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Role of honeydew of rice hoppers as a kairomone and nutrient to the predatory mirid bugs, *Cyrtorhinus lividipennis* Reuter and *Tytthus parviceps* (Reuter) (Hemiptera: Miridae)

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ABSTRACT: **Honeydew of brown planthopper (BPH), whitebacked planthopper (WBPH) and green leafhopper (GLH) of rice was evaluated for its role as an attractant and nutrient to their egg predators, *Cyrtorhinus lividipennis* Reuter and *Tytthus parviceps* (Reuter). The mirid bugs were attracted in more numbers to plants coated with honeydew than that of distilled water. The mirid bugs survived for 4-6 days on honeydew and 11-20 days on insect prey. It was found that honeydew attracts mirid bugs to the treated surface but it could not support the survival of mirid bugs for longer time.**

KEY WORDS: *Cyrtorhinus lividipennis*, honeydew, kairomone, rice hoppers, *Tytthus parviceps*

INTRODUCTION

Green mirid bug, *Cyrtorhinus lividipennis* Reuter and brown mirid bug, *Tytthus parviceps* (Reuter) are important egg predators of rice hoppers, *viz.* brown planthopper (BPH), *Nilaparvata lugens* (Stål), whitebacked planthopper (WBPH), *Sogatella furcifera* (Horvath) and green leafhopper (GLH), *Nephotettix virescens* (Distant) and keep the hoppers at low levels (Chiu, 1979). The hoppers excrete copious amounts of honeydew, which comprises substances derived from the host plant and some produced by the insect itself. Frequently chemicals associated with the homopteran honeydew have been termed as kairomones (Bouchard and Cloutier, 1984; Budenberg and Powell, 1992; Mc Ewen *et al.*, 1993). Kairomones attract natural enemies from a distance or can elicit intensive searches in the vicinity of the contaminated substrate (Vinson, 1968; Waage, 1978). Honeydew is a food source for many adult parasitoids and predators. It has been reported to increases the longevity and fecundity of insects (Heidari and Copland, 1993; McEwen *et al.*, 1993; England and Ewans, 1997). Keeping this in view, the present investigation was carried out to evaluate the role of planthopper and leafhopper's honeydew as a food source and attractant to the predatory mirid bugs.

MATERIALS AND METHODS

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

in the greenhouse. Mirid bugs were reared on BPH oviposited rice plants. Adult mirid bugs were confined to these plants for 2-3 days for oviposition. The nymphs hatched were maintained in separate cages to obtain nymphs or adults of specified age. Honeydew was collected with the help of capillaries and stored in the culture tubes in the deep freezer at -30° C and it was used as such in the experiments in the greenhouse.

Attractiveness of the honeydew

In the choice tests, plants coated with honeydew of BPH, WBPH and GLH and distilled water were arranged equidistantly at four corners of the wooden cage (100 X100 X 100 cm dimension with glass panels on one side and wire mesh on all sides). Honeydew was coated with the help of camel hairbrush @ 0.5 ml per plant. Fifty each of nymph, female and male of mirid bugs were released separately in the centre of the cage. In the no choice tests, mirid bugs were given honeydew of one species and distilled water as a control. Numbers of mirid bugs settled on plants were counted after 5 hours. Each treatment was replicated 5 and 7 times in choice and no choice tests, respectively and the data were analyzed in randomized complete block design and means were separated by DMRT.

Longevity of mirid bugs on honeydew

Honeydew of the BPH, WBPH and GLH in comparison with honey (50%) and sucrose (50%) were evaluated for their effect on longevity of mirid bugs. In the first set of experiments, mirid bugs were released on the plants and in the second set of experiments, they were maintained in the test tubes. The plants were covered with mylar tubes and mirid bugs were released singly. Mirid bugs were allowed to have access to water in one experiment on the plants and not allowed to have access to water in the other. The test materials were provided in small parafilm cups, which were adhered to or near the plants and inside the test tube. The materials were replenished in the parafilm cups whenever necessary. Twenty each of adults and nymphs were tested for each treatment and their mortality was recorded.

RESULTS AND DISCUSSION

In no choice test, the number of *C. lividipennis* and *T. parviceps* attracted to the plants

Table 1. Attraction of mirid bugs to honeydew coated plants

Honeydew	Mirid bugs attracted (%)							
	C. lividipennis				*T. parviceps*			
	Nymph	Female	Males	Mean	Nymph	Female	Male	Mean
No choice test								
BPH	75.90a	80.80a	78.80a	78.50a	74.70a	81.90a	75.30a	77.30a
WBPH	69.50a	69.70b	73.70a	70.96a	71.90a	75.90a	75.00a	74.27a
GLH	75.50a	83.90a	77.60a	79.00a	71.50a	75.40a	81.00a	75.97a
Choice Tests								
BPH	34.50a	40.10a	28.50a	34.70a	24.70b	30.10a	30.90a	28.56ab
WBPH	25.00b	23.80b	28.60a	25.80b	41.40a	30.60a	30.10a	34.03a
GLH	28.00b	23.50b	31.00a	27.83b	23.50b	24:90a	26.10a	24.83b
Control	12.40c	12.70c	12.00b	12.60c	10.40b	14.50b	12.90b	12.60c

Note: In a column figures followed by same letter are not significantly different at 5% (DMRT).

