host eggs and the percent reduction of nymphs was more in the

Table 1. Comparative biology of *C. lividipennis* and *T. parviceps* on rice planthopper and leafhopper hosts

Parameter	*C. lividipennis*			*T. parviceps*		
	BPH	WBPH	GLH	BPH	WBPH	GLH
Preoviposition period (days)	1.50^{b}	1.80^{b}	2.80^{a}	1.80^{b}	2.3^{ab}	1.90^{b}
Fecundity	169.11 (2.22)a	81.67 (1.88)^{b}	13.44 (0.98)^{c}	178.78 (2.22)^{a}	60.44 (1.76)^{b}	59.67 (1.72)^{b}
Incubation period (days)	8.83^{b}	8.47^{b}	9.87^{a}	7.80^{b}	8.10^{b}	9.45^{a}
Instar length (days) 1st Instar	3.00^{b}	4.00^{a}	4.00^{a}	4.00^{a}	4.00^{a}	4.00^{a}
2nd instar	2.00^{a}	2.00^{a}	2.00^{a}	2.00^{a}	2.00^{a}	2.00^{a}
3rd instar	2.00^{c}	2.00^{c}	3.00^{b}	3.00^{b}	3.00^{b}	4.00^{a}
4th instar	2.00^{b}	2.00^{b}	3.00^{a}	2.00^{b}	2.00^{b}	2.00^{b}
5th instar	2.00^{b}	2.00^{b}	2.00^{b}	2.00^{b}	2.00^{b}	3.00^{a}
Nymphal period (days)	11.48^{c}	11.60^{c}	13.68^{b}	13.48^{b}	13.48^{b}	15.44^{a}
Nymphal survival (%)	69.43 (56.43)^{a}	38.57 (38.32)^{c}	36.70 (37.22)^{c}	60.57 (51.16)^{b}	29.43 (32.76)^{d}	17.71 (24.83)^{e}
Sex ratio (F/M)	1.32^{a}	1.31^{a}	1.03^{a}	1.48^{a}	1.09^{a}	1.17^{a}
Males population (%)	44.48 (41.79)^{a}	40.81 (39.63)^{a}	51.45 (45.83)^{a}	42.84 (40.85)^{a}	49.35 (44.59)^{a}	40.64 (39.52)a
Adult longevity (days) Female	20.00^{a}	15.30^{abc}	16.80^{abc}	13.80^{def}	14.20^{cde}	12.20^{ef}
Male	15.40^{abc}	15.50^{abc}	17.50^{ab}	12.60^{ef}	15.20^{abc}	11.50^{f}
Body weight (mg) Female	0.90^{a}	0.46^{d}	0.29^{e}	0.70^{b}	0.62^{bc}	0.54^{cd}
Male	0.41^{a}	0.19^{c}	0.21^{bc}	0.29^{b}	0.28^{b}	0.23^{bc}

Values in a row followed by same letter are not significantly different at P=0.05 according to DMRT.
Values in parentheses are transformed values.

Table 2. Body measurements of mirid bugs

Mirid stage	*C. lividipennis*			*T. parviceps*		
	BPH	WBPH	GLH	BPH	WBPH	GLH
Nymphal instars (mm)						
2nd						
Length	0.44[a]	0.36[b]	0.39[a]	0.54[a]	0.52[a]	0.44[b]
Width	0.11[a]	0.10[a]	0.10[a]	0.19[a]	0.17[b]	0.16[b]
3rd						
Length	1.00[a]	1.00[a]	0.96[b]	1.00[a]	1.01[a]	0.96[b]
Width	0.28[a]	0.28[a]	0.28[a]	0.28[a]	0.27[a]	0.28[a]
4th						
Length	1.58[a]	1.53[a]	1.55[a]	1.52[a]	1.47[b]	1.42[c]
Width	0.59[a]	0.50[c]	0.53[b]	0.56[a]	0.52[a]	0.48[b]
5th						
Length	2.40[a]	2.04[b]	2.00[b]	2.15[a]	2.02[b]	1.97[b]
Width	0.93[a]	0.64[b]	0.60[c]	0.89[a]	0.83[b]	0.83[b]
Female						
Length	3.09[a]	2.80[ab]	2.83[ab]	2.70[ab]	2.78[ab]	2.60[b]
Width	1.02[a]	0.94[b]	0.92[b]	0.92[b]	0.94[b]	0.87[b]
Male						
Length	2.50[a]	2.12[a]	2.35[a]	2.10[a]	2.50[a]	2.10[a]
Width	0.69[a]	0.68[a]	0.65[a]	0.70[a]	0.80[a]	0.70[a]

The values in a row followed by same letter are not significantly different at P=0.05 according to DMRT.

Table 3. Prey preference of mirid bugs

Mirid bug stage	Reduction of host nymphs (%)					
	No choice			Choice*		
	BPH	WBPH	GLH	BPH	WBPH	GLH
C. lividipennis						
Adults	74.5(59.65)[a]	78.9(62.83)[a]	16.6(23.89)[b]	78.9(62.83)[a]	67.1(55.23)[a]	16.4(23.17)[b]
Nymphs	96.5(79.35)[a]	94.6(76.61)[a]	16.7(23.95)[b]	94.0(76.55)[a]	88.0(69.97)[b]	18.1(25.16)[c]
T. parviceps						
Adults	73.0(58.40)[b]	91.1(72.63)[a]	16.9(24.13)[c]	84.8(69.57)[b]	90.7(76.32)[a]	8.7(44.80)[c]
Nymphs	87.7(67.18)[b]	94.3(72.29)[a]	49.7(17.14)[c]	74.5(59.65)[a]	71.8(58.34)[a]	22.3(27.94)[b]

* BPH + WBPH + GLH released on same plant. The values in parentheses are arcsine-transformed values.
The values in a row followed by same letter are not significantly different at P=0.05 according to DMRT.

case of nymphal predation than in adult predation and *C. lividipennis* nymphs were considered better predators than adults. The percent reduction of nymphs of WBPH was more than that of BPH when fed upon by *T. parviceps* nymphs or adults. The percent reduction of GLH nymphs was significantly more when preyed upon by *T. parviceps* nymphs than by adults in both choice and no choice tests. From the above results it is evident that BPH is the preferred and primary host for both *C. lividipennis* and *T. parviceps* and they secondarily adapted to WBPH and GLH. These two mirid bugs are competitive in nature preferring the same insect host.

Similar results from earlier studies on biology of *C. lividipennis* reared on brown planthopper were reported by Pophaly *et al.* (1978). Different stages of the predator *viz.*, egg, nymph and adult took 7, 11 and 40 days, respectively and on an average a female laid 147 eggs and comparatively greater predation was observed on eggs of planthoppers. Soondo and Kyeongbae (1997) studied the biology of *C. lividipennis* on BPH where egg and nymphal period, and adult longevity were reported as 11, 13.7 and 22 days, respectively.

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