coated with honeydew of either BPH or WBPH or GLH were higher compared to those coated with distilled water. However, the differences among different honeydews were not significant except in the case of *C. lividipennis* females, which were attracted, in significantly low numbers to the honeydew of WBPH. In the choice test, plants coated with BPH honeydew attracted more number of *C. lividipennis* females and nymphs compared to those coated with WBPH, GLH honeydew and distilled water whereas the males of bugs did not exhibit any such preferences. In the case of *T. parviceps* except nymphs, attraction of adults to honeydews of different hoppers is not significantly different. However, all the stages showed least preference to distilled water (Table 1). Mirid bugs were attracted to honeydew coated plants from a distance of 40cm, which suggests the presence of volatile substances in the honeydew. The results indicate that honeydew has a kairomonal effect on mirid bugs and attracts them to the treated surface. It is reported that honeydew of homopteran insects acts as a kairomone to many insect parasitoids like *Aphidius nigripes* (Bouchard and Cloutier, 1984; Cloutier and Bauduin, 1990), *Aphidius rhopalosiphi* (Budenberg and Powel, 1992), *Lysiphlebus testaceipes* (Grass witz and Paine, 1993), *Encarsia formosa* (Vianen and Vande, 1988) and predators like syrphids (Budenberg and Powell, 1992), chrysopids (McEwen *et al.*, 1993) and coccinellids (Heidari and Copland, 1993). Homopteran honeydew was reported to contain some volatile substances like tryptophan (Hagen *et al.*, 1976; Van Emden and Hagen, 1976) and attract the predators like *Episyrphus balteatus* (Budenberg and Powell, 1992) and parasitoids like *Aphidius nigripes* (Bouchard and Cloutier, 1984) to the treated surface from a distance.

Mirid bugs fed on honeydew of rice hoppers on plant as well as in test tubes survived for 4.1 to 6.6 days and 1 day, respectively. The bugs fed on honey or sucrose survived for 7 to 9.1 days on plant and for 2 days in test tubes (Tables 2 and 3). Mirid bugs survived for 4.0 to 4.6 days on plants without any food material (Table 2). When fed on BPH oviposited plants, the adults survived for 13-20 days and nymphs completed their development with a nymphal period of 11.48 to 13.48 days (Table 2). The present results suggest that honeydew could not support survival of mirid bugs when provided alone without prey insect. Plant plays an important role in the survival of mirid bugs upto 4-5 days when the prey insect and other food were eliminated. Water with or without plant did not have any influence on mirid survival. Honey or sucrose alone and along with plant can support the survival of mirid bugs upto 7-9 days. Earlier workers (Bentur

Table 2. Longevity of mirid bugs on honeydew of rice hoppers on plants

Treatment	Duration in days							
	C. lividipennis		*T. parviceps*		*C. lividipennis*		*T. parviceps*	
	nymph	adult	nymph	adult	nymph	adult	nymph	adult
BPH honeydew	5.2bc	5.0d	4.3c	4.1d	4.7c	4.4e	4.8c	4.3c
WBPH honeydew	4.9c	5.2cd	4.3c	4.4d	4.3c	5.2d	4.9c	4.6c
GLH honeydew	6.6b	6.1c	5.8b	5.8c	4.4c	6.2c	4.8c	4.4c
Honey 50%	8.5a	7.2b	7.4a	7.6b	7.8b	7.4b	8.9b	8.7b
Sucrose 50%	8.3a	8.4a	7.2a	9.2a	8.1b	7.7b	9.1b	8.4b
BPH oviposited plants	-	-	-	-	11.48a	20.0a	13.48a	13.8a
Control plant	4.5c	4.6d	4.5bc	4.0d	4.3c	4.1e	4.5c	4.3c

Note: Means in a column followed by same letter are not significantly different at 5% (DMRT).

Table 3. Longevity of mirid bugs on honeydew in test tubes

Treatment	Duration in days			
	C. lividipennis		*T. parviceps*	
	Nymph	Adult	Nymph	Adult
BPH honeydew	1.00b	1.00a	1.00b	1.00c
WBPH honeydew	1.00b	1.0a	1.00b	1.00c
GLH honeydew	1.00b	1.00a	1.00b	1.00c
Honey 50%	2.00a	2.30a	2.10a	1.80b
Sucrose 50%	2.10a	2.40a	2.70a	2.50a
Control	1.00b	1.00b	1.00b	1.00c

Figures in a column followed by same letter are not significantly different at 5% level (DMRT).

and Kalode, 1985; Dyer and Landis, 1996; England and Evans, 1997; McEwen *et al.*, 1993) have reported that alternate food sources like honey, sucrose, sugars and artificial honeydew increase longevity of predators and parasitoids. Honeydew along with prey insect was reported to increase the fecundity of *Cryptolaemus montrouzieri* but honeydew alone resulted in low fecundity in *Cryptolaemus montrouzieri* (Heidari and Copland, 1993), reduced larval development period and increased survival in *Chrysoperla carnea* (McEwen *et al.*, 1993), decreased nymphal development time, preoviposition period and increased adult longevity and fecundity of *C. lividipennis* (Matsmura and Suzuki, 1999). As honeydew of rice hoppers consisted 97 - 98 per cent of water, it could alone support the survival of the mirid bugs till development is completed.

Based on the results, it could be made out that honeydew of rice hoppers acts only as an attractant and it could not support the survival of the mirid bugs for more than 4-6 days when provided alone with out the prey insect.

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